The Impact of MERCOSUR on Trade of Brazilian States

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Abstract –

We consider the impact of MERCOSUR on trade among Brazilian states and on trade by Brazilian states with MERCOSUR and the rest of the world. We use a theoretically founded gravity model to shed light on MERCOSUR's possible creation and diversion effects as well as its "preference erosion" effect on trade among Brazilian states. Using data on interstate trade over a four-year period, including one year prior to the MERCOSUR period (1991), we deliver empirical evidence at state level with a focus on the impact of MERCOSUR which can vary across Brazilian regions. We show that MERCOSUR increased Brazilian states' trade with member countries, but had no effect on either interstate trade or Brazilian states' trade with third countries. The paper finds that MERCOSUR's impact varies across Brazilian regions and that Center West region did not benefit from the integration *to MERCOSUR. We use an estimation method dealing better with the traditional issue of zero trade values and heteroskedasticity than ordinary least squares does.*

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I. Introduction

Much like other Latin American and many developing countries, Brazil long promoted an "import substitution" strategy and kept its doors relatively closed to international trade, endeavoring to take advantage of its subcontinental status to promote domestic trade. Starting in the 1950s and throughout the military dictatorship (1964-1985), governments implemented protectionist and industrial policies to diversify the production structure seen as too highly concentrated in primary goods. This strategy was closely associated with regional development policies, managed at federal level, with infrastructure investment (e.g., the Trans-Amazonian Highway) and with policies to attract foreign capital in order to produce manufactured goods mainly for the Brazilian market (creation of the Manaus Free Trade Zone in 1967). However, the "Brazilian miracle" turned into an inflationary and over-indebted economy. The return to democracy strengthened the federal system by giving more rights to states and municipalities (Constitution of 1988) and, starting in the 1990s, the Real Plan opened the country up to international trade.

The previous Brazilian development strategy should have promoted specialization across Brazilian regions instead of a specialization at national level. However, the most recent trade openness strategy, albeit incomplete, should lead Brazil as a whole to become more specialized. This implies a substitution of imported goods for previously uncompetitive homemade products, which means that, in relative terms, each state should trade less with one another and more with foreign countries. We would then expect international trade openness to reduce interstate trade compared with foreign trade.

Although openness had a significant multilateral component with the reduction of applied MFN (Most Favored Nation) tariffs, Brazilian trade openness went ahead within the regional MERCOSUR (Mercado Común del Sur) framework (Treaty of Asunción, 1991). However, unlike other Latin American countries (e.g., Chile, Mexico and Peru), Brazil has few preferential trade agreements. MERCOSUR is virtually the only regional or bilateral agreement Brazil has signed, which makes it easier to isolate its repercussions on Brazilian domestic and foreign trade.

The Vinerian empirical literature frequently uses gravity models in order to compare creation and diversion trade effects. Intra-Regional Trade Agreements are expected to increase trade between members to the detriment of it with the rest of the world with an indeterminate net effect. Literature usually confirms that MERCOSUR had a significant trade creation effect whatever the specification of the model and the estimation method (Soloaga and Winters, 2001; Dee and Gali, 2003; Ghosh and Yamarik, 2004; Carrère, 2006; Coulibaly, 2007; Magee, 2008). As expected by theory, the import trade diversion effect is also frequently observed by the same authors meaning that MERCOSUR's imports from the rest of the world decrease consecutively to the agreement. However, an export trade diversion effect -i.e., less exports to rest of the world- is not so clearly observed: it is insignificant (Coulibaly, 2007), varying with time (Soloaga and Winters, 2001) or trade creating (Carrère, 2006).The difference between trade creation and trade diversion frequently give off a net trade diversion effect for Mercosur (Dee and Gali, 2003; Carrère, 2006; Coulibaly, 2007).

Literature on the impact of customs unions on trade usually considers member countries to be a single, fully integrated entity and therefore ignores the effects of such agreements on domestic trade. The trade creation/diversion effect is supposed to be found only between member and third countries, not within countries. This is highly debatable for a country as fragmented as Brazil. We can consider pre-MERCOSUR Brazil to be a customs union between the 27 Brazilian states, diverting trade from other countries including the current MERCOSUR. We can then consider the Treaty of Asunción to be an enlargement to three neighboring countries (Argentina, Paraguay and Uruguay), expected to produce three different effects: first, a trade creation effect for Brazilian states, e.g., increasing trade between each Brazilian state and its new partners; second a diversion effect vis-à-vis third countries – the rest of the world – and, third, a "preference erosion" [1] effect due to the fact that "duty free" trade among Brazilian states is extended to MERCOSUR

[1]Preference erosion refers to erosion in the value of preferential access, where trade liberalization leads a decrease in prices on the market to which a country (Brazilian states) has been given preferential trading access.

countries, leaving some uncompetitive Brazilian producers exposed to new foreign competition. Theoretically, the eviction of uncompetitive outputs is part of the trade creation effect, e.g., a welfare gain for Brazil due to a net consumer gain derived from a lower price for goods imported from other MERCOSUR countries. However the trade effects of MERCOSUR could be unevenly distributed across Brazilian states. The most competitive states might maintain their market share on Brazilian markets and increase their exports to MERCOSUR, while others may be faced with dwindling exports to other Brazilian states as they fail to increase their exports to MERCOSUR. For a country like Brazil, which suffers from strong regional inequalities and whose domestic market is highly fragmented, the impact of MERCOSUR will vary a great deal across the 27 states (26+Federal District).

The Treaty of Asunción should then generate relative growth in Brazilian states' trade with other MERCOSUR countries and a decrease with other Brazilian states (preference erosion effect) and the rest of the world (diversion effect). However, this outcome based on basic static theory could well overlook unexpected adaptation to globalization. Actually, one of the most challenging consequences of trade globalization is the acceleration of the vertical specialization process and the international fragmentation of the "value chain". [2] Once we consider Brazil as an aggregation of 27 states, which all have their specific comparative advantages, trade openness might have led to greater vertical specialization between Brazilian states, e.g., São Paulo processing of primary products exported from Minas Gerais or relocation of labor-intensive activities from "rich" states to poor states paying lower wages. Moreover, the small number of "ports" (air or sea) might also foster vertical specialization, for example, with the location of assembly work close to a port.

This context of relatively rapid Brazilian openness in 1990s and the availability of even just a few years of interstate trade data mean that we can look at the Brazilian states as trade entities arbitrating between domestic and foreign markets, the former comprising trade among Brazilian states and the latter with MERCOSUR and other countries.

The aim of this paper is to consider the effects of MERCOSUR on the direction of Brazilian trade. In Section 1, we present the issue and the possible regionally different effects of MERCOSUR on Brazilian trade. In Section 3, we present our empirical methodology, the basic specification for the gravity model we use and our data sources. Section 4 delivers empirical evidence for trade creation, trade diversion and preference erosion at state level. Section 5 focuses on the impact of MERCOSUR which can vary across Brazilian regions. We conclude in Section 6.

II. Previous Studies and a New Focus on the Issue

Studies on interstate trade are nothing new, but the literature on the "border effect" gives new reasons to reconsider it. One of the most famous papers on the topic is McCallum's "home bias" (McCallum, 1995). In it, he estimates trade between Canadian provinces at 22 times expected trade between Canadian provinces and the United States. The inclusion of control variables in the gravity model used, including the distance between regions and their size, enabled the author to attribute this huge "home bias" to a "border effect" as a large impediment to trade. Since this seminal work, the border effect has been confirmed, albeit less intense, by refined econometric methods that do a better job of dealing with the omitted variables bias and size heterogeneity, obviously important in the case of US-Canadian trade (Helliwell, 1998; Wolf, 2000; Anderson & van Wincoop, 2003; Balistreri & Hillberry, 2007). Other empirical studies concern other countries like China (Poncet, 2003; 2005), Japan (Okubo, 2004) and the EU (Chen, 2004). However, there is a lack of domestic inter-regional trade data available to be able to estimate border effects for other countries and regions.

On the basis of available interstate trade data, some authors have quantified this domestic fragmentation compared with the level of Brazilian state integration into the world market. Hidalgo and Vergolino (1998) find that Brazilian interstate exports are 11.5 times higher than exports from Brazilian states to foreign countries (cross-section for 1991). However, the model is highly biased by the absence of country/state fixed effects to control for a heterogeneity bias and by the elimination of zero observations. Pooling the data for the four available years (1991, 1997, 1998 and 1999), Paz and

[2]See. for example, Hummels *et al* .(2001), Yi (2003; 2009) and Freund (2009).

Franco (2003) obtain border effect measurements that are sometimes implausible. Results are actually sensitive to different methods (inclusion of country/state fixed effects and treatment of zero observations). Using the same data for intra-state, interstate and international trade, Daumal & Zignago (2010) focus on both the "home bias" and on Brazilian interstate integration compared with intra-state trade. After controlling for size, distance and heterogeneity (country/state fixed effects), they show that Brazilian states trade 38 times more with each other than with foreign countries. Leusin *et al.* (2009) and Silva *et al.* (2007) find very similar results for the same time period.

Brazil's relative fragmentation originates mainly in historically uneven and disjointed development across different Brazilian regions, hardly corrected by regional integration policies. It is seen in high domestic transport costs due to the lack of infrastructures and large inter-regional inequalities accompanied by differences in consumption preferences. Even though it swings cyclically between "recentralization" and "decentralization" periods, Brazil is a federal country with considerable state autonomy in terms of regulation and fiscal policy. For example, the Brazilian equivalent of VAT (ICMS) is collected at state level, which introduces distortions in interstate trade and probably contributes to the interstate border effect (see Brami and Siroën, 2007). At the beginning of the 1990s, Brazil was not only an economy relatively closed to trade with foreign countries, but each state was more (Northern states) or less (Southern states) closed to trade with other states. Daumal & Zignago (2010) point out that, despite significant progress with integration policies, the Brazilian market is still fragmented, although less so than China (Poncet, 2005). Actually, the internal border effect relative to intrastate trade stood at a ratio of 23 in 1991 and even fell to 13 in 1999. Note that, in 1999, a Brazilian state traded 460 times more with itself on average than with a foreign country.

In this paper, we use a similar approach to address a different issue. We take the gravity model methodology inspired by the "border effect" literature, not to quantify it using intra-state trade as a reference, but to shed light on the impacts of MERCOSUR on the direction of Brazilian state trade, comparing intra-Brazilian, intra-MERCOSUR and international trade.

We suggest that Brazil's openness to international trade in the 1990s, especially within MERCOSUR, triggered a shock that affected the trade-off between the different possible trade directions for Brazilian states. We could expect this openness to be detrimental to domestic trade, because some states might prefer to trade with relatively more accessible foreign countries instead of other states, especially in the MERCOSUR area. After the "shock", it might have been cheaper for Paulistan firms to export to opening Argentina than to Amazonian states. If this hypothesis were to hold, it would mean that Brazil's integration into regional (MERCOSUR) and world markets could undermine the traditional Brazilian objective to promote a more integrated Brazilian market. However, this assumption might be contradicted by the fact that greater international trade could induce more labor division and specialization within Brazil and then drive up interstate trade in an overall trend towards vertical specialization.

III. Methodology and Data

Recent empirical studies on the impact of regional trade agreements (RTAs) on countries' trade and post-McCallum "border effects" studies to measure intra-country trade volumes usually use gravity models, which estimate the expected bilateral trade using a number of control variables including size and different distance measurements (geographical, cultural, institutional, etc.). The challenge here is to link both separately measured issues. For this purpose, we need to consider Brazil not as a single integrated country, but as a huge customs union covering 27 different "countries" (the Brazilian States).

The gravity model used in this paper takes up the theoretical rationale put forward by Anderson & van Wincoop (2003), which states that trade between two units, depends on their bilateral trade costs and their trade costs with the rest of world. They call the latter multilateral resistance (MR) as it measures the country's trade costs with all its trade partners, which have to be included to prevent an omitted variable bias in the regression.

The gravity model[3] generated by the theory is:

$$ln\frac{X_{ij}}{Y_i Y_j} = k + (1-\sigma)\left[lnt_{ij} - lnP_i - lnP_j\right]$$

where t_{ij} is the bilateral trade cost between *i* and *j*, while lnP_i and lnP_j are the logarithmic measurements of prices as an indicator of MR (e.g., high tariffs and non-tariff barriers imply higher domestic prices). This equation can be augmented with many structural and policy variables expected to have an impact on trade volumes as components of trade costs, e.g., contiguity, common language, common colonizer RTAs.

The usual way of addressing MR is to introduce country fixed effects, which are dummy variables attached to each exporter or importer trade unit. Our empirical model uses this methodology and controls for MR by introducing time invariant exporter and importer fixed effects for sample countries and Brazilian states. In addition to the basic variables in the traditional gravity model (exporter and importer GDPs, bilateral distance), we also control for contiguity (common border). In keeping with the trade creation-diversion literature, we augment the model introduced by Anderson and van Wincoop (2003) with the variables measuring MERCOSUR's trade impact.

The creation of MERCOSUR constituted a shock for Brazil's domestic and foreign trade costs and changed the country's domestic and international trade structure. In fact, although MERCOSUR directly reduced trade costs between local units and member countries (e.g., Minas Gerais-Argentina), it also changed the relative level of Brazil's trade costs with third countries (e.g., Minas Gerais-Germany) as well as relative costs among Brazilian States (e.g., Minas Gerais-Para). Following Magee (2008) and by considering each Brazilian state as a country, the impact of MERCOSUR on the exports and imports of states and member countries will be assumed as symmetric. Thus, we will measure MERCOSUR's trade creation between members (state or country), its diversion effect on Brazilian states trade with the rest of the world and the preference erosion impact (trade shift from Brazilian domestic market to MERCOSUR countries).

Gravity models, long estimated using ordinary least squares, were challenged by Santos Silva & Tenreyro (2006). In addition, many economists prefer the PPML (*Poisson Pseudo Maximum of Likelihood*) estimator over conventional log-normal methods in gravity equation estimations mainly due to the limits of log-normal specification in gravity models. First, the estimation methods calling for a logarithmic transformation give rise to inefficient estimated parameters and increase inconsistency since the error terms are heteroscedastic and their expected values depend on the model regressors (*Jensen's Inequality)*. Second, the PPML estimator is a useful tool for dealing with zero trade values, which conceal a large amount of information explaining why some countries trade very little. Log-linearization, which returns zero trade values to missing data points, can cause a bias in the estimation, especially when the zero trade outcomes are not randomly distributed.

However, the PPML estimator's assumption of equidispersion $V\left[T_{ij}|x\right] \propto E\left[T_{ij}|x\right]$ considers the conditional variance of the dependent variable (T_{ij}) to be equal to its conditional mean. Since this assumption is unlikely to hold, Santos & Tenreyro (2006) recommend estimating statistical inferences based on an Eicker—White robust covariance matrix estimator.

Burger *et al.* (2009) posit that other Poisson family estimators (*Negative Binomial* and *Zero Inflated Poisson*) can be used depending on the reason why the conditional variance is higher than the conditional mean, due to overdispersion or excess zero trade values or both. From an economic point of view, negative binomial specification accounts for unobserved heterogeneity, which is generated by an omitted variable bias. The distribution equation of this specification

[3] *See Deardorff (1998), Anderson and van Wincoop (2003), Feenstra (2004).*

is adjusted for the overdispersion. Yet its variance is a function of the conditional mean (μ) and the dispersion parameter (α). Another possible cause for the violation of the equidispersion assumption can be found in excess zeros in the trade volumes: the Zero-Inflated Poisson (ZIP) model (Lambert, 1992; Greene, 1994; Long, 1997) accounts for two latent groups. One is strictly zero for the entire sample period and the other presents positive trade potential, irrespective of whether they trade or not. The first part of the model is a logit regression estimating the probability of belonging to "never-trading group", while the second part is a Poisson regression.

Negative binomial specification introducing the overdispersion parameter in the distribution is an understandable statistical choice. However, unlike the ZIP specification, it does not provide an economic rationale for excess zeros. Furthermore, the negative binomial model is based upon a gamma mixture of Poisson distributions whose conditional variance is a quadratic function of its conditional mean. As Santos Silva & Tenreyro (2006) put it, within the power-proportional variance functions, the estimators assuming conditional variance as being equal to higher powers of the conditional mean give more weight to observations from smaller countries whose data quality is questionable.

From this perspective, we consider that the ZIP model is a stronger methodological tool than the negative binomial model for solving the overdispersion problem in a gravity model of trade, since it has a theoretical rationale in addition to its statistical value[4]. Thus, in this paper, we use two estimators: a PPML in line with Santos Silva & Tenreyro (2006) and a zero-inflated Poisson pseudo-maximum likelihood model (ZIPPML) from the modified Poisson estimator family to deal with the overdispersion problem encountered in Poisson estimations of trade models.

Our basic gravity model explains bilateral exports based on the usual variables: GDP of the exporter *i* and importer *j*, their bilateral distance and contiguity. However, since we work with cross-section time series data, the traditional model needs to be adjusted for distortions originating from price changes and shocks in world trade. Thus we introduce a time dummy for each year, which controls for fluctuations in dollar prices. Baldwin & Taglioni (2006) also advocate time dummies in gravity equations instead of deflating the nominal trade values by the US aggregate price index, which they call a "*bronze medal mistake*" since the common global trends in inflation rates raise spurious correlations. We include country fixed effects as previously justified. Then, our basic model is written as follows;

$$X_{ijt} = \beta_1 + \beta_2 \ln GDP_{it} + \beta_3 \ln GDP_{jt} + \beta_4 \ln Dist_{ij} + \beta_5 Contiguity_{ij} + \alpha_i + \alpha_j + \alpha_t + \varepsilon_{ijt} \qquad \textbf{(Eq. 1)}$$

X_{ij} is the export flow between the country (or Brazilian State) pair *i* and *j* in year *t* and $Dist_{ij}$ is the bilateral distance. T GDP_{it} and GDP_{jt} are the nominal gross domestic products of exporter country/state *i* and importer country/state *j* in year *t*. $Contiguity_{ij}$ takes value 1 if the trade pair *ij* (state or country) shares a common border, which makes them neighbors. The variables α_i and α_j are the country fixed effects respectively for the exporter and the importer, α_t is the time fixed effect. We inflate the model with the $\ln Dist_{ij}$ and $Contiguity_{ij}$ variables in ZIP estimations. [5]

The purpose of this paper is to consider the effect of MERCOSUR on trade among member countries, on interstate Brazilian trade and on Brazilian states' trade with third countries. The methodological choice is to introduce dummy variables for these three sets of bilateral relations, with a distinction made between the pre-MERCOSUR (1991) and post-MERCOSUR (1997 to 1999) period. Even constrained by the time lag between 1991 and 1997, we can consider that our data is relevant to capture the impact of MERCOSUR on Brazilian trade. While measuring MERCOSUR's bilateral trade impact, we also control for world RTAs.

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[4] *Negative binomial models have been tested, but are not presented in this paper.*

[5] *Frankel (1997) states that zero trade outcomes come mostly from a lack of trade between small and distant countries. Rauch (1999) adds a lack of historical and cultural links as a possible reason for zero trade between country pairs.*

In Equation 2, the star exponent indicates that the variables refer to the MERCOSUR period (1997 to 1999), while the pre-MERCOSUR period concerns 1991 only (t=1991).The variables $IST_{ijt}{}^{91}$ and IST^{*}_{ijt} refer to interstate trade during the considered period taking value 1 when i and j are both Brazilian states (e.g., Minas Gerais-Para). $MERCOSUR_{ijt}{}^{91}$ and $\text{MERCOSUR}^{*}_{\text{ijt}}$ indicate trade between members of the MERCOSUR agreement, including trade between Brazilian states and member countries (e.g., Minas Gerais-Argentina and Uruguay-Argentina). By introducing the variable$MERCOSUR_{ijt}{}^{91}$, we expect to estimate the preliminary impact and unobserved bilateral characteristics leading trade between MERCOSUR members even before the implementation of the agreement. The change in the coefficients between two periods shows if there has been a relative increase in trade for the countries concerned after the establishment of MERCOSUR. The variables $BRZ_{ijt}{}^{91}$ and BRZ^{*}_{ijt} are dummy variables, which are equal to 1 for export flows from Brazilian states to non-MERCOSUR countries. A comparison of these two variables' coefficients will show the extent of Brazil's integration into the international market compared to international trade in the rest of the world. All these dummies in *Equation 2* need to be interpreted relative to the reference group, which is equal to the bilateral trade structure of non-MERCOSUR countries, (e.g., China-Germany). The change in trade structure triggered by MERCOSUR can only be pointed up by comparing pre- and post-MERCOSUR years.

$$X_{ijt} = \beta_1 + \beta_2 \ln GDP_{it} + \beta_3 \ln GDP_{jt} + \beta_4 \ln Dist_{ij} + \beta_5 Contiguity_{ij} + \beta_6 IST_{ijt}{}^{91} + \beta_7 IST^{*}_{ijt} + \beta_8 MERCOSUR_{ijt}{}^{91} + \beta_9 MERCOSUR^{*}_{ijt} + \beta_{10} BRZ_{ijt}{}^{91} + \beta_{11} BRZ^{*}_{ijt} + \beta_{12} RTA_{ijt} + \alpha_i + \alpha_j + \alpha_t + \varepsilon_{ijt} \quad \textbf{(Eq. 2)}$$

Since the impact of an RTA can vary over time, our analysis goes further by conducting a yearly decomposition of the variables of interest in Equation 2. As mentioned by Frankel (1997), the period before and after the agreement enters into force has an impact on the annual extent of trade creation and trade diversion considered.[6] The time fixed effect introduced in the equation cannot specifically take into account this timely evolution in the impact of MERCOSUR on trade. We therefore isolate the three years (1997, 1998 and 1999) by decomposing our variable of interest (interstate, intra-MERCOSUR and trade with third countries).

However, caution is called for when interpreting evolution of the RTA's impact, because country-specific shocks can have a huge impact on members' trade volumes and bias the annual estimates. Thus we introduce time-varying country-fixed effects into our robustness test, which controls for specific economic shocks such as policy changes and recession as these shocks can have an impact on trade specifically within MERCOSUR (e.g., the 1999 Brazilian crisis with the depreciation of the Brazilian real against other currencies, including the Argentinean peso).

We use balanced panel data covering the export values of the 27 Brazilian states and 118 countries (see Table 5 in the Appendix) for 1991, 1997, 1998 and 1999. So the data consist of subgroups of trade pairs, with a different data source used for each. We draw on the export values of the 27 states trading with one another ($27^{*}26$), their trade with other countries ($27^{*}118^{*}2$) and the trade of the 118 countries with one another ($118^{*}117$), all for four years and balanced for the pairs with missing values while keeping zero values.

The Brazilian states' international trade flows are taken from ALICEWEB[7], and containing the export and import values for Brazilian states to and from each country. The export values of the 118 countries trading with one another are taken from the *Directory of Trade Statistics* (DOTs) published by the International Monetary Fund. Both sources concur and can be combined since they present similar total export volumes for all Brazilian trade with sample countries.

[6] *Magee (2008) posits that the agreement has no cumulative impact after its 11th year of being in effect.*
[7] *Secretaria de Comércio Exterior (Secex) do Ministério do Desenvolvimento, Indústria e Comércio Exterior (MDIC)*.

We also use Brazilian interstate export flows for our empirical study. Domestic tax regulation introduced by the federal system gives us bilateral export data on the Brazilian states for 1991, 1997, 1998 and 1999. The Brazilian authorities use the information from the ICMS tax accounts to measure interstate trade flows. The ICMS tax (*Imposto sobre Circulação de Mercadorias e Serviços*) is a type of value added tax (VAT) collected by the exporting State[8]. From this information delivered by the Brazilian Ministry of Finance, it has been constructed a database for 1997 (Ministério de Fazenda, 2000), 1998 and 1999 (Vasconcelos, 2001a, 2001b). The 1991 data come from SEFAZ-PE (1993)[9] and are measured and extrapolated by the Pernambuco Finance Ministry from the 1987 interstate database. Unfortunately, lack of data for a longer period and gaps between 1991 and 1997 place limitations on the study. However, we believe we can cover a large part of the shock triggered by the launch of MERCOSUR, since it came into effect in late November 1991 and was scaled up in 1994 by the Treaty of Ouro Preto.

GDP values for the countries are given in current dollars and drawn from the World Bank's *World Development Indicators* database. GDP values for the Brazilian states are provided by the IBGE (*Instituto Brasileiro de Geografia e Estatística)* in local currency units, in cruzeiro for 1991 and in real for the following years. Given that the exchange rate from cruzeiro to current dollars is not provided by the *WDI*, we calculate the ratio of state GDP to total Brazilian GDP based on the IBGE database presented in local currency units and multiply it by the total GDP of Brazil in current dollars provided by the *WDI*. For 1997, 1998 and 1999, the ratios turn up similar results to those calculated by the *WDI* exchange rates, which confirms the 1991 values of state GDP.

The distance and contiguity variables are taken from CEPII's *Distances* database. For the most part, the capital cities are the main unit of the distance measurements. However, the data occasionally also use the economic capital as the geographic center of the country. The *World Gazetteer* website furnishes the geographical coordinates of the state's capital from which we have calculated the states' bilateral distances from one another and the other countries. The information on state contiguity is conducted directly from Brazilian map. RTA dummy is also taken from CEPII; *Gravity Dataset* (Head, et al. 2010). [10]

IV. Results and Robustness Check

In Table 1, the basic gravity model (Model 1) presents coefficients similar to those usually found in the literature. We find very close β values with both estimators, PPML (Poisson Pseudo Maximum of Likelihood) and ZIPPML (Zero Inflated Poisson). Income elasticity is generally less than 1 for both estimators, which means that large countries trade relatively less than small countries. We hence relax the Anderson van Wincoop (2003) hypothesis of unitary elasticity. The logit regression finds that distance between countries increases the probability of zero trade, while sharing a common border decreases it. Since the coefficients are significantly different from zero and concur in sign and value with the theory, our choice of using ZIPPML over PPML is strengthened even though the results are quite similar. The significantly positive Vuong (1989) statistic also favors ZIPPML over PPML. The same holds true for the Akaike Information Criterion and the Bayesian Information Criterion, which are smaller in the ZIPPML model.

Starting with Model 2, we measure the impact of MERCOSUR based on Equation 2 augmented with dummy variables controlling for different groups of trade pairs over time and among subgroups. Their coefficients are to be interpreted compared to the reference group, which is bilateral trade between non-MERCOSUR countries after controlling for RTAs. All coefficients are significant. The interstate trade coefficients are higher than the intra-MERCOSUR trade coefficients for the entire period, which provides evidence of a home bias. The coefficients for Brazilian foreign trade with third countries are significantly negative for the entire period. The first conclusion is that Brazilian states trade more with one another than with other countries, even within MERCOSUR, and that their integration into world trade is

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[8] *We also use the terms "export" and "import" for trade between two Brazilian states (e.g. São Paulo-Minas Gerais).*
[9] *See Daumal and Zignago (2010).*
[10] *See for further information, http://www.cepii.fr/anglaisgraph/bdd/gravity.htm*

relatively weak on average. The second conclusion concerns the comparison between the pre- and post-MERCOSUR period (*MERCOSUR* and *MERCOSUR**). The coefficients for interstate trade (*IST* and *IST**) and international trade (*BRZ* and *BRZ**) are not significantly affected, although they are slightly lower for the post-MERCOSUR period, while intra-MERCOSUR trade is significantly higher after the establishment of MERCOSUR. These first results are consistent with the hypothesis that MERCOSUR had a trade creation effect within the area, without triggering either a decrease in trade among Brazilian states or a decrease in Brazilian trade with third countries.

In Model 3, we decompose the impact of MERCOSUR for each year using the pooled cross-section time series data. It has long been argued that the impact of an RTA is not uniform over time. However, the decomposition is particularly important in the Brazilian case. In this way, we can observe if the deterioration in the economic situation of Brazil and Argentina at the end of 1990s (devaluation of the Brazilian real in 1999) had an impact on MERCOSUR's trade performance as well as on Brazilian interstate trade. Descriptive statistics show that the value of Brazilian exports to MERCOSUR fell 24% between 1998 and 1999. [11] This drop is expected to have benefited Brazilian interstate trade, but it has to be balanced out by the consequences of the economic recession. In order to take a closer look at this development, we replace $\beta_7 IST^*_{ijt}$ with $\sum_{s=97}^{99} \beta_{ist,s} {IST^*_{ijt}}^s$; $\beta_9 MERCOSUR^*_{ijt}$ with $\sum_{s=97}^{99} \beta_{MERCOSUR,s} {MERCOSUR^*_{ijt}}^s$; and $\beta_{11} BRZ^*_{ijt}$ with $\sum_{s=97}^{99} \beta_{BRZ,s} {BRZ^*_{ijt}}^s$. We believe this method is better than a strict cross-section analysis conducted separately for each year, where the gravity benchmark is different for each year and hence vulnerable to yearly fluctuations and shocks in world trade. In the pooled panel data, given that we use a single control group for all years, the coefficients are comparable with one another and over time. [12]

Annual decomposition of the IST variable to identify differences over the four available years (Model 3) finds a small change in the key variables' general trends. We observe a small downturn in the impact of MERCOSUR's creation on trade followed by an increase in interstate trade and Brazilian trade with non-member countries in 1999. However, the change is not statistically significant and is negligible in value. Thus, Model 3 confirms our previous conclusion: MERCOSUR created trade without generating any significant loss in trade among states or in Brazilian trade with third countries.

[11] *From World Trade Organization (2000), Table III-24.*

[12] *For the reader's information, we did after all attempt to present the estimation results taken from the cross-section analysis. Unfortunately, PPML and ZIPPML do not converge for all the years (STATA), especially for 1991, which is vital to an evaluation of the impact of MERCOSUR since it is the only year in the sample before its creation.*

TABLE 1: Annual Decomposition of MERCOSUR impact

Table 1	Model 1			Model 2			Model 3		
Dependent Variable: X_{ijt} [1]	PPML	ZIPPML		PPML	ZIPPML		PPML	ZIPPML	
X_{ijt} [a]		Logit	Poisson		Logit	Poisson		Logit	Poisson
ln_*gdpnominali*	0.454***		0.451***	0.374***		0.372***	0.384***		0.381***
	(0.127)		(0.127)	(0.116)		(0.116)	(0.133)		(0.133)
ln_*gdpnominalj*	0.697***		0.683***	0.615***		0.603***	0.627***		0.614***
	(0.123)		(0.123)	(0.113)		(0.114)	(0.131)		(0.131)
ln_*distance*	-0.822***	0.560***	-0.818***	-0.472***	0.798***	-0.469***	-0.472***	0.798***	-0.470***
	(0.016)	(0.021)	(0.016)	(0.018)	(0.029)	(0.018)	(0.018)	(0.029)	(0.018)
Contiguity	0.684***	-1.116***	0.686***	0.658***	-0.648***	0.659***	0.658***	-0.648***	0.659***
	(0.060)	(0.216)	(0.059)	(0.056)	(0.239)	(0.055)	(0.056)	(0.239)	(0.055)
RTA				0.962***		0.967***	0.962***		0.966***
				(0.050)		(0.050)	(0.051)		(0.050)
*IST**91				3.434***		3.400***	3.445***		3.410***
				(0.276)		(0.273)	(0.278)		(0.274)
*IST**				3.346***		3.314***			
				(0.267)		(0.263)			
*IST**97							3.358***		3.329***
							(0.273)		(0.269)
*IST**98							3.320***		3.290***
							(0.271)		(0.267)
*IST**99							3.380***		3.343***
							(0.274)		(0.270)
*MERCOSUR**91				1.002***		0.970***	1.008***		0.977***
				(0.184)		(0.183)	(0.186)		(0.185)
*MERCOSUR**				1.675***		1.643***			
				(0.159)		(0.159)			
*MERCOSUR**97							1.689***		1.659***
							(0.184)		(0.183)
*MERCOSUR**98							1.714***		1.682***
							(0.177)		(0.177)
*MERCOSUR**99							1.614***		1.580***
							(0.178)		(0.178)
*BRZ**91				-0.651***		-0.638***	-0.646***		-0.633***
				(0.139)		(0.137)	(0.140)		(0.138)
*BRZ**				-0.567***		-0.565***			
				(0.129)		(0.127)			
*BRZ**97							-0.576***		-0.573***
							(0.144)		(0.143)
*BRZ**98							-0.597***		-0.594***
							(0.144)		(0.143)
*BRZ**99							-0.515***		-0.513***
							(0.143)		(0.141)
Constant	-21.018***	-6.490***	-19.634***	-21.845***	-9.043***	-21.381***	-22.309***	-9.043***	-21.773***
	(3.791)	(0.196)	(3.808)	(3.375)	(0.273)	(3.371)	(4.303)	(0.273)	(4.299)
Observations	78,580	78,580	78,580	78,580	78,580	78,580	78,580	78,580	78,580
-2 log pseudo-likelihood	7,542,282		7,383,215	5,568,066		5,441,724	5,567,418		5,441,115
Vuong *(z)*			28.40***			24.87***			24.88***
AIC	7,542,874		7,383,813	5,568,672		5,442,336	5,568,035		5,441,739
BIC	7,545,619		6,500,841	5,571,481		4,559,430	5,570,900		4,558,888

Importer, exporter and time fixed effects for all estimations.

[1] Dependent variable is scaled by 10^{-6}. Robust standard errors are in parentheses: All inferences are based on a Huber—White sandwich estimate of variance. *** Significant at 1%.

Being focused on trade of Brazilian states makes irrelevant the comparisons with previous studies which consider effects on trade at the level of each RTA. However in our model, the positive trade creation of MERCOSUR is measured for a region with 27 states and 3 countries (Argentina, Paraguay, Uruguay). Our results are in line with the current literature measuring the impact for the 4 member countries (Soloaga, and Winters, 2001; Dee and Gali, 2003; Ghosh and Yamarik, 2004; Carrère, 2006; Coulibaly, 2007; Magee, 2008).

Another source of divergence with literature is that we have introduced states/countries fixed effects in order to control the heterogeneity of states/countries and their MR (Anderson & van Wincoop, 2003). The alternative is to introduce country-pair fixed effects dealing with unobservable variables specific to the bilateral relations and constant in time, as historical or political relationship between the partners (Haveman and Hummel, 1998; Magee, 2008). Because the heterogeneity inside MERCOSUR, including the heterogeneity between Brazilian states, is a major matter of concern, we consider that states/countries fixed effects are more suitable.

Because all unobservable bilateral variables are not included in the model, we base the analysis on changes in the value of coefficients. In this way, Soloaga and Winters (2001) estimate the value of coefficients during 17 consecutive years by cross-country regressions. Alternatively, we follow Magee (2008) by periodizing the interest variable in a single pseudo-panel regression. However, the effects might be under-estimated because they frequently precede the implementation of the agreement (Magee, 2008). The adjustment in MERCOSUR appears to have begun between 3 years (Freund and McLaren, 1999) and 5 years (Coulibaly, 2007), before the entry in force of the agreement (1991). Unfortunately the year of the first available data for inter-state trade exactly corresponds to the launching of MERCOSUR and we cannot estimate pre-MERCOSUR effects.

In the next step, we present the results for the different versions of Model 3, considered as a benchmark and modified in order to check its robustness.

In the first column *(version 1*) of Table 2, we introduce into the model two new measurements of cultural and/or historical distance taken from *CEPII's Distances* database. The $colony_{ij}$ dummy indicates whether two countries have ever had a colonial relationship and $comlang\_ethno_{ij}$ is equal to one if a language is spoken by at least 9% of the population in both countries. Both variables are significantly different from zero and decrease the probability of being in the zero trading country pair group. These two dummies partially capturing trade between states by means of trade cost measurements decrease the value of the *IST* coefficient. However, it is always greater than intra-MERCOSUR trade. The values and change over time of MERCOSUR's trade creation and trade diversion impact are similar to previous results and evidence of the robustness of the model.

In the *2nd* and *3rd versions*, the results are found in order, after dropping Brasília (Distrito Federal) and Amazonas, which are two potential outliers. Brasília is a state planned and built as of 1956 with the objective of transferring the country's capital from Rio de Janeiro. Its economic activity is hence driven mostly by demand from the local population, who are basically occupied in bureaucratic jobs, and satisfied mainly by imports from other states while exports are abnormally low compared to the other states. The state of Amazonas can also be considered to be an exceptional case like Brasília. It potentially presents different trade patterns to other Brazilian states since it benefits from preferential tax regulations (e.g., lower interstate ICMS rates) for its business within the country and special trade incentives (exemptions from export and import taxes) within the Manaus Free Trade Zone, which accounts for the largest proportion of state production. This area is the number two high-tech district (after São Paolo) despite its location deep in the Amazonian forest without road access. This makes the state of Amazonas a highly specific case.

However, after controlling for specific trade patterns in Brasília (D.F.) and Amazonas by dropping them, the results remain unchanged. Thus, our fixed effects are correctly capturing the particular characteristics of trade units and the model is robust to the heterogeneity.

Another issue that makes an empirical analysis of MERCOSUR's impact vulnerable is the volatility of Brazil's and Argentina's economies, the two foremost members of MERCOSUR in terms of their economic size, in the 1990s.[13] The economic volatility of the MERCOSUR region over the period of analysis prompted us to introduce time-varying country fixed effects into the model represented in the second column of Table 2 (*version 4*).

Time-varying country fixed effects – in addition to accounting for the domestic level of prices, which is an indicator of the MR term in the theory – also account for time-varying characteristics specific to the trade unit (country/state) that have an impact on trade values such as recessions, economic or structural policy changes, and exchange rates. Replacing time-constant country-fixed effects with time-varying country-fixed effects adds a control for events specifically affecting one country. However, the huge number of dummies and the cumbersome iteration procedure make it extremely hard to obtain results due to convergence problems in the PPML and ZIPPML estimation procedures. Hopefully, the results we have provide some useful insights.

In Model 3-*Version 4*, after controlling for Brazil's economic deterioration in late 1990s and other time-varying characteristics in the sample, we observe a drop in interstate trade with MERCOSUR and then an upturn through to 1999. However, a clear conclusion cannot easily be drawn since the Fisher statistics show that we cannot significantly reject the hypothesis of the equality of coefficients. As regards the trade creation variable ($MERCOSUR_{ijt}^{*\ s}$), the introduction of time-varying fixed effects shows that trade between MERCOSUR members increases steadily and continuously even in 1999, which indicates that the collapse of trade within MERCOSUR was caused by recession in member countries rather than by a slowdown in regional integration.

However, compared with our reference model, the trade creation effect of MERCOSUR appears lower when we consider country-fixed effects to be time varying. Thus, the trade creation impact of MERCOSUR is questionable because the assumption of coefficient equality is not rejected by the Fisher statistics – unless the higher coefficient in 1991 is attributed to the preliminary impact of the agreement. Brazilian trade with non-member countries ($BRZ_{ijt}^{*\ s}$) follows the same trend as interstate trade, with an initial drop in trade volumes followed by a steady increase. However, the Fisher statistics are always non-significant. Yet we do believe that Brazil's specialization patterns changed slightly by creating new trade opportunities over the period, although only an analysis conducted at sector level could give clearer results on this issue.

[13] *The first period of the 1990s was marked by high inflation rates for both countries (inflationary pressure continued in Brazil until Plano Real in 1994 and in Argentina until 1993). Exchange rates were also highly volatile. The Brazilian Real was sharply devaluated in 1999. A recession started in Argentina in 1999 and continued with the crisis of 2001-2002 and the devaluation of peso.*

TABLE 2: Robustness Analysis

Table 2	Model 3_Augmented		Model 3_Without state of Brasilia		Model 3_Without state of Amazonas		Model 3_Time varying fixed effects	
Dependent Variable: X_{ijt}[1]	ZIPPML		ZIPPML		ZIPPML		ZIPPML	
	Logit	Poisson	Logit	Poisson	Logit	Poisson	Logit	Poisson
ln_*gdpnominali*		0.374*** (0.129)		0.381*** (0.133)		0.381*** (0.133)		
ln_*gdpnominalj*		0.607*** (0.128)		0.614*** (0.131)		0.613*** (0.131)		
ln_*distance*	0.696*** (0.030)	-0.460*** (0.018)	0.788*** (0.030)	-0.469*** (0.018)	0.792*** (0.030)	-0.471*** (0.018)	0.815*** (0.030)	-0.462*** (0.017)
Contiguity	-0.587** (0.260)	0.501*** (0.051)	-0.639*** (0.238)	0.661*** (0.056)	-0.600*** (0.237)	0.661*** (0.056)	-0.830*** (0.269)	0.658*** (0.055)
RTA		0.984*** (0.051)		0.967*** (0.050)		0.963*** (0.050)		1.006*** (0.046)
Colony	-1.883*** (0.213)	0.133*** (0.046)						
comlang_ethno	-0.217*** (0.059)	0.425*** (0.039)						
*IST**91		2.555*** (0.290)		3.387*** (0.274)		3.371*** (0.275)		3.753*** (0.367)
*IST**97		2.481*** (0.286)		3.308*** (0.269)		3.283*** (0.270)		2.958*** (0.420)
*IST**98		2.442*** (0.284)		3.271*** (0.267)		3.250*** (0.268)		3.305*** (0.408)
*IST**99		2.490*** (0.286)		3.327*** (0.270)		3.300*** (0.272)		3.787*** (0.454)
*MERCOSUR**91		0.953*** (0.186)		0.974*** (0.585)		0.970*** (0.187)		1.369*** (0.219)
*MERCOSUR**97		1.641*** (0.184)		1.659*** (0.184)		1.653*** (0.185)		1.436*** (0.255)
*MERCOSUR**98		1.664*** (0.179)		1.683*** (0.177)		1.675*** (0.178)		1.592*** (0.262)
*MERCOSUR**99		1.559*** (0.179)		1.580*** (0.178)		1.568*** (0.179)		1.835*** (0.274)
*BRZ**91		-0.771*** (0.141)		-0.633** (0.138)		-0.634*** (0.139)		-0.465** (0.185)
*BRZ**97		-0.702*** (0.145)		-0.573*** (0.142)		-0.598*** (0.146)		-0.783*** (0.213)
*BRZ**98		-0.723*** (0.145)		-0.594*** (0.142)		-0.607*** (0.146)		-0.605*** (0.207)
*BRZ**99		-0.645*** (0.144)		-0.519*** (0.141)		-0.530*** (0.144)		-0.300 (0.229)
Constant	-8.093*** (0.279)	-21.330*** (4.079)	-8.959*** (0.274)	-21.765*** (4.300)	-8.993*** (0.275)	-21.709*** (4.298)	-9.218*** (0.280)	3.771*** (0.422)
Observations	78,580	78,580	77,516	77,516	77,516	77,516	78,580	78,580
Importer fixed effects		Yes		Yes		Yes		
Exporter fixed effects		Yes		Yes		Yes		
Time varying exporter fixed effects								Yes
Time varying importer fixed effects								Yes
Time fixed effects		Yes		Yes		Yes		Yes
-2 log pseudo-likelihood		5,195,885		5,426,626		5,383,084		5,245,693
Vuong *(z)*		24.14***		24.79***		24.78***		23.48***
AIC		5,196,517		5,427,250		5,383,708		5,248,057
BIC		4,313,703		4,557,445		4,513,903		4,373,272

[1] Dependent variable is scaled by 10^{-6}. Robust standard errors are in parentheses: All inferences are based on a Huber—White sandwich estimate of variance. ** significant at 5%; *** significant at 1%. Results are given only for interest variables.

V. Measures of Trade Effects on Brazilian States

According to our estimations in Model 3 (Table 2) trade between states (*ceteris paribus)* in 1991 is approximately 29 times higher than the trade between countries other than MERCOSUR members after controlling for an eventual RTA impact. This number is ~26 times in 1998. Once we compare these two coefficients, we find the difference not to be statistically significant. On the other hand, trade between MERCOSUR members is 2,65 times higher than control group in 1991 and ~5,4 times higher in 1998; while the difference being statistically significant.

However, it can be misleading to conclude up uniquely on the basis of statistical significance of the average impact since the total impact depends on the number of observations under consideration. Especially, in our data structure we have 570[14] interstate observations of bilateral trade for each year while the number of observations for intra-MERCOSUR trade is only 168[15]. Thus, a small decrease in the average interstate trade once aggregated for 570 observations can be of an important size once compared to the aggregated impact of intra-MERCOSUR trade over 168 observations. Trade diversion variable measuring the average impact over 3,105 observations (27*115 nonmembers) can be reconsidered similarly.

In order to calculate the impact in dollar terms, we will first predict what would be the level of trade if there were no MERCOSUR in post-MERCOSUR period. For this, we will always use our benchmark model, the ZIPPML estimates of MERCOSUR impact in Model 3 which also decomposes the impact for each available year. In line with our methodology, we measure the impact of each interest variable by introducing a dummy for pre-and post-MERCOSUR period and we consider the evolution of trade instead of the value of the coefficient itself, we will assume counterfactually that for the post-Mercosur years, trade would show a similar structure pre-MERCOSUR period. For example in 1997, we will predict the level of trade under *no MERCOSUR hypothesis* by giving "0" to interest variables concerning the year 1997 (*IST**97, *MERCOSUR**97, *BRZ**97) and giving "1" to the interest variables concerning the year 1991 (*IST**91*), MERCOSUR**91, *BRZ**91) Thus, the export volume predictions for post-MERCOSUR period will be calculated from the coefficient values of the MERCOSUR dummies in 1991. Second, we will calculate the difference between the trade level fitted by the benchmark model ($\hat{X}_{ij,t}$) and the predicted trade under the hypothesis that there were no MERCOSUR ($\hat{X}_{ij,t}^{*}$) for each year. This difference is equal to the impact of MERCOSUR on bilateral trade in dollar terms for the year under consideration (1997, 1998 and 1999).

At last, we decompose the trade impact of MERCOSUR in dollars for preference erosion, trade creation, and trade diversion for each state. These three impacts will be separately calculated on the exports of each Brazilian states with relevant trade partners (States, MERCOSUR members, rest of the world), namely the sum of the difference between the export values fitted by the benchmark model and the counterfactual values.

The impact on export values in year *t* for state *i*, then is as follows

$$Preference\ Erosion_{state\ i,t}{}^{X} = \sum_{j \in Brazilian\ states}^{26} (\hat{X}_{ij,t} - \hat{X}_{ij,t}{}^{*})$$

$$Trade\ Creation_{state\ i,t}{}^{X} = \sum_{j \in MERCOSUR\ members}^{3} (\hat{X}_{ij,t} - \hat{X}_{ij,t}{}^{*})$$

$$Trade\ Diversion_{state\ i,t}{}^{X} = \sum_{j \in Nonmember\ countries}^{115} (\hat{X}_{ij,t} - \hat{X}_{ij,t}{}^{*})$$

[14] *Unfortunately due to lack of data, we have only 570 observations instead of 702 (27*26).*

[15] *Exports of states to member countries (27*3) , exports of members to states (3*27) and exports between members (3*2) which is totally equal to 168.*

Symmetrically, the impact on import values in year *t* for state *j* is the sum of export values from partner country/state *i* to state *j*:

$$Preference\ Erosion_{state\ j,t}^{M} = \sum_{i \in Brazilian\ states}^{26} (\widehat{X}_{ij,t} - \widehat{X}_{ij,t}^{*})$$

$$Trade\ Creation_{state\ j,t}^{M} = \sum_{i \in MERCOSUR\ members}^{3} (\widehat{X}_{ij,t} - \widehat{X}_{ij,t}^{*})$$

$$Trade\ Diversion_{state\ j,t}^{M} = \sum_{i \in Nonmember\ countries}^{115} (\widehat{X}_{ij,t} - \widehat{X}_{ij,t}^{*})$$

In Table 3, we show the results on exports and on imports separately for each state of Brazil. All numbers are calculated over three years, so are equal to the total impact of MERCOSUR in dollars for the whole post-MERCOSUR period available in data. Because these are measured regarding to export values fitted and predicted (*no MERCOSUR hypothesis)* by the benchmark model (Model 3), they should be interpreted as the gain/loss in the trade potential of the state rather than the real gain/loss accounted by the inauguration of MERCOSUR.

In Table 3 the preference erosion impacts are inevitably equal on exports and imports of states because the exports of states to states are *per se* equal to the imports of states from states. The table also reveals that predicted trade creation impact and trade diversion impact of MERCOSUR in dollar terms are of similar size. The diversion impact on Brazil's potential trade to nonmember countries seems to increase the export and import of states nearly as half of the increase in its potential with MERCOSUR during the period, for some states this potential increases even higher than MERCOSUR trade creation impact. This gain in trade potential of Brazil with other countries strengthens our position on the emergence of new specialization patterns in Brazil. On the other hand, the interpretation of the results for preference erosion impact is not straightforward. We observe a remarkable decrease in interstate trade potential in dollar terms relatively to *no MERCOSUR* hypothesis nevertheless, the econometric model reveals that this change can be arising by chance since Fisher statistic is not significant.

TABLE 3: Predicted Values of MERCOSUR's Total Trade Impact (Summed over 1997-1999; millions US $)

Exporting/ Importing State	Impact of MERCOSUR on Export			Impact of MERCOSUR on Imports		
	Preference Erosion	Trade Creation	Trade Diversion	Preference Erosion	Trade Creation	Trade Diversion
Center-West	-2,337.812	383.400	259.691	-4,483.815	633.623	543.940
Distrito Federal (DF) [a]	-182.361	28.858	21.686	-1,216.634	174.214	156.382
Goiás (GO)	-1,109.548	142.455	104.109	-1,745.721	186.309	163.833
Mato Grosso do Sul (MS)	-529.010	103.251	52.887	-697.542	110.079	75.361
Mato Grosso (MT)	-492.350	101.558	74.374	-754.645	144.702	128.600
Acre (AC) [a]	-24.543	7.279	6.635	-69.273	18.319	19.765
North	-2,101.739	480.080	509.474	-1,902.731	392.705	496.491
Amazonas (AM) [a]	-1,345.395	332.523	352.767	-732.921	165.954	208.228
Amapá (AP)	-18.093	4.053	4.518	-46.758	9.714	12.816
Pará (PA)	-599.715	110.172	120.304	-718.793	127.855	165.795
Rondônia (RO) [a]	-76.188	20.838	19.058	-210.710	51.980	56.411
Roraima (RR) [a]	-4.730	1.307	2.886	-30.395	7.679	21.795
Tocantins (TO) [a]	-57.618	11.187	9.942	-163.154	29.523	31.445
North-East	-4,361.834	670.700	694.969	-7,403.411	1,204.384	1,522.388
Alagoas (AL) [a]	-194.913	29.978	29.842	-403.587	64.440	76.916
Bahia (BA)	-1,595.928	231.154	210.238	-2,223.963	324.301	354.493
Ceará (CE)	-693.676	112.804	122.729	-1,093.550	187.974	244.206
Maranhão (MA) [a]	-227.563	44.000	47.619	-516.184	95.824	123.522
Paraíba (PB)	-282.889	36.788	38.912	-511.353	75.755	96.075
Pernambuco (PE)	-1,025.317	151.798	157.193	-1,667.913	265.957	329.623
Piauí (PI) [a]	-55.524	9.629	9.958	-280.184	48.720	60.127
Rio Grande do Norte (RN) [a]	-169.493	29.017	31.427	-461.406	81.051	105.299
Sergipe (SE) [a]	-116.532	25.535	47.051	-245.272	60.361	132.127
South	-12,453.186	4,729.838	1,254.800	-11,804.762	3,956.879	1,216.952
Paraná (PA)	-4,879.291	1,173.775	347.419	-4,974.053	978.637	346.404
Rio Grande do Sul (RS)	-4,176.804	2,437.390	572.761	-3,955.360	2,107.777	572.570
Santa Catarina (SC)	-3,397.091	1,118.673	334.620	-2,875.349	870.466	297.978
South-East	-36,827.541	6,085.777	3,914.900	-32,487.394	4,856.079	3,791.366
Espírito Santo (ES)	-1,707.642	228.326	173.556	-1,890.234	239.132	218.506
Minas Gerais (MG)	-7,913.272	811.761	585.369	-6,907.651	645.520	559.091
Río de Janeiro (RJ)	-4,255.867	442.507	302.232	-7,603.289	641.619	528.413
São Paulo (SP)	-22,950.760	4,603.183	2,853.743	-16,086.220	3,329.809	2,485.356
BRAZIL (BRZ)	-58,082.112	12,349.795	6,633.834	-58,082.113	11,043.670	7,571.137

Source: Impacts of MERCOSUR on exports and imports are calculated in dollar terms by authors and based on the predictions of the estimation Model 3.

[a] *Unfortunately, due to the lack of data, preference erosion numbers for indexed states are measured by summing bilateral impacts only over 15 partner states instead of 26.*

VI. Regional Decomposition of the Impact of MERCOSUR

In Table 1, we have previously seen that MERCOSUR creates trade without significantly reducing trade with non-member countries and among Brazilian states. This means that there is no evidence of a "preference erosion" effect in Brazil. Yet this result is not necessarily clear-cut for all regions and states of Brazil. Indeed, MERCOSUR's impact can vary depending on regional differences in production structure. In the Brazilian case, it is particularly important to decompose the aggregate impact in regional terms, since there are substantial regional disparities among states' economic development levels and huge differences in specialization patterns. Where the MERCOSUR's "preference erosion" effect might undermine uncompetitive activities in some regions and reduce interstate trade, this effect could be offset by a domestic specialization process. So in order to find the size and direction of the international trade impact by region, we decompose MERCOSUR's Trade Creation ($MERCOSUR_{ijt}$) in regional terms. Unfortunately, we will not be able to keep in equation the Trade Diversion impact (BRZ_{ijt}) due to colinearity problems. It is impossible to measure the states' fixed effects as exporter and importer while decomposing the regional effects on both; trade of states with members and nonmembers for whole sample period since these are just two different ways of decomposing the same variation. The reference will then be slightly different since it includes also the trade of Brazilian states with the rest of world and the results are notcomparable with the estimates of previous models.

We use the Instituto Brasileiro de Geografia e Estatística (IBGE)'s regional nomenclature for our regional decomposition. The IBGE divides Brazil into five macro-regions. We use this macro-level division: namely South, South-East, North-East, Center-West and North (see Figure 1 in the Appendix). The IBGE endeavors to group together states with similar cultural, economic, historical and social characteristics in the same region provided they are geographically clustered. Thus there is minimum uniformity within each regional division and the study at regional level provides enough information to capture the differences in trade impact.

We decompose MERCOSUR's trade creation for each region by introducing a bilateral dummy for the period before and after MERCOSUR. Thus we have k=5 dummies of the trade creation variable for the pre-MERCOSUR period ($\sum_{k=1}^{5} \beta_{MERCOSUR,k} MERCOSUR_{ijt}{}^{91^k}$), 5 dummies of the trade creation variable for the post-MERCOSUR period ($\sum_{k=1}^{5} \beta_{MERCOSUR,k} MERCOSUR^{*}_{ijt}{}^{\mathrm{k}}$). For example, $MERCOSUR_{ijt}{}^{91^{north}}$ is equal to 1 for Northern states' exports to MERCOSUR members as well for their imports from member countries in 1991. We also introduce a dummy for the pair of MERCOSUR countries other than Brazilian states (*mercosur_memb*). For ease of reading, the results in Table 3 are presented horizontally for post- and pre-MERCOSUR dummies. The results for the basic control variables (GDP, distance, contiguity, RTA, etc.) in Equation 2 are not given in this table since they concur with previous results. We also conduct a Fisher test to control for whether the difference in the value of the coefficients is statistically significant. Both methods of estimation produce very similar results.

In Table 4, different than previous results *IST* and *IST** variables are of bigger size. This is a consequence of the change in the reference with the inclusion of Brazilian states' trade with nonmembers as we found above to be very little integrated to world trade relatively to average. However, in line with previous estimations, we do not find any significant preference erosion impact. Results for regions show that even before MERCOSUR, the trade of Brazilian states was significantly (except for North) higher with members relatively to the average integration level of world exports. Furthermore, Fisher test showed MERCOSUR has significantly created trade in all regions except the Center-West. The South-Eastern states, which are the most economically developed part of Brazil, already strongly integrated, have posted an important increase. The Southern and, more surprisingly, North-Eastern states have also benefited from the creation of MERCOSUR. The North-East has probably benefited from a relative relocation of businesses prompted by incentives and lower labor costs. Northern region disadvantaged before MERCOSUR has also increased, albeit less so, its trade with MERCOSUR countries Center-West economic activity has not benefited from the creation of MERCOSUR. The region Center-West became more specialized in exportable agricultural goods over the period, which could be a plausible explanation why it trades very little with MERCOSUR members whose agricultural specialization is in similar products (soya, beef, etc.).

TABLE 4: Regional Decomposition of the impact of MERCOSUR

	PPML			ZIPPML		
Dépendent Variable $Xijt$[1]:	Pre—MERCOSUR period	Post—MERCOSUR period	Fisher Test of equality	Pre—MERCOSUR period	Post—MERCOSUR period	Fisher Test of equality
	β	B	$\chi^2(1)$	β	β	$\chi^2(1)$
IST	4.595***	4.504***	1.06	4.551***	4.463***	1.00
	(0.116)	(0.093)		(0.116)	(0.093)	
MERCOSUR_north	0.366	1.013***	3.88***	0.345	0.965***	3.34**
	(0.325)	(0.176)		(0.337)	(0.178)	
MERCOSUR_south	1.290***	1.996***	6.40***	1.247***	1.959***	6.64***
	(0.276)	(0.143)		(0.274)	(0.143)	
MERCOSUR_northeast	1.394***	2.100***	10.72***	1.338***	2.050***	10.58***
	(0.204)	(0.134)		(0.207)	(0.137)	
MERCOSUR_southeast	1.832***	2.538***	28.11***	1.793***	2.505***	29.08***
	(0.141)	(0.102)		(0.140)	(0.103)	
MERCOSUR_centerwest	0.578*	1.145***	2.64	0.613**	1.091***	1.96
	(0.305)	(0.209)		(0.297)	(0.210)	
MERCOSUR_memb	1.201***	1.655***	9.84***	1.162***	1.624***	10.79***
	(0.163)	(0.162)		(0.161)	(0.161)	
Observations	78,580	78,580		78,580	78,580	
Importer fixed effects	Yes	Yes		Yes	Yes	
Exporter fixed effects	Yes	Yes		Yes	Yes	
Time fixed effects	Yes	Yes		Yes	Yes	
-2 log pseudo-likelihood	5,561,942	5,561,942		5,435,436	5,435,436	
Vuong *(z)*				24.92***	24.92***	
AIC	5,562,565	5,562,565		5,436,064	5,436,064	
BIC	5,565,448	5,565,448		4,553,232	4,553,232	

[1] Dependent variable is scaled by 10^{-6}. Robust standard errors are in parentheses: All inferences are based on a Huber—White sandwich estimate of variance. * Significant at 10%; ** significant at 5%; *** significant at 1%. Results are given only for interest variables.

VI. CONCLUSION

The purpose of this paper was to consider the effects of MERCOSUR on the trade of Brazilian states by highlighting three contradictory effects: a trade creation effect with MERCOSUR countries and an expected diversion effect with other countries, but also a preference erosion effect on interstate trade. We confirm that Brazil "prefers" to trade with itself and with MERCOSUR countries rather than trading with the rest of the world. In spite of its trade openness, Brazil remains poorly integrated compared with the other countries in the world. However, MERCOSUR has had a significant trade creation effect without affecting either interstate trade or trade with the rest of the world. Although trade with MERCOSUR decreased in the late 1990s, this was mainly due to the economic crisis and monetary adjustments rather than a lack of integration. Nevertheless, MERCOSUR's positive effects are unevenly spread across the different Brazilian regions.

A lack of updated statistics on interstate trade means that the number of years considered in this article is unfortunately too short to see how MERCOSUR's impact on trade develops over a longer period.

The updating of data would mean that we could analyze the effects of MERCOSUR over a longer period. We would then expect the effects to dwindle over time. The analysis also needs extending in a number of directions. We need to improve the identification of trade barriers between states caused mainly by poor infrastructures and the particularity of the Brazilian tax system. And an analysis should be conducted of changes in states' specialization patterns in order to point up the paradoxical development of high-tech industries in Manaus, the recent industrialization of the east coast and the displacement of agriculture from the south to the center.

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Appendix

Figure 1. Brazilian Regional Map and States

Source: IBGE (http://www.ibge.gov.br/ibgeteen/mapas/brasil_regioes.htm)

Region North: Acre, Rondônia, Amazonas, Roraima, Pará, Amapá, Tocantins

Region North-East: Maranhão, Pauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia

Region Center-West: Mato Grosso, Mato Grosso do Sul, Goiás

Region South-East: Minas Gerais, Espírito Santo, Rio de Janeiro, São Paulo

Region South: Paraná, Santa Catarina, Rio Grande do Sul

1. List of Countries

Algeria (DZA)
Angola (AGO)
Argentina (ARG)
Australia (AUS)
Austria (AUT)
Bahamas, The (BHS)
Bahrain (BHR)
Bangladesh (BGD)
Barbados (BRB)
Belize (BLZ)
Benin (BEN)
Bermuda (BMU)
Bolivia (BOL)
Bulgaria (BGR)
Burkina Faso (BFA)
Cameroon (CMR)
Canada (CAN)
Cape Verde (CPV)
Central African Republic (CAF)
Chad (TCD)
Chile (CHL)
China (CHN)
Colombia (COL)
Comoros (COM)
Congo, Rep. (COG)
Costa Rica (CRI)
Cyprus (CYP)
Denmark (DNK)
Dominican Republic (DOM)
Ecuador (ECU)
Egypt, Arab Rep. (EGY)
El Salvador (SLV)
Ethiopia (ETH)
Fiji (FJI)
Finland (FIN)
France (FRA)
Gabon (GAB)
Gambia, The (GMB)
Germany (DEU)
Ghana (GHA)
Greece (GRC)
Grenada (GRD)
Guatemala (GTM)
Guinea (GIN)
Guinea-Bissau (GNB)
Guyana (GUY)
Haiti (HTI)
Honduras (HND)
Hong Kong SAR, China (HKG)
Hungary (HUN)
Iceland (ISL)
India (IND)
Indonesia (IDN)
Ireland (IRL)
Israel (ISR)
Italy (ITA)
Jamaica (JAM)
Japan (JPN)
Jordan (JOR)
Korea, Rep. (KOR)
Kuwait (KWT)
Lebanon (LBN)
Liberia (LBR)
Libya (LBY)
Madagascar (MDG)
Malawi (MWI)
Malaysia (MYS)
Mali (MLI)
Malta (MLT)
Mauritania (MRT)
Mauritius (MUS)
Mexico (MEX)
Morocco (MAR)
Mozambique (MOZ)
Nepal (NPL)
Netherlands (NLD)
New Zealand (NZL)
Nicaragua (NIC)
Niger (NER)
Nigeria (NGA)
Norway (NOR)
Pakistan (PAK)
Panama (PAN)
Paraguay (PRY)
Peru (PER)
Philippines (PHL)
Poland (POL)
Romania (ROM)
Portugal (PRT)
Qatar (QAT)
Rwanda (RWA)
Saudi Arabia (SAU)
Senegal (SEN)
Sierra Leone (SLE)
Singapore (SGP)
Spain (ESP)
Sri Lanka (LKA)
Sudan (SDN)
Suriname (SUR)
Sweden (SWE)
Switzerland (CHE)
Syrian Arab Republic (SYR)
Tanzania (TZA)
Thailand (THA)
Togo (TGO)
Trinidad and Tobago (TTO)
Tunisia (TUN)
Turkey (TUR)
Uganda (UGA)
United Arab Emirates (ARE)
United Kingdom (GBR)
United States
Uruguay (URY)
Venezuela, RB (VEN)
Vietnam (VNM)
Yemen, Rep. (YEM)
Zambia (ZMB)
Zimbabwe (ZWE)