Did MERCOSUR affect interstate Brazilian trade?

WORK IN PROGRESS

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Abstract –

We consider the effect of MERCOSUR on trade between Brazilian states and on trade of Brazilian states with the rest of the world. We use a gravity model to shed light on the possible diversion effect of MERCOSUR. Thanks to the data on inter-state trade only for four years including one available year for the pre-MERCOSUR period (1991). We show that MERCOSUR led to an increase of trade of Brazilian states with member countries however without neither affecting intra-state trade nor trade of Brazilian states with third countries. The paper also shows the lack of integration of the Northern region.

Keywords: Regional Trade Agreements; Brazil; MERCOSUR; Gravity Model; Border Effect

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1. Introduction

In 2000, Obstfeld and Rogoff (2000) considered that by introducing the transaction costs of international trade (transport costs, tariffs and nontariff barriers and other transaction costs), the international macroeconomists should be able to solve the six leading empirical puzzles that they have met since 1975s. One of them was the McCallum's home bias (McCallum, 1995) who estimated that trade between provinces within Canada was 22 times of the expected trade between the Canadian provinces and the U.S. The inclusion of control variables in the used gravity model, including the distance between regions and their size, authorized 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 lowered thanks to refined econometric methods that better deal with the omitted variables bias and the size heterogeneity, obviously important for the US-Canadian trade (Helliwell, 1998; Wolf, 2000; Anderson & van Wincoop, 2003; Balistreri & Hillberry, 2007).

Other empirical studies have concerned other countries like China (Poncet, 2003; 2005), Japan (Okubo, 2004) or EU (Chen, 2004). However, to estimate the border effects for other countries or regions have been confronted with a lack of data in regional trade. Concerning Brazil, many authors have used such data, only available for 4 years (1991, 1997, 1998, 1999): Daumal & Zignago (2010), Leusin & alii (2009), Silva & alii (2007), Arinos de Mello & Franco Neto (2003), Hidalgo & Vergolino (1998). They all used a gravity model.

As other Latin American and many developing countries, Brazil has led an "import-substitution" strategy and stayed for a long time very little open to international trade. Brazil has attempted to take advantage of its status of subcontinent to promote internal trade. From 1950s and during the military dictatorship (1964-1985), the governments have led protectionist and industrial policies in order to diversify the production structure considered as too focused on primary goods. This strategy was closely associated with regional policies, led at the federal level, through the infrastructure investment (e.g. the Transamazonian road) and increased attractiveness for foreign capital in order to produce manufactured goods mainly dedicated to Brazilian market (creation of the Manaus Free Trade Zone in 1967). However, the "Brazilian miracle" turned into an inflationary and over-indebtedness economy. The return to democracy strengthened the federal

system by giving larger rights to states and municipalities (Constitution of 1988) and, starting from the90's, the openness to international trade has been implemented, first within the regional framework of MERCOSUR (Treaty of Asunción, 1991) and after, with the rest of the world. However, unlike other Latin American countries (e.g. Chile, Mexico, Peru), Brazil is still less active in preferential trade agreements not only with regional partners, but also with more distant countries.

The Vinerian and post-Venerian literature on the impact of RTAs on trade usually considers member countries as fully integrated entities and therefore ignores the regional consequences of such agreements. The trade creation/diversion effect only plays between member and third countries, not inside countries, what is highly debatable for a country as fragmented as Brazil. It is exactly this gap that "border effect" literature should permit to fulfill.

This context of relative rapid Brazilian openness in 1990s and the availability of data for the period give the opportunity to study Brazilian border's effect, eventually going further than post-McCallum's puzzle i.e. considering the Brazilian states as trade entities arbitrating between internal and external markets, the former including the trade between Brazilian states and the latter is with foreign countries.

The aim of this paper is to consider the consequences of MERCOSUR on the direction of trade of Brazilian states and to determine if the trade agreement generated a net trade creation or a net trade diversion effect on Brazilian internal trade as well as with other member countries.

2. Previous works and renewed problematic

For a country like Brazil, which suffers from strong regional inequalities and whose internal market is highly fragmented, the differences in welfare gains from MERCOSUR might strongly be different among 27 states (26+Federal District). Using available inter-state trade data, some authors have quantified this internal fragmentation comparatively with the level of integration of Brazilian states to world market.

Hidalgo and Vergolino (1998) find that Brazilian inter-state exports are 11.5 times larger than exports from 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 heterogeneity bias and by the

elimination of zero observations. By pooling the data for the four available years (1991, 1997, 1998, 1999), Paz and Franco (2003) obtain results in border effect measures which are sometimes implausible. Results are actually sensitive to different methods (inclusion of country/state fixed effects, treatment of zero observations). Using the same data for inter-state and international trade, Daumal & Zignago (2010) not only focus on the "home bias" but also on the Brazilian inter-state integration relatively to the intra-state trade. After controlling by size, distance and heterogeneity (country/state fixed effects), they show that Brazilian states trade 38 times more between each other than with foreign countries. Leusin & *alii* (2009) and Silva & *alii* (2007) find very similar results for the same time period.

Daumal & Zignago (2010) point out that, despite the fact of significant progresses in integration policies, the Brazilian market is still fragmented, but less than China (Poncet, 2005). Actually, the internal border effect relative to intrastate trade is equal to 23 in 1991, even decreasing to 13 in 1999. Note that in 1999 and in average, a Brazilian state trade 460 times more with itself than with a foreign county.

Beyond the debate concerning the bias frequently encountered in gravity models, this relative fragmentation originates mainly from historically unequal and disjointed development among different Brazilian regions hardly corrected by the integrative regional policies, high internal transport costs due to the lack of infrastructures and large inter-regional inequalities accompanied by differences in consumption preferences. Even cyclically floating between recentralization and decentralization periods, Brazil is a Federal country with a large autonomy of states concerning the regulation and fiscal policy domain. For example, the main Brazilian VAT (ICMS) is perceived at state level and introduces distortions in inter-state trade (see Brami and Siroen, 2007).

At the beginning of the 1990s, Brazil is not only an economy relatively closed to trade with foreign countries, but moreover each state was more (Northern states) or less (Southern states) closed to trade with other states.

We consider that the Brazil's openness to international trade in the 1990s, especially in the MERCOSUR framework, provoked a shock that affected the arbitration between the accessible directions of trade for Brazilian states. We can expect that this openness might be detrimental to

internal trade, because some states might prefer to trade with relatively more accessible foreign countries instead of other states, especially in the MERCOSUR area. It might be less costly for Paulistan firms to export to opening Argentina than to Amazonian states. If this hypothesis is verified, it would mean that the integration of Brazil to regional (MERCOSUR) and world markets might contravene the traditional Brazilian objective to promote a more integrated Brazilian market. However, this assumption can be contradicted by the fact that expansion of international trade might induce more labor division and specialization inside Brazil and then boosting inter-state trade, in a global trend to vertical specialization.

3. Methodology

Recent empirical studies concerning the impact of RTAs on trade as well as the post McCallum literature on "border effects" usually use gravity models, which estimate the expected bilateral trade with several control variables including size and different measures of distance (geographical, cultural, institutional, etc.). The challenge is to link both problematic worked out conventionally apart from each other. For that purpose, we have to consider Brazil not as a single integrated country but as a huge and unaccomplished free trade area gathering 27 different countries.

However, since we use a database between the entities from different administrative division levels (states and countries) and with several sub groups of trade pairs identified by dummy variables (Brazilian State-Brazilian State, Brazilian State-MERCOSUR Country, Brazilian State-Non MERCOSUR Country; MERCOSUR country-MERCOSUR country, Non MERCOSUR Country- Non MERCOSUR Country[1]) the choice of the reference group becomes an important and complicated task for a viable estimation of the counterfactual. The impact of MERCOSUR can vary in size and in direction for different sub groups of the sample, thus we need to control for its impact on every sub groups individually and use a unique reference group for the comparability reasons.

[1] For example, respectively : Minas Gerais-Para ; Minas Gerais-Argentina; Minas Gerais-Germany; Germany-Japan

The gravity model used in this paper follows the theoretical rationale introduced by Anderson & van Wincoop (2003). According to the model A&vW (2003), trade between two units depends on their bilateral trade costs as well as the trade costs that they face with the rest of world.

MERCOSUR, while decreasing directly the trade costs between local units and member countries (e.g. Minas Gerais-Argentina), changes also the relative importance of the trade costs in the country compared to the trade costs with third countries (e.g. Minas Gerais-Germany) as well as the trade costs between Brazilian States (e.g. Minas Gerais-Para) even though it remains unchanged in absolute terms. In this perspective, the MERCOSUR created a shock on internal and external trade costs of Brazil and changed the internal and international trade structure of the country.

A&vW (2003) call the relative trade costs of the country with its trade partners as Multilateral Resistance (MR), which have to be included to avoid an omitted variable bias in the regression. The usual way to deal with this issue is to introduce country (exporter and importer) fixed effects, which are simple dummy variables attached to each country (or Brazilian State).

Theory induced gravity model is :

$$\frac{\ln X_{ij}}{Y_i Y_j} = k + (1-\sigma)\left[\ln t_{ij} - \ln P_i - \ln P_j\right]$$

Where t_{ij} is the bilateral cost of trade between *i* and *j*; while $\ln P_i$ and $\ln P_j$ are the measures of MRs. This equation can be augmented with many structural and policy variables having an impact on trade volumes and trade costs, e.g. contiguity, common language, common colonizer … or RTAs.

Following the trade diversion literature, we will augment the model introduced by A&vW with the variables measuring trade creation impact of MERCOSUR, trade diversion impact of MERCOSUR on Brazil's trade with rest of the world and the trade moved from Brazilian internal market to MERCOSUR countries

The empirical model used in this paper controls for the multilateral resistance by introducing time invariant exporter and importer fixed effects. Besides the basic variables of the traditional gravity

model (exporter and importer GDPs, bilateral distance), we also control for contiguity (common border). Variables of interest measure the trade diversion of MERCOSUR from Brazilian internal market and international market, as well as its trade creation between member countries.

Since Santos Silva & Tenreyro (2006), many economists prefer the usage of PPML (*Poisson Pseudo Maximum of Likelihood*) estimator over the conventional log-normal methods in the gravity equation estimations. In fact, there are many limits in the log-normal specification of the gravity models. First, the estimation models requiring a logarithmic transformation result with inefficient estimated parameters and rise the inconsistency since the error terms are heteroscedastic and their expected values depend on the regressors of the model. Second, PPML estimator is a useful tool to deal with zero trade values which hide an important amount of information explaining why some countries are trading very little. The log-linearization returning 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 equidispersion assumption $V[T_{ij}|x] \propto E[T_{ij}|x]$ of PPML estimator considers the conditional variance of the dependent variable being equal to its conditional mean. Since this assumption is unlikely to hold, Santos & Tenreyro (2006) advocate for the estimation of statistical inferences based on an Eicker-White robust covariance matrix estimator.

According to Burger & *alii* (2009), depending on the reason why the conditional variance is higher than conditional mean, due to overdispersion or excess of zero trade flows or both, other estimators of Poisson family (*Negative Binomial* and *Zero Inflated Poisson*) can be pursued. From an economic point of view, Negative binomial specification accounts for unobserved heterogeneity, which rises from an omitted variable bias. The distribution equation of this specification is adjusted for the overdispersion; yet its variance is a function of the conditional mean (μ) and the dispersion parameter (α). Another possible cause of the violation of the equidispersion assumption of PPML can be found in excess zeros in trade volumes hiding the two latent groups: first, zero trade flows whose trade probability are exactly zero and the second group having positive trade potential.

Frankel (1997) tells that zero trade outcomes originate mostly from the lack of trade between small and distant countries. Rauch (1999) adds the lack of historical and cultural links as a

possible reason of zero trade between country pairs. Negative binomial specification introducing the overdispersion parameter in distribution is a comprehensible statistical choice; however it has no economical explanation for excess zeros. Further, this model is based upon a gamma mixture of Poisson distribution whose conditional variance is a quadratic function of its conditional mean. As Santos Silva & Tenreyro (2006) mentioned, within the power-proportional variance functions, the estimators assuming the conditional variance as being equal to higher powers of conditional mean gives more weight to observations from smaller countries whose data quality is questionable.

In this perspective, we use a Zero-inflated Poisson (ZIP) model (Lambert (1992); Greene (1994); Long (1997)) accounting for two latent groups, one is strictly zero for whole sample period and the other which has the positive trade potential, either trading or not. The first part of the model is a logit regression estimating the probability of belonging to "never-trading group", while second part is a Poisson regression.

We consider that Zero-inflated model is a stronger methodological tool compared to Negative binomial model to solve the overdispersion problem in gravity model of trade since it has a theoretical rational besides its statistical value. Thus, we in this paper use two estimators: a Poisson pseudo-maximum likelihood model (PPML) following Santos Silva & Tenreyro (2006) and Zero-inflated Poisson pseudo-maximum likelihood model (ZIPPML) from modified Poisson estimator family in order to deal with the overdispersion problem encountered in Poisson estimations of trade models. A Vuong statistic (Vuong, 1989) will authorize to compare the ZIPPML model with PPML.

4. Empirical Model and Database

We use a balanced panel data counting for the export values of 27 Brazilian states and 118 countries in bilateral terms for the years 1991, 1997, 1998 and 1999. Thus, we can consider that the data consists of sub group of pairs that for each a different data source is used.. Totally we use the export values of 27 states between each other (27*26), their trade with other countries (27*118*2) and the trade of 118 countries between each other (118*117), all for four years and balanced for the pairs with missing values while zero values are kept.

The international trade flows of Brazilian states are taken from ALICEWEB maintained by *Foreign Trade Secretariat of the Brazilian Ministry of Development* and contain the export and imports values of Brazilian states to and from each country. Values of exports of 118 countries between each other are taken from Direction of Trade Statistics (DOTs) updated and published each year by the International Monetary Fund. Two sources are in concordance and yet combinable since they give similar total export volumes for the whole Brazilian trade with sample countries.

We also use interstate export flows of Brazilian states for our empirical work. Thanks to its internal tax regulation led by the federal system, we have the bilateral export data of Brazilian states for the years 1991, 1997, 1998 and 1999. Brazilian authorities use the information coming from ICMS tax accounts in order to measure the interstate trade flows. In fact, ICMS tax (*Imposto sobre Circulação de Mercadorias e Serviços*) is a Value Added Tax perceived by the exporting State. The Ministry of Finance of Brazil constructed a database for the years 1997, 1998 and 1999 (*Ministério de Fazenda* 2001, 2000a, 2000b). For the year 1991, data come from SEFAZ-PE (1993) and is measured and extrapolated by the Financial Ministry of Pernambuco from the interstate database of 1987.

GDP values of the countries are in current dollar and drawn from *World Development Indicators* of *The World Bank.* For Brazilian states, the GDP values are provided by *IBGE (Instituto Brasileiro de Geografia e Estatística)* in local currency units, in *Cruzeiro* for 1991 and in *Real* for the following years. Since the exchange rate from *Cruzeiro* to current dollar terms is not provided by *WDI*, we calculate state to total GDP ratios by using the database of *IBGE* in local currency unit and multiply it with the total GDP of Brazil in current dollars provided by *WDI*. For the years 1997, 1998, 1999 the ratios give similar results with the ones calculated by *WDI* exchange rates which is insuring for the 1991 values of states' GDP.

Distance and Contiguity variables are taken from *CEPII's distances* database. Mostly, the capital cities are the main unit of distance measures, however exceptionally the data use also the economic center as the geographic center of the country. *World Gazetteer* web site furnishes the geographical coordinates of states' capital from which we calculated the bilateral distances of the states between each other and the other countries. The information about the contiguity of states

is manipulated manually from Brazilian map. Unfortunately, the lack of data for a longer period and the existence of gaps between 1991 and 1997 raise limits on the work. However, we believe to be able to cover an important part of the shock provoked by the launching of MERCOSUR since it enters in force in the end of November 1991 and is reinforced in 1994 by the Treaty of Ouro Preto.

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

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

where 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. 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 the value 1 if the trade pair *ij* (state or country) shares a common border which makes them neighbors.

In Eq(2), we will measure the Brazilian interstate trade for the period after MERCOSUR. We introduce as well the trade creation impact of MERCOSUR on its member countries (Uruguay, Paraguay, Argentina, and Brazil) and the average impact of six main RTAs (ANDEAN, ASEAN, APTA, CACM, EC, NAFTA) other than MERCOSUR on bilateral trade. Another interest variable in Eq(2) is the impact of MERCOSUR on Brazil's external trade. We believe for a better understanding of to what extent the interstate trade of Brazil depends on the substitution between domestic and international market led by the tariff changes with member countries, it is an important task to see the whole impact of MERCOSUR, the trade diversion as well as the trade

creation. Yet, the trade creation not always happens merely at the cost of a decrease in trade volumes with nonmember countries, it can also originate from a contraction in domestic market.

Other than measuring the evolution of interstate trade, the strength of Eq(2) stands in its comparability with the results in the literature since the reference group used for the measure of MERCOSUR impact is the same with other conventional researches in the field, namely the exports of 118 countries between each other.

$$X_{ijt} = \beta_1 + \beta_2 \ln [GDP]_{it} + [\beta_3 lnGDP]_{jt} + \beta_4 \ln [Dist]_{ij} + [\beta_5 Contiguity]_{ij} + [\beta_6 IST]_{ij(t=19} \quad \textbf{(2)}$$

$IST_{ij(t=1991)}$=1 when *i* and *j* are two states and the year is equal to 1991 (pre-MERCOSUR). $IST_{ij(t=mercosur)}$ takes the value 1 for interstate trade of Brazil for the time period after the creation of MERCOSUR, namely for the years 1997, 1998 and 1999. $MERCOSUR_{hyp_{ij(t=1991)}}$ indicates trade between MERCOSUR members, including the trade between Brazilian states and member countries for the year 1991. By including this variable, we expect to estimate the preliminary impact of MERCOSUR and see if there has been an increase in the trade of member countries after MERCOSUR. $BRZ_{INT_{ij(t=1991)}}$ is a dummy variable which takes the value 1 for the export flows from Brazilian states to non-MERCOSUR countries in *t*=1991. This indicator shows Brazil's integration level to international market in 1991, so that we can see its evolution after the launching of MERCOSUR. $BRZ_{INT_{ij(t=mercosur)}}$ is the same variable for the post-MERCOSUR period. In fact, all these dummies in Eq(2) must be interpreted relatively to the reference group, namely the bilateral trade of countries which don't belong to an RTA (MERCOSUR or other RTAs). The change in their trade structure provoked by MERCOSUR can only be amplified by comparing pre- and post-MERCOSUR years.

The impact of an RTA is not uniform for the whole period. As mentioned by Frankel (1997) the time before and after the agreement goes into effect has an impact over the extent of trade creation and trade diversion considered. According to Magee (2008), the agreement has no cumulative impact after the 11th year of the implementation.

Thus, in Eq(3), we will decompose the interstate trade for each year by always using the pooled cross-section-time series data. We believe this method to be better than a strict cross-section

analysis driven for each year. In fact, in cross-section analysis, we use a gravity benchmark which is different for each year and so vulnerable for yearly fluctuations and shocks in world trade. On the other hand, in a pooled panel data, since we use a unique control group for all years, the coefficients are comparable between each other and in time[2].

$$X_{ijt} = \beta_1 + \beta_2 \ln GDP_{it} + \beta_3 \ln GDP_{jt} + \beta_4 \ln Dist_{ij} + \beta_5 Contiguity_{ij} + \beta_6 MERCOSUR_{hyp_{ij(t=1991)}} + \beta_7 MERCOSUR_{ijt} + \beta_8 E$$

(3)

Once we consider each Brazilian state as a separate trade entity, we can study the trade creation and the trade diversion effects of a trade agreement at this level. These static effects can vary depending on the regional differences in production structure. In Brazilian case, it is particularly important to decompose the aggregate impact in regional terms, since the regional disparities in states' economic development levels and the structural differences are very strong in the country. These differences fragile the production in certain states with high production costs. In fact, the size of *TC* and *TD* effects change according to differences in these production costs. On the contrary, the internal trade impact can be positive. The more competitive the state, there will be more sectors in which it will get specialized after the RTA. The increased specialization of states can boost the internal trade, at least between the advantageous ones. Thus, in order to see the size and the direction of the internal trade impact, we need to precede an interstate decomposition of the aggregate *Interstate Trade Impact* that we measured in first part.

Brazil is divided into five macroregions by the *Instituto Brasileiro de Geografia e Estatística (IBGE)*: North, Northeast, Central-West, Southeast, South; see the map in annex). We will use this macro-level division, namely South, Southeast, Northeast, Center-west and North. *IBGE* makes an effort to gather the states of similar cultural, economical, historical and social characteristics under the same region as long as they are geographically clustered. Thus, there is a minimum uniformity inside each regional division and the study at regional level will furnish sufficiently large amount of information to understand the differences in trade impact.

[2] For the curiosity of the reader we made after all an attempt to give the estimation results driven from cross-section analysis. Unfortunately, PPML and ZIPPML are not converging for all the years (STATA), especially for the year 1991 which is essential in order to evaluate MERCOSUR impact as being the only year in the sample before its creation.

In Eq(4), we will introduce bilateral interregional trade variables for the period before and after MERCOSUR. Since, our variables are bilateral we have totally 15 ($\frac{5*4}{2}+5$) interregional trade pairs comprising the trade between the states of the same region.

$$X_{ijt} = \beta_1 + \beta_2 \ln GDP_{it} + \beta_3 lnGDP_{jt} + \beta_4 \ln Dist_{ij} + \beta_5 Contiguity_{ij} + \beta_6 MERCOSUR_{hyp_{ij(t=1991)}} + \beta_7 MERCOSUR_{ijt} + \beta_8 BRZ_{INT_{ij(t=1991)}} + \beta_9 \quad (4)$$

$IST^{k}_{ij(t=1991)}$ is a dummy variable which is equal to 1 depending on *k* which is an index for 15 regional pairs (north-north, north-south, north-southeast etc…). If k=north-south than $IST^{k}_{ij(t=1991)}$ takes the value 1 for export of a northern state to a southern state as well as the export of southern state to northern state in year 1991. $\sum_{k=1}^{15} \beta^{k}_{IST_{mer}} IST^{k}_{ij(t=mercosur)}$ measures the aggregate impact for whole MERCOSUR period, but decomposed for each pair of regions.

In Eq(5), we go one step further and measure the Trade Creation effect of MERCOSUR individually for each Brazilian region and between other member countries. Highly unequal regional economic structure of Brazil makes it necessary to decompose regionally the MERCOSUR impact. These regional MERCOSUR variables measure the differences in production costs and economic specializations of the regions besides with the possible advantages they draw due to their historical close relations with member countries.

$$X_{ijt} = \beta_1 1 + \beta_2 2 \ln [GDP]_{it} + [\beta_3 3\, lnGDP]_{jt} + \beta_4 4 \ln [Dist]_{ij} + [\beta_5 5\, Contiguity]_{ij} + \beta_6 6\, [MERCOSUR_{h} \quad (5)$$

$\mathbf{MERCOSUR^{z}_{ijt}}$ is the MERCOSUR impact on the trade of five Brazilian regions with MERCOSUR member countries as well as the member countries between each other, thus totally it makes *z*=6 dummy variables. It is in both directions: export from states in regions to member countries and exports of member countries to the region.

Lastly, we will see the evolution of the interstate trade between the regions separately for each year before and after MERCOSUR. The equation is as follows,

$$\beta_0 BRZ_{INT} \qquad (6)$$

where $IST_{ijt}^{k,t}$ is a dummy counting for interstate trade belonging to same or different regions of Brazil (k=15) decomposed separately for each year (t=1991, 1997, 1998, 1999). Therefore, we have totally k*t dummies in order to measure in details the regional differences in the evolution of interstate trade with MERCOSUR.

5. Results

The estimation results for models 1 to 3 are furnished in Table 1.

Table 1:

Dependent variable=ExportCurrent	Model 1	Model 1		Model 2	Model 2		Model 3	Model 3	
	PPML	Logit	ZIPPML	PPML	Logit	ZIPPML	PPML	Logit	ZIPPML
ln_gdpnominali	.4536886***		.4499205***	.4504992***		.448813***	.4784798***		.4753046***
ln_gdpnominalj	.6969415***		.680983***	.7103235***		.6987728***	.7406768***		.7274434***
ln_distance	-.8215273***	.3536553***	-.8181211***	-.6211342***	.3536553**	-.6179738***	-.6209514***	.3536553***	-.6178074***
Contiguity	.6837528***	-1.475198***	.6866379 ***	.6898418 ***	-1.475198***	.6913232***	.6896492***	-1.475198***	.6911453***
IST_91				2.591874***		2.544252***	2.607355***		2.558824***
IST_mercosur				2.460291***		2.416505***			
IST_1997							2.444005***		2.402448***
IST_1998							2.407612***		2.365111***
IST_1999							2.556148***		2.506924***
MERCOSUR_hypo_1991				.5078708***		.4748947**	.5196454***		.4859372**
MERCOSUR				1.149378***		1.111592***	1.1482***		1.110415***
BRZ_INT_t=91				-.9038175***		-.8729523***	-.895696***		-.8653772***
BRZ_INT_t=mercosur				-.8341045***		-.8243811***	-.8348414***		-.8251083***
RTA				.4071401***		.4157494***	.4078387***		.416392***
Constant	-7.202867**	-3.539839***	-5.397823	-9.42369 ***	-3.539839***	-8.653841**	-10.62176**	-3.539839***	-9.786933**
Exporter Fixed Effects	Yes		Yes	Yes		Yes	Yes		Yes
Importer Fixed Effects	Yes		Yes	Yes		Yes	Yes		Yes
Time Dummies	Yes		Yes	Yes		Yes	Yes		Yes
Huber-White Sandwich Estimator	Yes		Yes	Yes		Yes	Yes		Yes

*** Significant at 1%

** Significant at 5%

* Significant at 10%

The basic model (Model 1) gives coefficients very close of those usually found in the literature. Both estimations –PPML and ZIPPML- give similar results. The income elasticity is generally

inferior to 1 in PPML and ZIPPML and it is reason why we relax the A&vW (2003) hypothesis of unitary elasticity. Daumal & Zignago (2010) estimate a coefficient of -.5 with PPML estimator by using a database of Brazilian interstate, intrastate and international trade volumes. According to logit model specification which is estimated at first place in ZIPPML, an augmentation of 1% in distance between two units increases their probability of being in zero trading group in average by .35%, while having a common border (*Contiguity* dummy) decreases this probability by 77% (1-exp(-1.4752)).

In Model 2, we introduce dummy variables which allow the clustering of bilateral relations for certain groups however; their coefficients must be interpreted relatively to the reference group that is the bilateral trade between countries not involved in one of the considered RTAs. All coefficients are significant. The coefficients of inter-state trade are higher than coefficients for intra-MERCOSUR trade over the whole period. The coefficients for external trade with third countries are significantly negative. The first conclusion is that Brazilian "border effect" exists: Brazilian states trade more between each other than they do with foreign countries even inside MERCOSUR and, in average; their integration to world trade is relatively weak. The second conclusion concerns the comparison between the pre- and the post-MERCOSUR period. The coefficients of inter-state (IST) and international (BRZ_INT) trade are not significantly affected although they are slightly lower, while intra-MERCOSUR trade is significantly higher after the implementation of MERCOSUR than the pre-MERCOSUR period. These first results are coherent with the hypothesis that MERCOSUR had a trade creation effect inside the area without diverting trade between the Brazilian states and with third countries.

If we refine the analysis by fragmenting the IST variable in order to identify the differences over four available years (Model 3), we confirm the previous conclusion: MERCOSUR does not seem to have affected the Brazilian inter-state trade.

The regional decomposition of IST and MERCOSUR variables is given in Table 2. As reported in model 4, inter- and intra-regional trade of Brazilian states is higher than the average trade within MERCOSUR members which is an evidence for the existence of *Border effect* across the whole country. Nevertheless, the intra-regional trade in the North of the country is less than the average MERCOSUR trade in post-MERCOSUR period. This can be considered as an evidence for the high fragmentation between the states of the region and their disadvantageous production

costs which render the MERCOSUR members a strong rival against the Northern states in the regional market once the tariff rates decrease.

In the last column of Model 4, we calculated the differences between the coefficients estimated for the post- and pre-MERCOSUR period by Model 4 and pursued a Fisher test. The differences are mostly negative however negligible, since either they are insignificant or the change in their values is very small. The only exception seems to be the difference in the bilateral trade of the states of Northern and Center-West regions which is positive and statistically significant at 5% level. A possible change in the industrial specialization patterns of the regions could have created complementary sectors located in two regions and generate an increase in their bilateral trade volumes. However, a more detailed research led at industrial level is necessary to conclude with the case of North-Center-West trade.

Table 2:

Dependent variable=ExportCurrent	**Model 4**			**Model 5**		
	Logit	**ZIPPML**	**Difference for *t=mercosur***	**Logit**	**ZIPPML**	**Difference for *t=mercosur***
Interstate trade over years and among regions						
IST_nord91		1.826652***	-.8955626*		2.230672***	-.896092*
IST_sud91		2.604844***	.010739		2.945627***	.010664
IST_nest91		4.330246***	-.186261		5.000114***	-.186367
IST_sest91		1.807291***	-.057422		2.358602***	-.05752
IST_couest91		4.369643***	-.298923		4.805954***	-.29905
IST_n_s91		2.452858***	-.118391		2.826541***	-.118874
IST_n_nest91		2.922055***	-.115267		3.459841***	-.115718
IST_n_sest91		2.789678***	-.033497		3.269658***	-.034042
IST_n_couest91		2.203142***	.768839**		2.623637***	.768289**
IST_s_nest91		3.472713***	-.329649**		3.978367***	-.329701**
IST_s_sest91		2.375598***	-.160373		2.823547***	-.160457
IST_s_couest91		4.039721***	-.537871**		4.429773***	-.537981**
IST_nest_sest91		3.334541***	-.212444**		3.946755***	-.212544**
IST_nest_couest91		3.408381***	-.037034		3.963378***	-.037135
IST_sest_couest91		3.263577***	-.117373		3.758797***	-.117467
IST_nord		.9310894*			1.33458**	
IST_sud		2.615583***			2.956291***	
IST_nest		4.143985***			4.813747***	
IST_sest		1.749869***			2.301082***	
IST_couest		4.07072***			4.506904***	
IST_n_s		2.334467***			2.70764***	
IST_n_nest		2.806788***			3.344123***	
IST_n_sest		2.756181***			3.235616***	
IST_n_couest		2.971981***			3.391926***	
IST_s_nest		3.143064***			3.648666***	
IST_s_sest		2.215225***			2.66309***	
IST_s_couest		3.50185***			3.891792***	
IST_nest_s~t		3.122097***			3.734211***	
IST_nest_c~t		3.371347***			3.926243***	

IST_sest_c~t	3.146204***	3.64133***
RTAs and International trade of Brazil		
MERCOSUR_hypo(*t*=1991)	.4458341**	.651793***
MERCOSUR	1.086265***	
MERCOSUR_nord		.2648969
MERCOSUR_sud		.9924192***
MERCOSUR_nest		2.067599***
MERCOSUR_sest		1.502501***
MERCOSUR_couest		1.003783***
MERCOSUR_omembers		1.068209***
BRZ_INT(*t*=91)	-.8805249***	-.6235276***
BRZ_INT(*t*=mercosur)	-.8241265***	-.5675654***
RTA	.4025257***	.401502***
Basic gravity equation		
ln_gdpnominali	.4476799***	.4476088***
ln_gdpnominalj	.6986994***	.6986668***
ln_distance	.3536553*** -.62179***	.3536553*** -.6215608***
Contiguity	-1.475198*** .7047674***	-1.475198*** .7077635***
Constant	-3.539839*** -9.0801***	-3.539839*** -9.469284***
Exporter Fixed Effects	Yes	Yes
Importer Fixed Effects	Yes	Yes
Time Dummies	Yes	Yes
Huber-White Sandwich Estimator	Yes	Yes

*** Significant at 1%

** Significant at 5%

* Significant at 10%

In Model 5, decomposing the MERCOSUR impact among the regions, we found that the trade between the Northern states and MERCOSUR members are less important than it is for the other regions and smaller than the country average (1.086). This result reveals the unequal gains drawn by the Brazilian regions from MERCOSUR after controlling for the geographical closeness (distance and contiguity) and country fixed effects. Hence, it strengthens the assumption that there are structural limits to the Northern regions' integration to international trade which cannot be worked off easily.

In Model 6, we led an estimation decomposing IST variable regionally and on a yearly basis. The trade structures of the regions are significantly different from the reference group and are similar in size and in sign to the estimation results found in Model 4 and Model 5. However, Fisher tests pursued to understand the yearly evolution in the regional structure of trade do not show any specific trend.

TABLE 3:

Dependent variable=ExportCurrent	Model 6				
	Logit	ZIPPML	Dif_1997	Dif_1998	Dif_1999
Interstate trade over years and among regions					
IST_nord91		1.836456***	-1.558406**	-1.0448431**	-.215614
IST_sud91		2.620704***	-.094243	-.016126	.133514
IST_nest91		4.343592***	-.186696	-.252904	-.145774
IST_sest91		1.821694***	-.070072	-.120541	-.007702
IST_couest91		4.387335***	-.195296	-.452715	-.315298
IST_n_s91		2.466125***	-.165342	-.199149	.007559
IST_n_nest91		2.933802***	-.179727	-.292712	.051691
IST_n_sest91		2.80238***	-.00551	-.109565	.024094
IST_n_couest91		2.219337***	.712144	.664159	.926761**
IST_s_nest91		3.486829***	-.386226**	-.388683***	-.222838*
IST_s_sest91		2.390791***	-.205883	-.21802	-.074207
IST_s_couest91		4.056434***	-.61042**	-.609038**	-.0404339*
IST_nest_sest91		3.348389***	-.235212	-.291336**	-.124779
IST_nest_couest91		3.423771***	-.175211	-.087313	.155891
IST_sest_couest91		3.279235***	-.135107	-.203287	-.032627
IST_nord97		.278055			
IST_sud97		2.526461***			
IST_nest97		4.156896***			
IST_sest97		1.751622***			
IST_couest97		4.192039***			
IST_n_s97		2.300783***			
IST_n_nest97		2.754075***			
IST_n_sest97		2.79687***			
IST_n_couest97		2.931481***			
IST_s_nest97		3.100603***			
IST_s_sest97		2.184908***			
IST_s_couest97		3.446016***			
IST_nest_sest97		3.113177***			
IST_nest_couest97		3.24856***			
IST_sest_couest97		3.144128***			
IST_nord98		.7916129			
IST_sud98		2.604578***			
IST_nest98		4.090688***			
IST_sest98		1.701153***			
IST_couest98		3.93462***			
IST_n_s98		2.266976***			
IST_n_nest98		2.64109***			
IST_n_sest98		2.692815***			
IST_n_couest98		2.883496***			
IST_s_nest98		3.098146***			
IST_s_sest98		2.172771***			
IST_s_couest98		3.447396***			
IST_nest_sest98		3.057053***			
IST_nest_couest98		3.336458***			
IST_sest_couest98		3.075948***			
IST_nord99		1.620842***			
IST_sud99		2.754218***			
IST_nest99		4.197818***			
IST_sest99		1.813992***			
IST_couest99		4.072037 ***			

IST_n_s99	2.473684***	
IST_n_nest99	3.085493***	
IST_n_sest99	2.778286***	
IST_n_couest99	3.146098***	
IST_s_nest99	3.263991***	
IST_s_sest99	2.316584***	
IST_s_couest99	3.652095***	
IST_nest_sest99	3.22361***	
IST_nest_couest99	3.579662***	
IST_sest_couest99	3.246608***	
RTAs and International trade of Brazil		
MERCOSUR_hypo(*t*=1991)	.4568407**	
MERCOSUR	1.085108***	
BRZ_INT(*t*=91)	-.8728915***	
BRZ_INT(*t*=mercosur)	-.8248168***	
RTA	.4031757***	
Basic gravity equation		
ln_gdpnominali	.4739644***	
ln_gdpnominalj	.7274031***	
ln_distance	.3536553***	-.6216225***
Contiguity	-1.475198***	.7045803***
Constant	-3.539839***	-10.20891**
Exporter Fixed Effects	Yes	
Importer Fixed Effects	Yes	
Time Dummies	Yes	
Huber-White Sandwich Estimator	Yes	

*** Significant at 1%

** Significant at 5%

* Significant at 10%

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Annex –


Roraima
Amapá
Amazonas
Pará
Maranhão
Ceará
Rio Grande do Norte
Paraíba
Piauí
Pernambuco
Alagoas
Sergipe
Acre
Rondônia
Tocantins
Bahia
Mato Grosso
Brasília(DF)
Goiás
Minas Gerais
Espírito Santo
Mato Grosso do Sul
São Paulo
Rio de Janeiro
Paraná
Santa Catarina
Rio Grande do Sul
Região Norte
Região Nordeste
Região Centro-Oeste
Região Sudeste
Região Sul