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Competitiveness, commercial blocks, and regional growth

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Competitiveness, Commercial Blocs and Regional Growth

Carlos Roberto Azzoni* and Paulo C.de Sá Porto**

ABSTRACT

This paper analyzes the effects of the Mercosul Preferential Trade Agreement on export intensity of different regions in Brazil. A gravity model is employed to explain the intensity of exports of different Brazilian regions according to country of destination, differentiating those pertaining to Mercosul. Using panel data, we implement the model in three different ways: a pooled cross section model, a fixed effects model and a first differences model. Besides GDP, population and distance, typical explanatory variables of the gravity model, indicators of regional openness and competitiveness came out as an important variable to explain regional export performance. Moreover, the results indicate that the Mercosul commercial bloc does not improve the export performance of regions, which are explained by the other economic variables of the model.

KEYWORDS

Mercosul, regional development, and gravity model.

JEL Classification:
F15, R15

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1. INTRODUCTION

The interest in economic integration among countries has recently been renewed, as Free Trade Areas and other types of Preferential Trade Agreements (PTAs) are flourishing all over the world. The debate is very lively on whether regional economic integration ("regionalism") is welfare improving, and thus is a building block towards the achievement of free trade, or if it is welfare reducing, and thus is a stumbling block to achieve free trade¹.

However, even if one agrees that recent Preferential Trade Agreements are, on the majority, committed to open regionalism, and thus welfare improving for participating countries and the world as a whole, economic integration may affect unevenly the regions of participating countries. As relative prices change in these countries, they will increasingly specialize in the production of goods in which they have a comparative advantage; the regions that concentrate a large share of the booming or contracting industries will be more than proportionally affected by economic integration. Therefore economic integration may affect different regions of a country in a different way, thereby easing or aggravating regional disparities in a country (Bröcker 1988). Thus, it is very important that we have a better understanding on how economic integration impacts the economic structure of the regions comprising the participating countries.

The objective of this article is to evaluate the impacts of the different economic integration blocs on Brazilian state's trade flows (as in previous works by the authors, such as Sá Porto 2002a, Sá Porto 2002b, Sá Porto and Canuto 2002 and Sá Porto and Canuto 2004). We will use a gravity model extended to include economic integration variables for the main economic integration blocs, such as Mercosur, Nafta and the European Union (the most relevant trading blocs for Brazil, given the country's total trade). Besides, we will add variables that account for the share of each state interregional and international trade flows on Brazil's total trade, which simulate the openness of regional economies. Moreover, we will add a variable that account for each state's competitiveness. These variable will add to the explanatory power of the model.

But in order to evaluate the impacts of regional integration on Brazil's regional trade flows, instead of using two dummy variables, one for an economic integration bloc and another for a region of the country (as in previous works by the authors), we use a *dummy* variable specific for each trade pair between a Brazilian region and a trading partner. Those impacts will be assessed using Brazilian state exports to twenty-four countries, which account for about 80 per cent of the country's total trade. This approach allows one to evaluate the effects regional integration on state's trade flows in more detail, since we estimate the direct effect that a specific trade flow to a partner country has on a state's economy.

Moreover, as in Sá Porto and Canuto 2004, we will use panel data and implement the model

¹ The literature on whether regional trade arrangements are welfare improving or welfare reducing is vast. See, for example, Pomfret (1988) and Bayoumi e Eichengreen (1997).

in three different ways, following a methodology developed by Cheng e Wall (1999): a pooled cross-section model (PCS model), a fixed effects model (FE model) and a first differences model.

This article is organized in four sections, including this introduction. In section 2 we will review the theoretical and empirical literature of the gravity model, as well as of the regional impacts of economic integration. In section 3, we present our econometric models and results. We present our conclusions in section 4, as well as further research for this study.

2. LITERATURE REVIEW

In this section, we will carry out a brief literature review with regards to the theoretical and empirical aspects of the gravity model, as well as briefly review the literature on the impacts of economic integration on regional development.

2.1 – Theoretical and Empirical Analyses on the Gravity Model

The original gravity model was proposed independently by Tinbergen (1962) and Pöyhönen (1963), and was later on improved by Linnemann (1966). Tinbergen's initial objective was to account for the factors that explained the size of trade flows between two countries. He found three types of factors which explained those flows: the total potential supply of the exporting country, the factors related to the total potential demand of the importing country, and the factors related to a resistance to trade. The first two factors were basically the Gross Domestic Product (GDP) of the exporting and importing country, respectively. Later on, Linnemann included the size of the populations of both countries, in order to reflect the role of economies of scale. Finally, a third factor was resistance to trade, be it natural or artificial. Natural trade resistance was defined as the obstacles to trade imposed by nature, such as transportation costs, transport time etc., whereas artificial barriers are those imposed by governments, such as tariffs, quantitative restrictions, exchange controls, etc. Dummy variables were also included in the model, specially those ones for preferential trade arrangements. Thus, the original gravity model was the following:

$$X_{ij} = a_0 (Y_i)^{a_1} (Y_j)^{a_2} (N_i)^{a_3} (N_j)^{a_4} (\text{Dist}_{ij})^{a_5} e^{(\text{Pref}) a_6} (e_{ij}), \quad (1)$$

where X_{ij} is the dollar value of exports from country i to country j ; Y_i is the nominal value of country i 's GDP; Y_j is the nominal value of country j 's GDP; N_i is the population of country i ; N_j is the population of country j ; Dist_{ij} is the distance between the commercial centers of the two countries, and is used as a proxy for the trade resistance variables; Pref is a dummy variable which equals to 1 if both countries belong to a specific preferential trade area and zero otherwise; and e_{ij} is the error term. The coefficients a_0 through a_6 are to be estimated by the econometric regression.

As it was originally proposed, the gravity model's main weakness was its lack of a solid theoretical microeconomic foundation. The model described in equation (1) above is not an economic model, although it is a plausible one. In particular, the greatest challenge was to develop a

structural model from a reduced form model such as equation (1). Many authors have contributed in order to build a theoretical microeconomic foundation for the gravity model, such as Anderson (1979), Bergstrand (1985 and 1989), Deardorff (1998) and Anderson and van Wincoop (2003)². Moreover, other authors have added other explanatory variables to the original gravity equation (such as relative distance, GDP deflator, exchange rates, a country's openness index, etc.), in order to increase its explanatory power.

Besides the problem mentioned above, the gravity model has also other problems from the econometric point of view. The gravity model has been implemented empirically in most cases using cross section data. For instance, one can pick several years in a time series and compare different cross section, evaluating how a coefficient's estimate evolved over time in a specific time period by comparing the coefficient's estimate of one seccional unit with an estimate of another seccional unit.(one can compare, for example, Mercosur's 1990 coefficient with the coefficient for 1998). But the problem here is that even though this method can yield a high value for the R², this method tends to underestimate the trade volume between pair of countries which has a high volume of trade, and it overestimates the trade volume between pair of countries which has low volume of trade (Cheng and Wall 1999). This generates a “heterogeneity bias”, which is overcome by Cheng and Wall (1999) by removing the gravity model's assumption of one only intercept for all trade flows between pairs of countries³.

As we use trade data between the Brazilian states and the country's main trade partners, this problem will arise, as the trade between the state of São Paulo and the United States, for example, is substantially different from the trade between the state of the state of Mato Grosso and Paraguay. To correct this problem, in this article we use a methodology developed by Cheng and Wall (1999), which estimates the gravity model using three different models. The first is the pooled cross section model (PCS model), in which the standard gravity equation is estimated using pooled cross section data, the constrain in which the intercept is the same for all trade pairs is kept, and, finally, the coefficients are estimated using the ordinary least squares (OLS) method for the pooled data⁴. When this model is estimated, the heterogeneity bias is not corrected (the coefficients estimates are indeed biased); rather, those estimates are compared to the estimates of two other models: a fixed effects model and a first differenced model.

In the fixed effects model (FE model), the restriction in which the intercept is the same for all trade pairs is removed and it is assumed that there are fixed and specific effects for each trade flow (the dependent variable in a gravity model)⁵. An advantage of the fixed effects model is that the time invariant variables are incorporated into the specific intercept for each trade pair (Wall

²For a detailed literature review on the theoretical foundations of the gravity model, please see Sá Porto (2002b).

³ Another common problem with *cross-sections* models is the impossibility of testing the stability of the coefficients; with this regard, please see Soloaga and Winters (2001).

⁴Cheng and Wall (1999), p.6.

⁵ For a detailed analysis on the econometrics of fixed effects models, see Johnston and DiNardo (2001).

1999), solving a possible specification error (Anderson and van Wincoop 2003). That is, the fixed effects model is robust to a possible omission of time-invariant, non-observable regressors (Johnston and DiNardo 2001). Under this method, dummy variables are created for each trade pair (thus simulating the unique intercept for each trade pair) and are added to the original gravity equation.

Finally, our third model is the first differences model (FD model), where the first difference operator is applied to the dependent and independent variables of the standard gravity equation, thus eliminating any time invariant variable (such as distance and adjacency). As in the case of the FE model, the first differences model is robust with regards to any omission of time invariant variables, but it has one disadvantage, as its intercept does not vary for each specific trade pair.

With respect to the empirical tests of the gravity model, it empirically explains a large part of international trade among countries.⁶ Moreover, it is being widely used in models which seek to estimate the welfare impacts of a regional integration scheme.⁷ The literature on the empirical tests of the gravity model to evaluate regional integration cases is large; since the end of the 1960s, many studies have sought to evaluate the effects of the European Union, such as Aitken (1973), Frankel (1992) and Frankel and Wei (1992), Frankel, Stein and Wei (1995), Kume and Piani (2000), among others.⁸

2.2 – The Impacts of Economic Integration on Regional Development

The impacts of economic integration on regional development can be analyzed theoretically as follows. A neoclassical view of economic theory recognizes that regions have different natural endowments and policy-created strengths. As economic integration proceeds and trade barriers fall for all participating countries, relative prices change for all sectors within regional economies. Each region will then specialize in the production of the goods that intensively use those endowments and strengths, and the industrial structure of the countries (and their regions) will change accordingly to exploit comparative advantages.

As trade barriers fall, welfare increases for the world as a whole as well as for the countries which participate of a regional integration scheme, but the theory does not show how

⁶ For example, Bergstrand's (1989) generalized gravity equation explained empirically between 40 and 80 percent of the variation across countries in one-digit SITC trade flows

⁷ Viner (1950) noted that, while a customs union between some (and not all) countries would create trade and thus have positive effects on welfare, trade diversion might offset these positive effects. A regional integration scheme is net creator of trade if trade creation is larger than trade diversion. These net effects from trade creation and trade diversion are known as the static effects of economic integration. In the gravity model, when a bloc is net trade creator the coefficient for the bloc dummy variable is positive. Note, however, that in some cases it is possible that one or more countries in a regional bloc obtain significant gains even though the bloc's net trade creation is negative (as, for instance, argues Panagariya 1999, p. 483). As in the literature, we assume that a bloc is net trade creator when the net effect is positive.

⁸ Once again, see Sá Porto (2002b) for a detailed review of this literature.

those effects are transmitted throughout the regions of participating countries. In fact, it is possible that some countries have positive welfare effects while other may have their total welfare decrease. Trade liberalization given by regional integration benefits the industries (and the regions where these industries are located) which use the factors intensive in the use of the country's most abundant factors, and increases income and welfare in those industries. A region in a country will gain from economic integration if it concentrates a large share of those gaining industries. Moreover, trade liberalization increases the real returns of those factors specific to the country's export industries, and, again, if a region concentrates a large share of those industries, it will gain from regional integration. This is the standard analysis⁹ using the neoclassical theory of international trade to assess the impacts of liberalization in the participating countries of a PTA, extended to include the regions of those countries.

The argument is further developed in the more recent new economic geography literature. Fujita, Krugman and Venables (1999) show that, in a relatively closed economy, the capital city (and its larger metropolitan area) is where firms typically have the best access to both domestically produced inputs and to domestic markets. This creates forward and backward linkages in this “core” economy which lead to agglomeration of economic activity there. As trade liberalization moves forward, those linkages become less important, as firms will receive more intermediate inputs from abroad and will sell a larger part of their output abroad, and thus there will be less incentives to locate (in the case of new firms) or maintain location in the country's core. Firms and consumers will become more outward oriented, and trade liberalization will lead to spatial deconcentration. Congestion costs which may develop in the core region help to push industry away from the center and towards other regions. But as external trade now plays the role of balancing supply and demand for each sector's products in each location, industrial specialization is facilitated and driven by intra-industry linkages. Thus, regions will specialize and industrial clustering of particular industries in each region will occur¹⁰.

With respect to the empirical tests of the impacts of economic integration on a participating country's region, note that the empirical tests of the gravity model mentioned in the subsection 2.1 have all dealt with testing the overall impacts of economic integration arrangements, i.e., they assessed the welfare impacts of those arrangements in the countries as a whole. But none of those studies considered how economic integration affected the different regions of a country. Indeed, few studies have tried to evaluate the regional impacts of economic integration¹¹. Two of these studies have used the gravity model; one such study is the one by Bröcker (1988). This author uses a variant of the gravity model to estimate the impact of the EEC and EFTA on the regions of four countries in Northern Europe (Germany, Norway, Sweden, and Denmark), and he extends the

⁹ A análise padrão sobre os efeitos da liberalização econômica de acordo com a teoria neoclássica do comércio pode ser encontrada nos livros textos de economia internacional, como Krugman e Obstfeld (1999).

¹⁰ Fujita, Krugman and Venables (1999) pp. 329-343.

¹¹ A more detailed version of this literature review of this subsection can be seen in Sá Porto (2002b).

original gravity model to include other variables, such as regional supply, regional demand, international and interregional trade flows among regions. Using 1970 data, he evaluated the impacts of integration in Europe for a total of 73 regions and 36 industries.

The impacts of Mercosur in Brazil's regions was evaluated by Sá Porto (2002a). Using a gravity model expanded to include dummy variables for Mercosul and for a region in Brazil, he found that the trade bias¹² with Mercosur has increased from 3.4 in 1990 to 27.1 in 1998 in Brazil's region South. That is, trade between a state in the Brazilian South (a region that borders all the Mercosur countries) in 1998 was more than 27 times larger than trade with other countries. Brazil's Southeast, a region which includes the country's three largest regional economies, saw its trade bias increase from 4.7 in 1990 to 21.9 in 1998. The other regions (North, Northeast and Center-West) also had increases in their trade biases with Mercosur, although at a much smaller scale. He concluded that, although as a whole Mercosur was net trade creating¹³ and Brazilian states as a whole benefited from Mercosur, the results imply that a Preferential Trade Agreement such as Mercosur impacts differently the regions of participating countries. Thus, a PTA that is welfare improving for the country as a whole may increase welfare in only a few regions of the partner countries.

Sá Porto and Canuto (2002) continued that study¹⁴, including a industry dummy variable and extending the analysis to the year 2000. In order to analyze the impacts of the change in Brazil's exchange rate regime in early 1999, they showed that Brazilian states' trade flows to Mercosur countries fell substantially in 2000, but they remained higher than trade levels that prevailed prior to the implementation of Mercosur's custom union (January 1st 1995). Sá Porto and Canuto (2004) further extended this previous study, by using panel data and the three models designed by Cheng and Wall (1999) previously mentioned: pooled cross section, fixed effects and first differences models. They showed that regardless of the data type that is used (cross section or panel), the results for the impacts of Mercosur on Brazilian states trade flows are robust, that is, they are the same and are independent of the data structure used.

Other methods can be used to associate changes in international and interregional trade flows with changes in regional economic structures. One set of models is based on input-output tables, such as the interregional input-output (IRIO) model or the multiregional input-output (MRIO) model, such as Polenske (1970) and Polenske (1980). Shift-share models are also used to estimate the regional impacts of PTAs (such as the study by Kume and Piani 1999).

¹² In the literature, trade bias is a measure of the net effect of trade creation and trade diversion.

¹³ This is true to the extent that higher trade bias with Mercosul will improve welfare in the South and Southeast due to the increase in exports. He used, as in the literature, trade bias as a proxy for changes in welfare effects. However, the view that trade bias can be used as a proxy for changes in welfare effects is not consensual (see, for example, Bhagwati and Panagariya 1996).

¹⁴ See also Sá Porto (2002b).

General equilibrium models have also been used to evaluate the economic integration impacts on the regional economies of participating countries. Barros (1997) used such a model to evaluate the impacts of Mercosur trade flows in Brazil's Northeastern region. By means of a model which simulates the impacts of economic integration by using the changes in the bilateral exchange rates of all Mercosul partners (thus assuming that the effects of integration are passed to the economy through changes in relative price, which will in turn affect GDP growth), he found that the impacts of the implementation of Mercosur were positive but modest: the region's GDP would grow by an extra 2% per year due to Mercosur, five years after its implementation. That is less than the rest of the country would due to Mercosur (around 3% a year). Moreover, he also found that those positive impacts on the region's states were differentiated: whereas the states of Ceará and Rio Grande do Norte would benefit the most from Mercosul (and the states of Pernambuco and Bahia as well), the states of Piauí, Alagoas and Maranhão (the region's poorer states) would hardly benefit from Mercosur, whereas Paraíba would actually lose from Mercosur.

Domingues (2002a) uses General equilibrium model to evaluate the impacts of the Free Trade Area of the Americas (FTAA) to the Brazilian economy, at both regional and industry levels. By dividing the country in two regions, the state of São Paulo and the rest of the country, the author shows that at an aggregate level the implementation of the FTAA would act as a force towards the concentration of production in São Paulo. Moreover, the liberalization from the implementation of the FTAA would have differentiated effects in the countries' sectors, as, for example, the automotive industry would reconcentrate in the regional economy of São Paulo due to the FTAA.

Brandão, Lopes e Pereira (1996) used a GTAP general equilibrium model to simulate the impacts of adopting a complete customs union in Mercosul by the year 2006 on the Brazilian economy as a whole and then in its sectors. They showed that the impacts on Brazil's total production are very small, but the impacts on the country's trade flows are large: the increase in Brazilian exports of capital intensive goods and Machinery and Electrical Equipment goods would be very significant, whereas Brazil's imports would also grow on most sectors considered on that study.

Haddad, Domingues e Perobelli (2001) use another type of general equilibrium model (EFES-IT) to evaluate aggregate as well as regional and industry impacts in Brazil of three possible free trade arrangements: the implementation of the FTAA, the implementation of a Free Trade Area between Mercosul and the European Union (EU), and a generalized (with all Brazil's main trade partners) free trade area. They show that the three regional liberalization schemes have concentration effects in the Brazilian economy, i.e., they tend to reinforce economic activity to locate and/or relocate to the states in the Southeast and South regions, the country's most developed regions. Moreover, they show that regional and industry effects of liberalizations tend to occur in a small set of Brazil's states.

Finally, a GTAP general equilibrium model is also used in Domingues (2002b), where he uses that model to simulate the welfare impacts in Brazil, Argentina and Uruguay of two possible free trade arrangements: the implementation of the FTAA, and the implementation of a Free Trade Area between Mercosul and the European Union (EU). He found that in the first case all non-FTAA countries would have welfare losses, and Argentina and Uruguay as well. In that simulation Brazil would face net welfare gains from an FTAA. In the second case (a Mercosul-EU Free Trade Area) non-participating countries would face welfare losses (as in the previous case), but Brazil, Argentina and Uruguay would have welfare gains, although Brazil's gains would be much larger than those gains accrued to the other two Mercosul partners.

3. ECONOMETRIC MODELS AND RESULTS

In the next section, we will use a standard gravity model but we will add dummy variables for the three main economic integration blocs, namely Mercosur, Nafta and EU (European Union), as well as time dummy variables (as in Sá Porto and Canuto 2004). Moreover, we will add variables which measure Brazil's twenty seven states degree of openness and competitiveness. We use panel data for the state's exports, and the results are evaluated using three different models: a pooled cross section model (PCS model), a fixed effects model, (FE model) and a first differences model (FD model).

In section 3.2 we evaluate the effects of integration in Brazil's states and regions by using another approach. Instead of using a *dummy* variable for a trade bloc and another for a region, and then evaluate its joint effect (as in Sá Porto and Canuto 2004), here we use a dummy variable for a region-country pair. Thus, we have a dummy for the pair Region South and Argentina, for example, another for the pair Region South and Uruguay, and so on. Since we have twenty-four countries and five regions, we have $24 \times 5 = 120$ region-country dummies. Here we measure the specific effects that a partner country may have on a state's (which belongs to a specific region) export flow by means of a specific dummy variable for a region-country pair.

3.1 Main Model

In this section, the basic model to be estimated (PCS model) is the following:

$$\ln X_{ijt} = \ln a_0 + a_1 \ln Y_{it} + a_2 \ln Y_{jt} + a_3 \ln N_{it} + a_4 \ln N_{jt} + a_5 \ln \text{Dist}_{ij} + a_6 \text{Adj} + a_7 \text{Mercosur} + a_8 \text{Nafta} + a_9 \text{EU} + a_{10} \text{Dummy94} + a_{11} \text{Dummy98} + a_{12} \text{Dummy02} + a_{13} \text{Interreg} + a_{14} \text{Internat} + a_{15} \text{Compet} + \log e_{ij} \quad (2),$$

where X_{ij} is the dollar value of exports from the state i to country j , Y_i is the nominal value of state i 's GRP, Y_j is the nominal value of country j 's GDP, N_i is the population of state i , N_j is the population of country j , Dist_{ij} is the distance between the commercial centers of the state and the country, Adj is a dummy variable which equals to 1 if the state and the country are adjacent, Mercosul is a dummy variable that equals to 1 if the country belongs to Mercosul, and 0 if that is not the case (of course, all the states also belong to Mercosul since Brazil is part of Mercosul), Nafta is a dummy variable that equals to 1 if the country belongs to Nafta, and 0 if that is not the case, EU is a dummy variable that equals to 1 if the country belongs to the European Union, and 0 if that is not the case, Dummy94 is a dummy variable that equals to 1 if the export from state i to

country j occurred in 1994, and 0 if that is not the case, Dummy98 is a dummy variable that equals to 1 if the export from state i to country j occurred in 1998, and 0 if that is not the case, Dummy02 is a dummy variable that equals to 1 if the export from state i to country j occurred in 2002, and 0 if that is not the case, Interreg is state i 's share of interregional trade, Internat is state i 's share of international trade, and Compet is state i 's degree of competitiveness.

These three last variables are defined as follows. Interreg is state i 's share of interregional trade, that is, the state's exports to the rest of Brazil plus the state's imports from the rest of Brazil, and that divided by the country's total interregional trade (the country's total regional exports plus total regional imports). Internat is state i 's share of international trade, that is, the state's exports to the rest of the world plus the state's imports from the rest of the world, and that divided by the country's total international trade (the country's total exports plus total imports). These two variables are measures of the country's degree of openness. Finally, Compet is state i 's degree of competitiveness, that is, the state's exports to the rest of Brazil plus the state's exports to the rest of the world, and that divided by the state's gross regional product. This is a measure of how competitive a state's total exports (interregional and international) are with respect to its Gross Regional Product.

Secondly, we will estimate the first differences model (FD):

$$d(\ln X_{ijt}) = a_{0ij} + a_1 d(\ln Y_{it}) + a_2 d(\ln Y_{jt}) + a_3 d(\ln N_{it}) + a_4 d(\ln N_{jt}) + a_5 \text{Mercosur} + a_6 \text{Nafta} + a_7 \text{EU} + a_8 \text{Dummy94} + a_9 \text{Dummy98} + a_{10} \text{Dummy02} + a_{11} \text{Interreg} + a_{12} \text{Internat} + a_{13} \text{Compet} + \log e_{ij} \quad (3),$$

where the all the variables are the same as in equation (2), d is the first difference operator diferença and a_{0ij} is the intercept of the state-country trade pair. In the first difference model, the effect of the time invariant variables (such as distance and adjacency) is captured by the intercept (as in Bayoumi and Eichengreen 1997).

Then we will estimate the fixed effects model (FE):

$$\ln X_{ijt} = a_{0ij} + a_{0t} + a_1 \ln Y_{it} + a_2 \ln Y_{jt} + a_3 \ln N_{it} + a_4 \ln N_{jt} + a_5 \text{Mercosur} + a_6 \text{Nafta} + a_7 \text{EU} + a_8 \text{Dummy94} + a_9 \text{Dummy98} + a_{10} \text{Dummy02} + a_{11} \text{Interreg} + a_{12} \text{Internat} + a_{13} \text{Compet} + \log e_{ij} \quad (4),$$

where the all the variables are the same as in equation (3) above, a_{0ij} is the intercept of the state-country trade pair and a_{0t} is a constant. In a fixed effects model, the are factors specific to a

state-country trade pair, and those effects are correlated with the dependent variable (bilateral trade) and with the independent variables. Thus, in this model we will assume that the gravity equation has as a unique intercept for each state-country trade pair and one for all bilateral trade flows. Since we have 27 states and 24 countries (Brazil's largest trade partners in 2003) in the sample, we thus have 648 intercepts for the different state-country trade pairs¹⁵.

We have chosen to use the standard gravity equation, with all of its traditional variables: GDP, population and distance. We tried to substitute the population variables with per capita GDP, but its coefficients were neither stable nor significant. Moreover, after our tests we removed the adjacency variable for it was insignificant in the presence of the distance variable. We also added variables which were proxies for a state's openness, the state's shares of interregional¹⁶ and international trade, and they contributed to increase the model's explanatory power. Finally we added a variable, the state's competitiveness index, to measure the effect of a state's degree of competitiveness on its trade.

With respect to the treatment of the data, we removed all zero flows in order to remove the influence with trade very little or did not trade at all abroad. We only kept the state-country flows which were greater than zero for at least two years in our sample (which included, as mentioned before, the years 1990, 1994, 1998 e 2002). In table A.1 (in the appendix), we marked all the export and import trade flows with a X and a M, respectively, and we marked the zero trade flows with a zero.¹⁷

The results for the coefficient estimation for the three models are displayed in Table 1. In the case of the PCS model, we first notice that the coefficients for GDPs (Y_i and Y_j) and for distance ($Dist_{ij}$) have the expected sign and are significant. Second, one of the population coefficients (the one for the partner country) was not significant, although the coefficients for the exporting state was significant. Moreover, the time dummies were not significant either, and one did not have the expected sign (in the case of 1998). These results were similar to other studies by the authors.

With regards to the regional integration dummy variables (Mercosur, Nafta and EU), we notice that the Mercosur coefficient is significant but considerably less significant here than in Sá Porto and Canuto (2004), for instance¹⁸. The reason for this is that Mercosur is a less important destination for Brazilian states' exports than it is for Brazilian state's total trade, i.e., Mercosur is

¹⁵ The twenty four countries are the following (with corresponded to 85 percent of Brazil's total trade in 2003): France, Germany, Italy, United Kingdom, Netherlands, Belgium, Spain (which are part of the European Union), United States, Mexico, Canada (which are part of NAFTA), Argentina, Paraguay, Uruguay (which are part of Mercosul), Chile, Colombia, Venezuela, China, Japan, South Korea, Russia, Switzerland, Nigeria, Saudi Arabia and Algeria. The 27 Brazilian states are: São Paulo, Rio de Janeiro, Minas Gerais, Espírito Santo (which comprise the Region Southeast), Paraná, Santa Catarina, Rio Grande do Sul (which comprise the Region South), Goiás, Mato Grosso, Mato Grosso do Sul, Distrito Federal (which comprise the Region Center-West), Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia (which comprise the Region Northeast), Acre, Amapá, Amazonas, Pará, Rondônia, Roraima e Tocantins (which comprise the Region North).

¹⁶ This index was built based on interregional data (see Haddad et al. 2002). This variable is of importance, as a large share of Brazil's states trade is done with other Brazilian states (see Perobelli 2004).

¹⁷ The source of this data is SECEX (2003).

¹⁸ Note that while here we used export data, Sá Porto and Canuto (2004) used total trade (exports plus imports) data.

more important for Brazil's imports than for Brazil's exports. For the EU coefficient, unlike Sá Porto and Canuto's (2004) results, the EU coefficient is significant. This means that the EU is important for Brazilian states' exports (and less important for states' imports). That is, in spite of the absence of trade preferences between Brazil and the EU, that bloc of countries is an important destination for Brazilian states. Finally, the NAFTA coefficient is not significant (as in Sá Porto and Canuto 2004). This may be an odd result at first, as Nafta countries (specially the U.S.) are an important trade partner of Brazilian states. This may be due to the fact that these trade flows may have specificities that cannot be explained to this aggregate variable and needed to be explained by the dummies of the state-country trade pairs (the subject of the next section)

The coefficient of the share of interregional trade variable was significant and had the expected sign (negative), that is, the states which have larger shares of interregional trade tend to trade less internationally. Moreover, the coefficient of the share of international trade variable was also significant and had the expected sign (positive), the states which have larger shares of interregional trade tend to trade more with foreign countries. Finally, coefficient for the degree of competitiveness variable was significant and had the expected sign (positive), meaning that states that are more competitive tend to trade more with Brazil's trade partners.

Table 1 - Gravity Equation Coefficients Estimates for the Export Trade Flows between Brazilian States and Brazil's Major Trading Partners, PCS, FE e FD Models , 1990-2002

Independent variable	“Pooled” Cross Section data (PCS)	Fixed Effects(FE)	First Differences (FD)
Constante a_{0ij}	-14.05* (1.36)	—**	-1.86* (1.55)
Y_i	0.57* (0.10)	0.44* (0.09)	0.37* (0.09)
Y_j	0.84* (0.05)	0.67* (0.04)	0.65* (0.05)
N_i	0.94* (0.11)	0.89* (0.13)	0.94* (0.12)
N_j	0.03 (0.18)	0.01 (0.15)	0.09 (0.17)
$Dist_{ij}$	- 0.71* (0.12)	—***	—***
Mercosul	1.05* (0.18)	2.01* (0.18)	1.89* (0.20)
NAFTA	0.22 (0.16)	0.19 (0.12)	- 0.03 (0.13)
EU	0.75* (0.12)	0.56* (0.09)	0.49* (0.14)
1994	0.14 (0.12)	-0.03 (0.10)	0.17 (0.13)
1998	- 0.19 (0.17)	-0.16 (0.10)	0.01 (0.12)
2002	0.18 (0.16)	0.08 (0.10)	- 0.02 (0.10)
Interregional	-4.64* (2.00)	—***	—***
International	4.40* (1.88)	—***	—***
Competitiveness	2.75* (0.20)	—***	—***
R^2	0.57	0.43	0.39
Number of observations	1961	1961	1961

* Significant at the 5% level, one-tail test.

** The trade pair intercepts were omitted for space reasons.

*** These variables are invariant in the FE and FD models.

Notes: X_{ij} is the dependent variable. Standard errors are given in parentheses. All variables except dummies are expressed in natural logarithms for the PCS and FE models, and in first differences for the FD model; estimation by ordinary least squares.

The results for FE and FD models are as follows. First we notice that variables such as distance, degree of openness (interregional and international) and degree of competitiveness were excluded since they are time invariant¹⁹. Moreover, we also notice that the values for the coefficients for the GDP (0.44 and 0.67 for the FE model, and 0.37 and 0.65 for the FD model, respectively) and population (0.89 and 0.01 for the FE model, and 0.94 and 0.09 for the FD model) variables are not substantially different from the results for the PCS model. They were somewhat lower in the FE and FD models. With regards to the regional integration variables, the Nafta coefficients remained insignificant in both models. The Mercosur and Eu coefficients were now larger than the PCS model: 2.01 and 0.56 for the FE model, and 1.89 and 0.49 for the FD model, respectively. Finally, the time dummies were all insignificant, as was the case in the PCS model.

3.2 Main Model with region-country pairs dummies

In this section, we will choose one of the models from the previous section (PCS, FE and FD models) and then add dummies for all of the region-country pairs. The objective here is to evaluate whether there are specific effects on Brazilian state's exports that are explained by factors that are related to that specific sending region or receiving country for that trade flow. We will use the same panel data and the PCS (pooled cross section) model, which is equivalent to the fixed effects and first differences models previously shown. The three models that were estimated in the previous subsection yielded similar results for the coefficients, but the PCS model comprises all the variables, including the time invariant variables, so that it is easier to assess the increased explanatory power that may eventually be added to the original model by the new region-country dummy variables. Thus, our model is as follows:

$$\ln X_{ijt} = \ln a_0 + a_1 \ln Y_{it} + a_2 \ln Y_{jt} + a_3 \ln N_{it} + a_4 \ln N_{jt} + a_5 \ln \text{Dist}_{ij} + a_6 \text{Adj} + a_7 \text{Mercosur} + a_8 \text{Nafta} + a_9 \text{EU} + a_{10} \text{Dummy94} + a_{11} \text{Dummy98} + a_{12} \text{Dummy02} + a_{13} \text{Interreg} + a_{14} \text{Internat} + a_{15} \text{Compet} + a_{ij} \text{Region}_i\text{-Country}_j + \log e_{ij} \quad (5),$$

where all the variables are the same as in equation (1), and Region_i-Country_j Mercosul is a dummy variable for the trade between state *i* (which belongs to one of Brazil's five regions) and country *j* (one of 24 Brazil's main trade partners). If, for example, a dummy Region_i-Country_j is defined for the trade between Region Southeast and Argentina, that dummy equals to 1 if the state belongs to Region Southeast (for example, São Paulo) and the country is Argentina, and 0 if that is

¹⁹ Our interregional and international trade share and degree of competitiveness indices were built for the year as in Haddad et al. (2002).

not the case. We have to choose a reference region, so that we do not get perfect multicollinearity in our regression, so we chose the Region Northeast as the reference region since it is the less open of all five Brazilian regions. Thus, we have $4 \times 24 = 96$ of these dummies.

We had similar results as in the previous subsection with respect to the stability and significance of the coefficients of GDP, population, distance, NAFTA, EU, time dummies, and openness and competitiveness variables, so we will thus concentrate here on the analysis of the region-country pairs coefficients. Our results are presented in Table 2, where we only present the regression estimates for those coefficients that are significant. Turning our attention to Mercosur countries, we notice that the only export flows to those countries that are important (relatively to the reference region) is the exports from Region South (to Paraguay) and North (to Argentina and Uruguay). Region Center-West had a negative coefficient with respect to exports to Paraguay, meaning that the Center-West exports less to Paraguay than the reference region (the Northeast), which is supposedly the less open Brazilian region. The estimates for the coefficients for the other export flows are not significant, meaning that there are not any other factors left to be explained solely to specificities of that particular trade flow, that is, the traditional gravity variables, plus the regional integration and the degree of openness and competitiveness variables can solely explain those trade flows.

We also note that, when we look at the export flows towards European countries (EU and non-EU), there are important specificities to export flow to those countries, specially from Region South, Southeast and North. The same happens with export flows from the South and the Southeast towards Mexico and the U.S. Things like trade agreement in some sectors such as the automobile industry and trade links that have been forged since colonial times (such as export of coffee and iron ore to Europe) may explain some of those specificities.

South American countries that are not part of Mercosul have also trade specificities with exports coming from regions South and Southeast. Russia and South Korea have trade specificities with regions South and Center-West. Finally, Japan and China have important import links left to be explained with all of the four regions.

Table 2 - Gravity Equation Coefficients Estimates for the State-Country pair Dummies, for the Export Trade Flows between Brazilian States and Brazil's Major Trading Partners, PCS Model, 1990-2002

Bloc	Country	Region			
		S	SE	N	CW
Mercosur	ARG	-	-	1.82	-
	URU	-	-	1.26	-
	PAR	1.46	-	-	- 1.44
Nafta	MEX	1.79	1.62	-	-
	USA	2.14	1.69	-	- 1.35
	CAN	-	-	-	- 2.13
EU	FRA	1.76	-	1.05	-
	GER	2.34	1.25	0.96	0.58
	ITA	2.24	1.61	-	-
	UKG	2.34	-	1.25	-
	NL	3.39	1.97	1.09	4.22
	BEL	2.82	2.19	1.85	2.09
	SPA	2.39	1.06	1.05	-
South America	COL	1.11	-	-	- 2.78
	VEN	1.44	1.14	-	- 1.51
	CHL	1.39	1.32	-	- 1.65
Rest of Europe	SWI	1.11	-	-	-
	RUS	2.63	-	-	2.15
Rest of Asia	JAP	2.05	1.59	2.35	1.17
	CHI	3.67	2.54	1.61	2.18
	KOR	2.01	2.66	-	1.21
Africa/ Middle East	NIG	2.17	-	-	-
	ALG	-	-	-	-
	SAU	3.38	1.45	-	-

4. CONCLUSIONS AND FURTHER RESEARCH

In this paper we presented a model that shows the aggregate impacts of Mercosul in Brazil's regions, a model that controls for income and distance effects and concentrates on the economic integration, openness, competitiveness and specificities of region-country pair effects on the Brazilian states' trading patterns. We showed in last subsection that the openness variables (share of interregional and international trade) and the degree of competitiveness variable were important in order to explain Brazilian states export patterns.

Moreover, we showed that, besides of the traditional gravity variables (GDP, population and distance), the economic integration variables (such as Mercosur, EU and Nafta), and the openness and competitiveness variables, in some specific cases there are things left unexplained by those previous variables that are specific to a region-country trade pair. For example, we showed that Japan and China have trade biases with all four (South, Southeast, North and Center-West) regions, with regards to exports coming from those regions to those countries.

This study can be extended in several ways. First, we can assess the previously mentioned impacts at the industry or sectoral level. In order to evaluate this, we can estimate the current gravity equation using data at the industry level, aggregated at the one-digit SIC level, for example, or with the sectors grouped in a few sectors, in a classification which include, for example: agriculture, natural resource-based industry; non-durable consumer goods; durable consumer goods; and intermediate goods. Moreover, we can further increase the explanatory power of the model by adding interactive dummy variables, such as: industry-GDP interaction dummy; distance-industry dummy; and region-industry-country interaction dummy.

APPENDIX

Table A.1: Presence of trade flows between Brazilian states and Brazil's trade partners, 1990, 1994, 1998 e 2000.

	ARG	CHL	FRA	GER	ITA	JAP	MEX	HOL	PAR	U.K.	URU	USA
AC	000X 00mm	0X00 0000	0000 00m0	000X 0000	0X0X 0000	000X mmmm	0X00 0000	000X 0000	0000 0000	XX0X 0m00	000X 0000	XXXX mmmm
AL	XXXX mmmm	0XX0 0mmm	XXXX mmmm	XXXX mmmm	XX0X mmmm	XXXX mmmm	0000 mmmm0	00XX 0mmm	00X0 mmmm	0000 mmmm	0XXX 00mm	XXXX mmmm
AM	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXX0 mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	X0XX mmmm	XXXX m0mm	XXXX mmmm	XXXX mmmm	XXXX mmmm
AP	XXXX m0mm	XXX0 0000	XXXX 0mmm	0XXX mmmm	XXX0 mmmm	XXXX mmmm	00X0 00mm	XXX0 00m0	0XXX 0000	XXX0 m0mm	XXXX 0000	XXXX mmmm
BA	XXXX mmmm	XXXX mmmm	X0XX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	00XX m0mm	XXXX mmmm	XXXX mmmm	XXXX mmmm
CE	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	0XXX mmmm	XXXX mmmm
DF	00XX mmmm	00XX mmmm	XX0X mmmm	XX00 mmmm	0X0X mmmm	00X0 mmmm	0000 mmmm	0X0X mmmm	0XXX m0m0	0000 mmmm	0XXX 0mmm	XXXX mmmm
ES	XXXX mmmm	0XXX mmmm	0XXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	0XXX mmmm	X0XX mmmm	00XX 0mmm	XXXX mmmm	00XX mmmm	XXXX mmmm
GO	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	X0XX mmmm	XXXX mmmm	XXXX 0mmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	0XXX mmmm	XXXX mmmm
MA	XXXX mmmm	0XXX 0000	X0XX mmmm	XXXX mmmm	X0XX mmmm	XXXX mmmm	XXXX m0mm	XXXX mmmm	0XX0 0000	0XXX mmmm	0XX0 000m	XXXX mmmm
MG	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	00XX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm
MS	XXXX mmmm	000X m0mm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	00XX 000m	XXXX mmmm	XXXX mmmm	0XXX 0mmm	XXXX 00mm	XXXX mmmm
MT	X0XX mmmm	00XX 0mmm	XXXX 0mmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	00XX 00mm	XXXX mmmm	00XX 0mmm	XXXX 0mmm	XXXX mmmm	XXXX mmmm
PA	XXXX mmmm	00XX 0mmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	00XX 00m0	XXXX mmmm	00XX 00mm	XXXX mmmm
PB	XXXX mmmm	0XXX mmmm	X0XX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	X0XX mmmm	XXXX mmmm	XXXX 00mm	XXXX mmmm	XXXX mmmm	XXXX mmmm
PE	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	0XXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mm0m	XXXX mmmm	XXXX mmmm
PI	XXXX 0mmm	X0XX m0m0	XXXX mmmm	XXXX mmmm	XXXX 0mmm	XXXX mmmm	XXXX mmmm	XXXX m0mm	X0XX 0mmm	XXXX 0mmm	000X mmmm	XXXX mmmm
PR	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	0XXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm
RJ	XXXX mmmm	XXXX mmmm	0XXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm
RN	XXXX mmmm	0XXX mm0m	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX m00m	XXXX mmmm	XXXX mmmm	XXXX mmmm
RO	0XXX 0mmm	0000 0000	00XX 00mm	XXXX 0mmm	XXXX 0mmm	0XXX mmmm	XX0X 00mm	XXXX 0m0m	00X0 0000	XXXX mmmm	0XXX 00m0	XXXX mm
RR	X000 m000	0000 0000	0000 0m00	000X 0m00	0000 0mm0	0000 mm00	0000 0000	0000 0m00	0X00 0000	0000 0000	0X00 0000	0X0X mmmm
RS	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm
SC	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm
SE	XXXX mmmm	XXXX 0mmm	0X00 mmmm	XX0X mmmm	XXXX mmmm	0X00 mmmm	X0XX 0m00	XXXX 0mmm	XXXX mmmm	XX00 mmmm	0XXX 0mmm	XXXX mmmm
SP	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX mmmm	XXXX Mmmm
TO	00X0 00mm	0000 00mm	000X 00mm	00XX 00mm	00X0 0mm0	0000 0m0m	00X0 0000	0XXX 0000	0000 0000	000X 000m	0000 00m0	00XX 0mmm

Note: X = exports are present; M = imports are present; 0 = absence of export or import; first line in for exports, and the second line is for imports; first column=1990; second column=1994; third column=1998; fourth column=2002

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