Artigos

Mercosul: gains from regional integration and exchange rate regimes*

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RESUMO

O objetivo deste trabalho é avaliar os impactos do Mercosul nas regiões brasileiras e nos seus setores entre 1990 e 2000, utilizando-se de um modelo gravitacional que inclui variáveis dummy para Mercosul, Região e Indústria. Mostramos que os impactos positivos foram significativos para todas as regiões entre 1990 e 1998, especialmente para as regiões Sul e Sudeste. Além disso, mostramos que a mudança cambial de 1999 no Brasil não reverteu os vieses de comércio substanciais que o Mercosul detinha com as regiões brasileiras até 1998. Os mesmos resultados foram observados para os setores dentro das regiões, isto é, os vieses de comércio dos setores regionais com os países do Mercosul cresceram entre 1990 e 1998, mas caíram em 2000, embora a níveis ainda superiores aos de 1994. Isto foi mais pronunciado para os setores menos sensíveis a mudanças cambiais e aos setores no quais prevalece o comércio administrado. Naqueles setores em que tais condições não se deram, a queda no viés de comércio foi mais pronunciada.

Palavras-chave: Mercosul, desenvolvimento regional e modelo gravitacional.

ABSTRACT

This paper assesses the impacts of the Mercosul Preferential Trade Agreement on Brazil's regions and their industries between 1990 and 2000 by means of a gravity model, extended to include dummy variables for Mercosul, for a Brazilian region and for a industry within a region. The results show significant positive impacts between 1990 to 1998 to all of Brazil's regions, specially the Southern and Southeastern regions. It also shows that the change in the exchange rate regime in Brazil in January 1999 has not reverted the changes in trade biases created in the previous period, with the latter remaining at significantly high levels. The same results were observed for most of the sectors within the regions, i.e., their trade biases with Mercosul countries increased from 1990 to 1998 but fell in 2000, although to levels still higher than 1994 levels. This was specially true for those sectors where trade is managed within the bloc. For the sectors where this condition did not prevail, the drop in its trade bias was more pronounced for all regions.

Key words: Mercosul, regional development and Gravity Model.

JEL Classification: F15, R15.

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1 Introduction

Mercosul is a customs union characterized by a relatively strong heterogeneity of exchange rate regimes among its member countries. Since the beginning of the nineties, one of its two largest members - Argentina - has followed a very hard exchange rate peg, namely, a currency board with full convertibility and a constitutionally established peg of local currency to the US dollar. In the meantime, Brazil moved towards a floating exchange regime in 1999 - coupled with an Inflation Targeting monetary regime - after the adoption of exchange rate (moving) bands during the period from 1995 to the exchange rate crisis in the end of 1998. The other two members - Uruguay and Paraguay - have followed soft and informal exchange rate pegs.

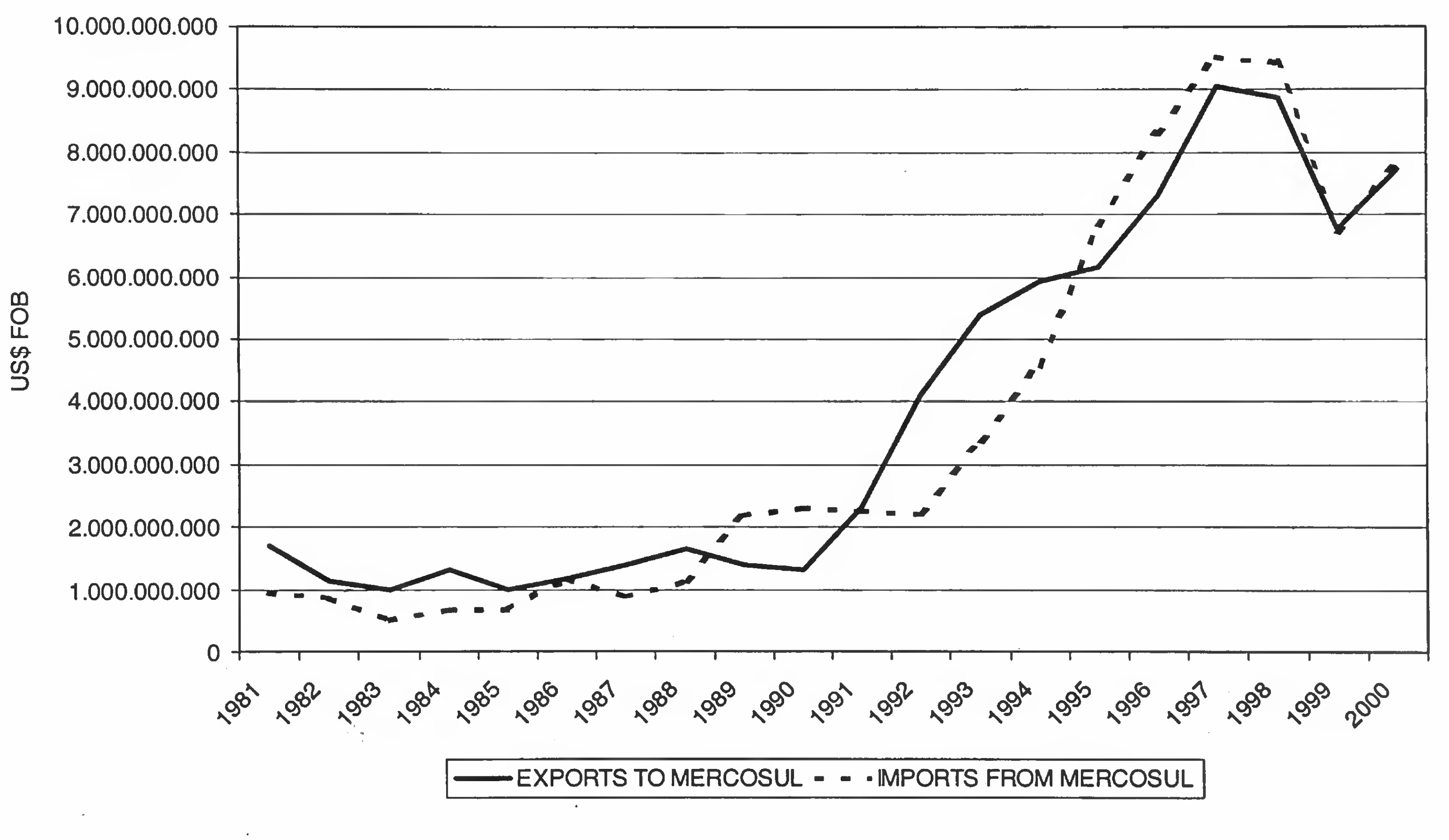
That heterogeneity of exchange rate regimes did not act as an obstacle to trade growth within the customs union, as it is shown in Graphs 1 and 2. On the one hand, Argentina's currency underwent an overvaluation process over time vis-à-vis the rest of the world, following the maintenance of its currency board whereas a residual inflation remained in nontradable goods for some period. On the other hand, from 1994 onwards, Brazil's exchange-rate based stabilization plan - the "Real Plan" - implied its own overvaluation process and a substantial devaluation in the bilateral exchange rate of Argentina's Peso with respect to Brazil's Real, as shown in Graph 3. That pattern of exchange rate levels among Mercosul partners, plus the application of Mercosul agreed trade rules (including the adoption of common external tariffs), were the most important factors for the trade results presented in the latter graph.

Brazil's movement towards a flexible exchange rate regime in 1999 - after which the Brazilian Real devalued substantially as compared to previous nominal and real levels - sparkled trade disputes within the customs union. Due to Argentina's prolonged recession, coupled with the devaluation of the Real, trade barriers were raised or strenghtened at Argentina's side. A new pessimistic mood regarding Mercosul's survival as a trade agreement in the long run has prevailed since then.

The objective of this paper is to assess the impact of Mercosul on Brazil's regions and their industries after the change in the country's exchange rate regime in January of 1999. Following a methodology used in Sá Porto (2002), we use a gravity model and show that, apart from income and distance effects, a large part of the trade of Brazilian states can be explained by a Mercosul effect, by a regional effect and by an industry effect. These three effects combined produces a trade bias which we estimated and compared for all Brazil's five regions for the years 1990, 1994, 1998 and 2000. We tracked how that trade bias evolved in that 10-year period and thus evaluated the impacts of Mercosul and the change in exchange rate regime on the regions' industrial structures.

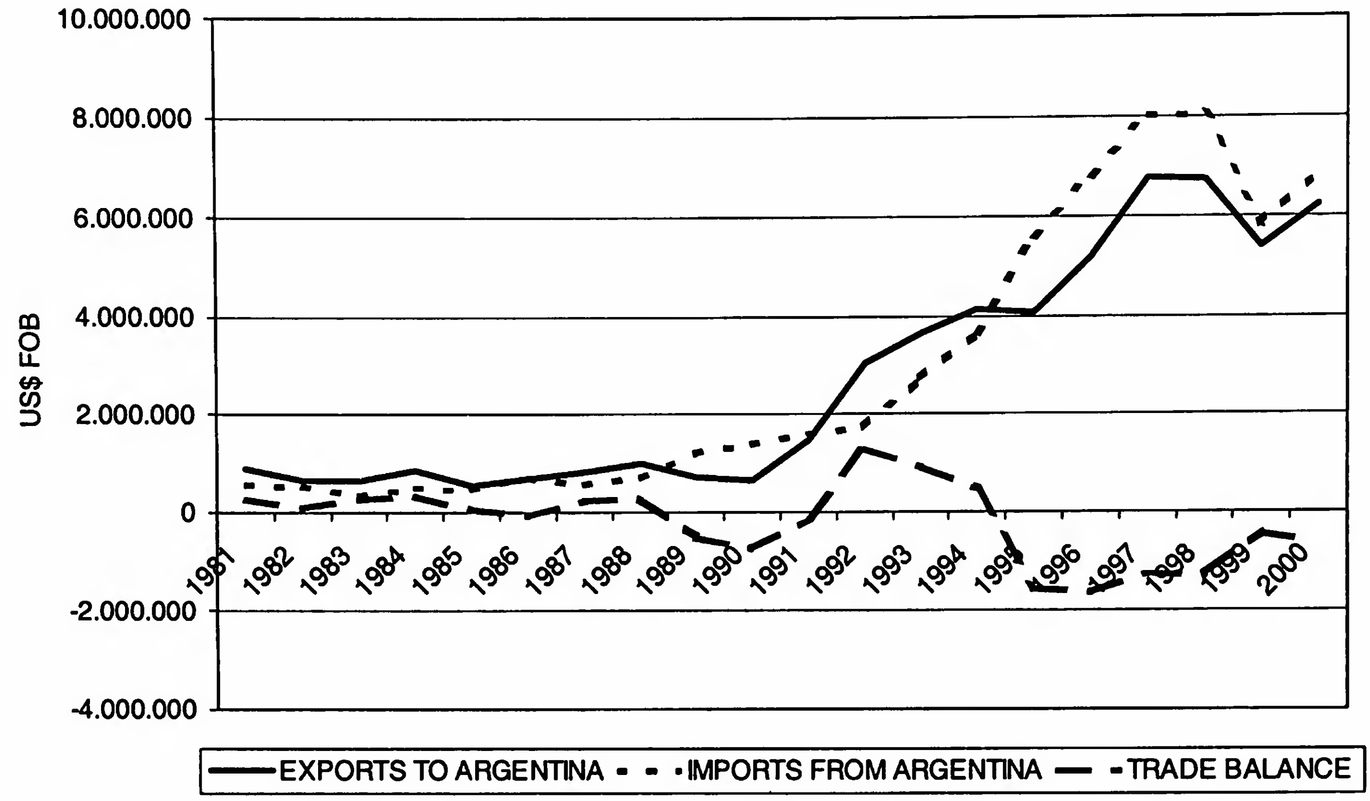
In the next section, we depict the theoretical foundations and empirical tests of the gravity model to assess the regional impacts of economic integration. In section 3 we analyze the results from three econometric estimations: one is the standard gravity model with a Mercosul dummy variable included, the second is the gravity model with both a Mercosul and a Region dummy variables included, and the third is the gravity model with a Mercosul, a Region, and a Industry dummy variables included. In section 4 we present some implications and concluding remarks, along with suggestions for further research in this topic.

Graph 1
Trade Between Brazil and Mercosul, 1981-2000



Source: www.mdic.gov.br.

Graph 2
Trade Between Brazil and Argentina, 1981-2000



Source: www.mdic.gov.br.

Graph 3
Brazil - Argentina: Trade Balance and Bilateral Exchange Rate - Real / Peso) 1992-2000

Source : Idéias Consultoria.

2 Economic integration and regional development

In this section, we will review the theoretical and empirical literatures on the gravity model, as well as the literature on the impacts of economic integration on regional development. As in Sá Porto (2002), we are not concentrating on the discussion on whether Preferential Trade Agreements (PTAs) such as Mercosul are beneficial or detrimental to achieving free trade; thus we will assume that a PTA may have either beneficial or harmful overall effects, depending on whether the PTA is trade creating or trade diverting to participating countries and to the world as a whole. We assume that the welfare effects of PTAs are mainly of a static nature in a Vinerian sense, so we discard any possible dynamic effects in participating countries of a PTA.

Moreover, in this paper we use the gravity model as an **ex-post** method to estimate empirically the static effects of economic integration arrangements. Other ex-post techniques (such as the Import Growth approach, or the the Shift-Share analysis), as well as **ex-ante** techniques (such as the Price Elasticities approach, the Import Demand Regression approach, and the Computational General Equilibrium models), are often used to estimates the effects of economic integration on participating countries and their regions and industries.[1]

2.1 Theoretical and empirical analyses on the gravity model

Linnemann (1966) used the gravity equation 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. Moreover, dummy variables were included in the model to evaluate the overall effects of preferential trade arrangements on trade flows. His original gravity model was thus as follows:

$$X_{ij} = a_0 (Y_i)^{a1} (Y_j)^{a2} (N_i)^{a3} (N_j)^{a4} (Dist_{ij})^{a5} e^{(Pref)\, a6} (e_{ij}), \qquad (1)$$

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 regression.

1 Sá Porto (2002, p. 7).

As it was originally proposed, the gravity model's main weakness was its lack of a solid theoretical microeconomic foundation. A gravity equation based on such a theory was first developed by Anderson (1979) and later extended in other articles by other authors such as Bergstrand (1985 and 1989) and Deardorff (1998).[2] In a more recent paper, Anderson and van Wincoop (2001) argue that the gravity model has been used throughout in a format which do not correspond to a theoretically grounded equation. They argue that trade between two regions (or countries) is decreasing not just with distance or with an "atheoretic" remoteness variable (used by some authors), but rather with their bilateral trade barrier relative to the average barrier of the two regions (countries) with all their trading partners. They found it crucial to include a "multilateral resistance" variable to assess the impacts of barriers with other partners, as *"the more resistant to trade with all others a region is, the more it is pushed to trade with a given bilateral partner."*[3]

They present an alternative format of the gravity equation in which *"bilateral trade, after controlling for size, depends on the bilateral trade barrier between i and j, divided by the product of their multilateral resistance."*[4] The bilateral trade barrier is given by the distance between i and j and the tariff-equivalent of the border barrier between them (if both regions belongs to the same country, this later term equals to one), and the multilateral resistance variable is given by a price index that depends on the trade barriers with all trade partners. In this manner they were able to, among other things, evaluate the impacts of national borders on bilateral trade. Indeed, they use this methodology to solve McCallum's (1995) border puzzle, in which trade between the United States and Canada in 1988 was 22 times greater than trade between US states or Canadian provinces. Anderson and van Wincoop found that the US-Canada border effect was much smaller than McCallum has found because this author did not include a multilateral resistance variable in his analysis, thus overestimating the impacts of the border effect.

With regards to empirical tests which have used the gravity model, to date there is a large number of empirical studies in which the gravity model is used to assess the welfare effects of regional economic integration on participating countries. In Sá Porto (2002) a comprehensive review of this literature is presented, citing most of the important work in this area, such as the studies by Aitken (1973), Frankel (1992), Frankel and Wei (1992), Frankel and Wei (1993a, 1993b), and Frankel, Stein and Wei (1995). These authors have used the gravity model to assess the impacts of the major economic integration agreements such as NAFTA, EU (and its

2 See Sá Porto (2002) for a detailed discussion on the theoretical foundations of the gravity model.

3 Anderson and van Wincoop (2001, p. 1).

4 Anderson and van Wincoop (2001, p. 8).

predecessors, EEC and EFTA), ASEAN and Mercosul on world bilateral trade. Kume e Piani (2000) evaluated the performance of several PTAs in the period 1986-1997, but they do look in more detail to the performance of Mercosul, and they found that, on the aggregate, Mercosul was net trade creating.

2.2 Theory and empiricism of 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 strenghts. 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 use those endowments and strengths, and the industrial structure of the countries (and their regions) will change accordingly to exploit comparative advantages. This is the standard analysis using the classical 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 occur.[5]

The empirical tests of the gravity model mentioned in the previous subsection 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

5 Fujita, Krugman and Venables (1999, p. 329-343).

considered how economic integration affected the different regions of a country. Indeed, few studies have tried to evaluate the regional impacts of economic integration. 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 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 Mercosul in Brazil's regions was evaluated by Sá Porto (2002). Using a gravity model expanded to include dummy variables for Mercosul and for a region in Brazil, he found that the trade bias[6] with Mercosul 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 Mercosul 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 Mercosul, although at a much smaller scale. He concludes that, although as a whole Mercosul was net trade creating[7] and Brazilian states as a whole benefited from Mercosul, the results imply that a Preferential Trade Agreement such as Mercosul 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.

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.[8] Kume and Piani (1999) have used a shift-share analysis to evaluate the impacts of Mercosul on the production structures of eight different Brazilian states, and they show that, between 1990 and 1995, the three states in the region South and the northeastern state of Bahia show the largest growth in both export and import components of the shift-share analysis, thus showing that these states are more integrated to international trade.

Barros (1997) have used a general equilibrium model to evaluate the impacts of Mercosul trade flows in Brazil's Northeastern region. By means of a model which simulates the impacts

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

7 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).

8 Sá Porto (2002, p. 13).

of economic integration by using the changes in the bilateral exchange rates of all Mercosul partners (thus assuming that the effetcs 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 Mercosul were positive but modest: the region's GDP would grow by an extra 2% per year due to Mercosul, five years after the implementation of a complete custom union. That is less than the rest of the country would due to Mercosul (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 would aldo benefit from Mercosul), the states of Piauí, Alagoas and Maranhão (the region's poorer states) would hardly benefit from Mercosul, whereas Paraíba would actually lose from Mercosul.

Two other studies using general equilibrium models are worth mentioning here, although they do not seek to evaluate the regional impacts of economic integration. First, Brandão, Lopes and 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.

Second, the GTAP general equilibrium model is also used in Domingues (2002), where he uses that model to simulate the welfare impacts in Brazil, Argentina and Uruguay of two possible free trade arrangements: one is the implementation of the FTAA (Free Trade Area of the Americas), a Free Trade Area including all the countries in the Americas but Cuba, and another is 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 order to assess the impacts of Mercosul in Brazil's regions and their industries, we chose the gravity model in its standard format. Our approach is to add three dummy variables to the standard gravity model, one for the Mercosul trade agreement, another for a region in Brazil, and another for an industry. We then estimate the joint trade bias of Mercosul, of belonging to a certain region in Brazil, and of being from one industry in a certain region by looking at the Mercosul, the region and the industry coefficients. The advantage of this approach is that the effects of Mercosul at the aggregate level in each of Brazil's regions and their industries can be easily estimated, using relatively less data than other models, such as Bröcker's (1988) gravity model, input-output models or computacional general equilibrium models.

In the next subsection, we will first use a gravity model with the Mercosul dummy only and compare the results for the years 1990, 1994, 1998 and 2000, and evaluate how the Mercosul trade bias evolved over time and how it performed after the change in exchange rate regime in January of 1999 towards a float exchange rate system.[9] In subsection 3.2 we will include a "region" dummy variable and present the results for 1990, 1994, 1998 and 2000, and compare the results for those years to evaluate how the impacts of the Mercosul agreement on the Brazilian regions as a whole, and more specifically, how the adoption of a float exchange rate system affected regional development in Brazil. Finally, we add an industry dummy and assess the impacts of Mercosul and the change in exchange rate regime in the regions' industrial structure.[10]

3.1 Main model

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

$$\ln X_{ij} = \ln a_0 + a_1 \ln Y_i + a_2 \ln Y_j + a_3 \ln N_i + a_4 \ln N_j + a_5 \ln Dist_{ij} + a_6 Adj + a_7 NAFTA + a_8 EU + a_9 Mercosul + \log e_{ij},$$

where X_{ij} is the dollar value of exports[11] from the state (country) i to country (state) j, Y_i is the nominal value of state i's GRP (country i's GDP), Y_j is the nominal value of country j's GDP (state j's GRP), N_i is the population of state (country) i, N_j is the population of country (state)

9 We chose the years 1990, 1994, 1998 and 2000, in order to compare a point in time before Mercosul was implemented (1990) with a point where Mercosul was partially implemented (1994), with a point where Mercosul was fully implemented (1998), and with a point where the effects of the changes in the exchange rate regime in Brazil was fully absorbed (2000).

10 The data for this paper was obtained from the following sources. Export and import data was provided by SECEX (2000), the Foreign Trade office of the Brazilian Ministry of Development, Industry and Commerce. The Gross Regional Product data and the population data for the Brazilian states was provided by IBGE (1999), the Brazilian Institute for Geography and Statistics of the Ministry of Planning. The Gross Domestic Product and the population for the countries in the sample was obtained from the STARS CD-ROM from the World Bank. Finally, the distance data was extracted from the World Atlas MPC CD-ROM.

11 This approach assumes that both trade flows (exports and imports) are equivalent in dollar values (both in FOB value, for example); that is, the exports from a country to a state equals the imports of that state from that 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, **NAFTA** is a dummy variable that equals to 1 if the country belongs to the North American Free Trade Area, and 0 if it does not, **EU** is a dummy variable that equals to 1 if the country belongs to the European Union, and 0 if it does not, and **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).

In Sá Porto (2002), eight alternative presentations of the gravity equation are estimated. The estimates for the eight equations yielded similar results for the coefficients, but, among those eight estimated equations, we chose the model with the lowest Mercosul coefficient to be used in this section (the model which includes all three regional dummies, Mercosul, NAFTA and EU[12]) because it lowers the probability of introducing an upward bias to that coefficient.[13]

The results are presented in Table 1.[14] 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 for all four years. Moreover, the range in which they vary across years is relatively narrow.[15] Y_i ranges from 0.62 to 0.79, Y_j from 0.99 to 1.25, and $Dist_{ij}$ from -1.91 to -1.38. Second, the population coefficients did not seem to be stable: while N_i was significant in three out of four years, N_j was never significant. Similarly, the adjacency variable was never significant, and it did not have the expected sign in 1990.

Although they were all significant, the coefficients for NAFTA were all negative for all four years. While it increased from –1.25 in 1990 to –1.07 in 1994 and to –0.86 in 1998, it fell to –1.49 in 2000. That is, although the trade bias with NAFTA countries has increased from 1990 to 1998 and fell in 2000, it is still less than unity (since the coefficients are negative). In the case of the EU, the coefficients were always non-significant and close to zero (which yields a trade bias of unity, i.e., there is no bias for the Brazilian states as a whole with the European Union countries.

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12 These three regional blocs are the most important for Brazil in terms of its total trade. The regional trading blocs in this paper are defined as in Thorstensen *et al.* (1994)

13 There might be a possibility that the Mercosul coefficient is overestimated, because for a log-distributed variable X with average μ and standard deviation σ, the expected value of X is E(exp log X) = exp (μ + $(1/2)\sigma^2$); in the text the term $(1/2)\sigma^2$ was ignored, and thus the deviation may not calculated correctly, potentially introducing an upward bias in the Mercosul coefficient.

14 In Tables 1 and 2 below, the number of observations is not the same for all years (it is actually 485 for 1990 data, 527 for 1994 data, 623 for 1998 data, and 678 for 2000 data). This is because E-views has excluded all zero flows, which were not the same for each year. For the same reason the number of observations is not the same for 1990, 1994, 1998 and 2000 in Table 3.

15 These results are consistent with estimates from other authors such as Aitken (1973) and McCallum (1995).

The most important finding in this section was the behavior of the coefficient for the Mercosul variable: not only was it significant and had the expected sign, but it was relatively large. It varied from 0.04 in 1990 (meaning that there was virtually no trade bias with Mercosul countries in that year) to 1.19 in 1994 (yielding a trade bias of 3.3 with Mercosul in that year, since $e^{1.19} = 3.3$) to 1.86 in 1998 (yielding a trade bias of 6.4). Thus, Mercosul had by far the largest coefficent of the economic integration dummy variables, and the trade bias with Mercosul countries was very large for the Brazilian states as a whole in 1998. The Mercosul coefficient in 2000 shows that, in spite of the fact that it fell to 1.47, it was still substantially large, yielding a trade bias of 4.35 ($e^{1.47} = 4.35$). That is, in spite of divergent exchange rate policies of Brazil and Argentina due to the change in Brazil towards a float exchange rate in 1999 (and the maintenance of Argentina´s fixed exchange rate system), this was not enough to revert the large trade biases built during the previous period. Indeed, the trade bias in 2000 was still significantly larger than in 1994. By then all Mercosul countries had phased out tariffs inside the bloc, although some sectors, such as the automotive sector, have remained protected even until now.

Table 1
Gravity Equation Coefficients Estimates for the Trade Flows Between Brazilian States and Brazil's Major Trading Partners, 1990, 1994, 1998 and 2000

Independent variable	1990	1994	1998	2000
Y_i	0.77*	0.62*	0.79*	0.66*
	(0.17)	(0.16)	(0.13)	(0.15)
Y_j	1.13*	0.99*	1.25*	1.18*
	(0.16)	(0.16)	(0.13)	(0.15)
N_i	0.33	0.74*	0.72*	1.05*
	(0.25)	(0.24)	(0.20)	(0.23)
N_j	0.05	0.40	0.08	0.33
	(0.24)	(0.24)	(0.20)	(0.23)
$Dist_{ij}$	-1.78*	-1.49*	-1.38*	-1.91*
	(0.25)	(0.25)	(0.20)	(0.23)
Adj	-0.15	0.49	0.54	0.07
	(0.69)	(0.69)	(0.60)	(0.68)
Mercosul	0.04	1.19*	1.86*	1.47*
	(0.40)	(0.40)	(0.33)	(0.38)
NAFTA	-1.25*	-1.07*	-0.86*	-1.49*
	(0.34)	(0.33)	(0.28)	(0.32)
EU	-0.51	-0.09	-0.07	0.23
	(0.28)	(0.26)	(0.23)	(0.25)

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

Notes: X_{ij} is the dependent variable. Standard errors are given in parentheses. All variables except dummies are expressed in natural logarithms; estimation by ordinary least squares. Number of observations = 485 for 1990, 527 for 1994, 623 for 1998 and 648 for 2000.

3.2 Model with "Mercosul" and "region" dummies

In this section, we will estimate the basic model from section 3.1 and include a dummy variable representing a Brazilian region. The model to be estimated is as follows:

$$\ln X_{ij} = \ln a_0 + a_1 \ln Y_i + a_2 \ln Y_j + a_3 \ln N_i + a_4 \ln N_j + a_5 \ln Dist_{ij} + a_6 Adj + a_7 NAFTA + a_8 EU + a_9 Mercosul + a_{10} Region + \log e_{ij},$$

where the all the variables are the same as in section 3.1 and **Region** is one of the following five Brazilian regions: South (S), Southeast (SE), North (N), Northeast (NE), and Center-West (CW).[16] Thus, if **Region** is the South region, then the dummy variable equals to 1 if the state belongs to the South, and 0 if that is not the case. We ran five regressions for the equation above for 1990, 1994, 1998 and 2000, where in each regression the Region variable takes one of the five possible values described above.

The Mercosul coefficient indicates the increase in trade for Brazilian states by trading with a Mercosul country. The Region coefficient indicates the increase in trade for a state from a certain region by trading with the world as a whole. If we look at the joint effect of both Mercosul and Region coefficients we can therefore estimate the combined effect of a state belonging to a certain region **and** of trading with a Mercosul country. For example, if we are interested in assessing the impacts of Mercosul in the South, we should look at the regression where the Region variable equals the South, and we should calculate the trade bias effect of both Mercosul and Region coefficients, i.e., $e^{(Mercosul+Region)}$, where Mercosul+Region is the sum of the coefficients for the Mercosul and Region variables. For each region, We then compared the results of the regression for 1990 with the results for 1994, 1998 and 2000 to see how the trade bias effect changed overtime with the implementation of the Mercosul agreement, and to see how the introduction of the float exchange rate regime has affected the regional economies. We can thus compute an estimate of the impact of Mercosul in each one of the Brazilian regions.[17]

16 This is the standard IBGE's definition of the country's regions and their mapping onto Brazil's 27 states.

17 I had similar results as in the previous subsection with respect to the stability of the coefficients of GDP, population, NAFTA, EU, distance, and adjacency variables, so I will thus concentrate here on the analysis of the Mercosul and Region coefficients.

The results are shown in Table 2. We first notice that the Mercosul coefficients increased significantly from 1990 to 1998 for all five regions.[18] The largest coefficients in 1998 were those of the regions South and Northeast (1.94 and 1.93, respectively, in the year 1998, as opposed to 1.29 and 1.37 in 1994, and 0.15 and 0.16 in 1990). Nonetheless, the coefficients for the other three regions also increased substantially (from 0.10 in 1990 to 1.78 in 1998 in the Southeast, from 0.05 to 1.85 in the same period in the North, and from 0.04 to 1.77 in the Center-West region). In 2000 the Mercosul coefficient fell for all regions, although to levels higher than those in 1994: 1.55 in the South, 1.54 in the Northeast, 1.39 in the Southeast, 1.44 in the North, and 1.39 in the Center-West.

The coefficient for the Region variable behaved differently. It increased only for the regions South (from 1.08 in 1990 to 1.36 in 1998), Northeast (from –0.76 to –0.68) and Center-West (from -1.82 to -0.96); note, however, that in spite of the increase, the Region coefficient for the Center-West and for the Northeast remained negative. This coefficient decreased from 1.45 to 1.31 in the Southeast and from 0.19 to -0.34 in the North. In 2000 the region coefficient increased in the South (to 1.44), Northeast (to -0.51) and Center-West (to -0.58), but it fell in the Southeast (to 1.01) and North (to -0.73).

Finally, the joint effect of the Mercosul and Region dummy is analyzed as mentioned before. The trade bias effect for a Brazilian state belonging to a certain region trading with a Mercosul country is given by $e^{(\text{Mercosul+Region})}$, where Mercosul+Region is the sum of the coefficients for the Mercosul and Region variables. In this manner we can estimate the effects of the Mercosul trade agreement in the trading patterns of the five Brazilian regions. We first notice that Mercosul had a very large impact in the South: its trade bias increased from 3.42 in 1990 to 14.30 in 1994 and to 27.11 in 1998; that is, trade between a state in the Brazilian South (a region that borders all the Mercosul countries) in 1998 was more than 27 times larger than trade with other countries. Another impressive impact of Mercosul was in the Region Southeast: the trade bias increased from 4.71 in 1990 to 11.94 in 1994 and to 21.98 in 1998. Moreover, the region North, Northeast, and Center-West had increases in trade bias from 1.27 in 1990 to 4.53 in 1998, from 0.54 to 3.49, and from 0.17 to 2.25, respectively. From this analysis we conclude that the most significant regional impacts of Mercosul were on its South and Southeast regions, which already had the largest bias towards trade with Mercosul countries in 1990. The North, Northeast and Center-West regions saw an increase in trade bias towards those trade partners, but not as significant.

18 A Chow test was not carried out here, since there are only four data points considered a few years apart (1990, 1994, 1998 and 2000), as it would have made sense to perform it if I had several cross-section data sets available.

Table 2

Gravity Equation Coefficients Estimates for the Trade Flows Between Brazilian States and Brazil's Major Trading Partners Including a Region Dummy, 1990, 1994, 1998 and 2000

	Region South				Region Southeast				Region North				Region Northeast				Region CenterWest			
Independent variable	1990	1994	1998	2000	1990	1994	1998	2000	1990	1994	1998	2000	1990	1994	1998	2000	1990	1994	1998	20
Y_i	0.68*	0.54*	0.67*	0.52*	0.60*	0.43*	0.65*	0.55*	0.76*	0.62*	0.81*	0.69*	0.44*	0.22*	0.54*	0.46*	1.04*	0.82*	0.90*	0.
	(0.16)	(0.15)	(0.13)	(0.15)	(0.16)	(0.16)	(0.13)	(0.15)	(0.16)	(0.16)	(0.13)	(0.15)	(0.17)	(0.17)	(0.15)	(0.15)	(0.16)	(0.16)	(0.13)	(0.
Y_j	1.04*	0.90*	1.14*	1.04*	0.95*	0.80*	1.12*	1.07*	1.12*	0.99*	1.27*	1.21*	0.79*	0.60*	1.00*	0.98*	1.43*	1.23*	1.38*	1.
	(0.16)	(0.15)	(0.13)	(0.15)	(0.16)	(0.16)	(0.13)	(0.15)	(0.16)	(0.16)	(0.13)	(0.15)	(0.17)	(0.17)	(0.15)	(0.15)	(0.16)	(0.16)	(0.13)	(0.
N_i	0.40	0.79*	0.81	1.15*	0.34	0.81	0.71*	1.04*	0.37	0.75*	0.65*	0.92*	0.74*	1.26*	1.03*	1.29*	-0.11	0.42	0.53*	0.
	(0.24)	(0.22)	(0.19)	(0.23)	(0.21)	(0.22)	(0.18)	(0.23)	(0.24)	(0.23)	(0.19)	(0.23)	(0.27)	(0.27)	(0.21)	(0.25)	(0.23)	(0.23)	(0.19)	(0.
N_j	0.12	0.43	0.15	0.42	0.07	0.45	0.05	0.32	0.09	0.40	0.01	0.19	0.48	0.89*	0.38	0.57	-0.44*	0.00	-0.12	0.
	(0.23)	(0.22)	(0.19)	(0.12)	(0.21)	(0.22)	(0.18)	(0.23)	(0.24)	(0.23)	(0.19)	(0.23)	(0.27)	(0.26)	(0.21)	(0.25)	(0.23)	(0.23)	(0.19)	(0.
$Dist_{ij}$	-1.63*	-1.33*	-1.23*	-1.73*	-1.42*	-1.13*	-1.08*	-1.67*	-1.80*	-1.49*	-1.33*	-1.82*	-1.50*	-1.14*	-1.17*	-1.72*	-1.92*	-1.62*	-1.46*	-1.
	(0.25)	(0.24)	(0.20)	(0.23)	(0.25)	(0.25)	(0.20)	(0.24)	(0.25)	(0.24)	(0.20)	(0.24)	(0.26)	(0.26)	(0.21)	(0.24)	(0.24)	(0.24)	(0.20)	(0.
Adj	-0.76	-0.31	-0.25	-0.76	0.68	1.32*	1.28*	0.65*	-0.15	0.49	0.55	0.11	-0.05	0.60	0.56	0.11	-0.31	0.32	0.46	0.
	(0.69)	(0.69)	(0.60)	(0.68)	(0.68)	(0.69)	(0.59)	(0.68)	(0.68)	(0.69)	(0.60)	(0.67)	(0.68)	(0.67)	(0.59)	(0.68)	(0.65)	(0.67)	(0.59)	(0.
NAFTA	-1.16*	-0.99	-0.79	-1.39*	-0.96*	-0.85*	-0.63*	-1.28*	-1.29	-1.08*	-0.77	-1.33*	-1.26	-1.18*	-0.93	-1.49	-1.11	-0.93	-0.79	-1.
	(0.33)	(0.32)	(0.27)	(0.31)	(0.33)	(0.32)	(0.28)	(0.32)	(0.34)	(0.26)	(0.29)	(0.32)	(0.34)	(0.32)	(0.28)	(0.32)	(0.32)	(0.32)	(0.28)	(0.
EU	-0.43	-0.05	0.12	0.28	-0.38	-0.01*	0.12	0.26	-0.50	-0.09	0.06	0.22	-0.26	0.05	0.18	0.30	-0.70	-0.14	-0.01	0.
	(0.28)	(0.25)	(0.22)	(0.25)	(0.27)	(0.25)	(0.22)	(0.25)	(0.28)	(0.26)	(0.23)	(0.25)	(0.29)	(0.26)	(0.23)	(0.25)	(0.27)	(0.25)	(0.23)	(0.
Mercosul	0.15	1.29*	1.94*	1.55*	0.10	1.15*	1.78*	1.39*	0.05	1.19*	1.85*	1.44*	0.16	1.37*	1.93*	1.54*	0.04	1.10*	1.77*	1.
	(0.42)	(0.35)	(0.32)	(0.37)	(0.41)	(0.34)	(0.32)	(0.32)	(0.42)	(0.35)	(0.33)	(0.37)	(0.42)	(0.35)	(0.33)	(0.38)	(0.41)	(0.39)	(0.33)	(0.
Region	1.08*	1.37*	1.36*	1.44*	1.45*	1.33*	1.31*	1.01*	0.19	-0.04	-0.34*	-0.73*	-0.76*	-0.93*	-0.68*	-0.51*	-1.82*	-1.39*	-0.96*	-0.
	(0.27)	(0.28)	(0.25)	(0.25)	(0.26)	(0.27)	(0.22)	(0.22)	(0.28)	(0.26)	(0.21)	(0.23)	(0.24)	(0.24)	(0.19)	(0.22)	(0.27)	(0.26)	(0.21)	(0.
Trade Bias fMercosul **	1.16	3.63	6.96	4.71	1.11	3.16	5.93	4.01	1.05	3.29	6.36	4.22	1.16	3.94	6.89	4.66	1.04	3.00	5.87	4.
Trade Bias fRegion ***	2.94	3.94	3.90	4.22	4.26	3.78	3.71	2.75	1.21	0.96	0.71	0.48	0.47	0.39	0.51	0.60	0.16	0.25	0.38	0.
Joint Trade Bias from Mercosul & Region ^	3.42	14.30	27.11	19.89	4.71	11.94	21.98	11.02	1.27	3.16	4.53	2.03	0.54	1.55	3.49	2.80	0.17	0.75	2.25	2.

*Significant at the 5% level, one-tail test.; **Calculated as $e^{Mercosul}$; ***Calculated as e^{Region}; ^ Calculated as $e^{(Mercosul + Region)}$

Notes: X_{ij} is the dependent variable. Standard errors are given in parentheses. All variables except dummies are expressed in natural logarithms; estimation by ordinary least squares. Number of observations = 485 for 1990 data, 527 for 1994 data, 623 for 1998 data, and 678 for 2000 data.

More interestingly, we noticed that in 2000 the large regional biases with Mercosul of the South and Southeast decreased but were not reversed: they fell to 19.89 and 11.02, respectively. Indeed, the regional biases with the North and the Northeast had the same pattern: they fell to 2.03 and 2.80 but were not reversed either. The trade biases with the Center-West did not even change comparing to 1998 (a trade bias of 2.25). Thus, as in the previous sub-section, the lack of a common exchange rate regime for Mercosul countries was not enough to revert the large regional trade biases created in the period prior to 1999.

3.3 Model with "Mercosul", "region" and "industry" dummies

We will now add a third dummy variable to our basic model. This time we will add an "Industry" variable, and the model to be estimated is the following:

$$\ln X_{ijk} = \ln a_0 + a_1 \ln Y_i + a_2 \ln Y_j + a_3 \ln N_i + a_4 \ln N_j + a_5 \ln Dist_{ij} + a_6 Adj + a_7 NAFTA + a_8\, EU + a_9 Mercosul + a_{10}\, Region + a_{11}\, Industry + \log e_{ij},$$

where all the variables are defined as in section 3.2, except for X_{ijk} (which is now the dollar value of exports within sector k from the state (country) i to country (state) j), and for **Industry**, which is one of the following fourteen industries: Food, Tobacco, and Beverages (Industry 1),[19] Minerals (Industry 2), Chemicals (Industry 3), Plastic and Rubber Products (Industry 4), Footwear and Leather Products (Industry 5), Wood (Industry 6), Paper (Industry 7), Textiles (Industry 8), Nonmetallic Minerals and Precious Metals (Industry 9), Basic Metals (Industry 10), Machinery and Electrical Equipment (Industry 11), Vehicles and Transportation Materials (Industry 12), Instruments (Industry 13), and Other Industries (Industry 14). If, for example, **Industry** is Industry 1 (Food, Tobacco, and Beverages), then the dummy variable equals 1 if the trade flow in question refers to exports (or imports) of Food, Tobacco, and Beverages, and 0 if that is not the case. We ran fourteen regressions for the equation above for 1990, 1994, 1998 and 2000, where in each regression the Industry variable takes one of the fourteen possible values mentioned above.

19 These fourteen industries are defined as in Thorstensen *et al.* (1994, p. 50-51). This product classification map the 99 SITC (Standard International Trade Classification) groups of products and the 21 NBM-SH (Brazilian Trade Classification – Harmonized System) groups onto fourteen groups of products chosen by those authors.

As in the previous section, the Mercosul coefficient indicates the increase in trade for Brazilian states by trading with a Mercosul country. The Region coefficient indicates the increase in trade for a state from a certain region by trading with the world as a whole. And the Industry coefficient indicates the increase in trade for a certain sector by trading with the world as a whole. The joint effect of Mercosul, Region and Industry coefficients estimates the combined effect of a specific industry from a state belonging to a certain region trading with a Mercosul country. Thus, to assess the impacts of Mercosul in the Food/Tobacco/Beverages industry of the region South, for example, we should look at the regression where the Region variable equals the South and the Industry variable is Industry1. The trade bias in this case is given by $e^{(Mercosul+Region+Industry)}$, where Mercosul+Region+Industry is the sum of the coefficients for the Mercosul, Region and Industry variables. For each region, we then compared the results of the regression for 1990 with the results for 1994, 1998 and 2000 to see how the trade bias effect changed overtime with the implementation of the Mercosul agreement and how the introduction of the floating regime in early 1999 impacted the sectors throughout the regions.

The results are shown in Table 3. As in the previous section, we concentrate in the analysis of the Mercosul, Region and Industry coefficients, since we had similar results as in the two previous subsection with respect to the stability of the coefficients of GDP, population, NAFTA, EU, distance, and adjacency variables. For every region and for each year, we had to estimate the coefficients for Mercosul, region and industry 14 times. Since we have five regions and four points in time, we had to run 14x4x5 = 280 regression equations. In the first and second rows of the table we only report the range of coefficients that we obtained for the Mercosul and Region coefficients, respectively. But we do report all the coefficients for the industry variables in the second part of the table, for each region and for each year. Finally, for each industry within a region and for a certain year, we compute the joint trade bias of Mercosul in the manner we mentioned above, which are reported in the second half of the table.

With respect to the number of observations of our data, for each year we had 9072 observations (27 states x 12 countries x 14 sectors x 2 export and import flows). However, the number of observations that we reported on Table 3 is the number of rows not excluded by E-Views, which excluded all the zero trade flows, but in some cases this accounted for about 50% of the flows at this level of disaggregation of the data. From the economic modelling point of view it is possible that we had that many zero flows, but econometrically we tested for a possible introduction of a bias that such a large amount of zero trade flows may have introduced. We substituted each zero flow by a very small value (as in Castilho, 2001), first by 0.001 and then by 1.0×10^{-9}, to see how the equation coefficients would change, but in both cases, all of the coefficients did not behave as expected in the economic model or they became insignificant. Thus, we maintained the model with all the zero flows; note, however, that many of those disaggregated flows were expected to be zero. For example, for the Vehicles and Transportation Materials industry, the production of vehicles is confined so far to only a few states, which are obviously the only ones which could report nonzero export flows. In the same manner, vehicles are imported into the country using a ports that are located in a small number of states.

We turn now the attention to the joint trade biases. We first observe that for certain industries the trade bias is very significant for all regions (although this is specially true for the South and the Southeast). The sectors with the largest trade biases are Food/Tobacco/Beverages (Industry 1), Chemicals (Industry 3), Textiles (Industry 8), Metals (Industry 10), Machinery and Equipment (Industry 11), and Transportation Materials (Industry 12), so that we will concentrate our analysis in these sectors.

For the Food/Tobacco/Beverages industry (Industry 1), we notice that the trade bias increased from 10.8 in 1990 to 24.3 in 1994 and to 39.2 in 1998 in the South, but it fell to 26.8 in 2000. This sector followed the same trend as the results we had for the two previous subsections, where the trade bias has fallen in the year 2000 but remained significantly larger than in 1994. The coefficient for Industry 1 in the North evolved as in the South, but in the Southeast it fell more pronouncedly in 2000, to levels lower than in 1994. In the Northeast and in the Center-West it increased constantly from 1990 to 2000.

The same pattern was observed in Industry 3 (Chemicals): for example, for the region South, Industry 3's trade bias increased from 5.16 in 1990 to 10.28 in 1994 to 13.60 in 1998 but fell to 11.25 in 2000. The fall in the Industry 3 coefficient for the year 2000 was more pronounced in the Southeast, where it fell to levels lower than in 1994. In the North, the Industry 3 coefficient showed an upward trend throughout the ten-year period. The other two regions also showed higher coefficients in 2000, although these are much lower in this case.

In Industry 8 (Textiles) and Industry 10 (Basic Metals), the same patterns for the trade bias have developed: trade biases have increased from 1990 to 1998 but have fallen in 2000. As in the other sectors, the fall in the Industry coefficient in the Southeast was more pronounced, to lower levels when compared to 1994. Another important pattern was that the trade bias for the South has surpassed the Southeast in this two sectors (and indeed in other important sectors, such as the ones analyzed previously).

Table 3

Gravity Equation Coefficients Estimates for the Trade Flows Between Brazilian States and Brazil's Major Trading Partners Including a Region Dummy and a Industry Dummy, 1990, 1994, 1998 and 2000

	Region South				Region Southeast				Region North				Region Northeast				Region CenterWest			
Coefficients	1990	1994	1998	2000	1990	1994	1998	2000	1990	1994	1998	2000	1990	1994	1998	2000	1990	1994	1998	200
Mercosul ***	0.19–0.25*	0.48–0.53*	0.67–0.72*	0.46–0.50*	0.06–0.12*	0.33–0.36*	0.48–0.54*	0.32–0.38*	0.19–0.23*	0.59–0.63*	0.48–0.52*	0.43–0.48*	0.23–0.25*	0.54–0.66*	0.68–0.73*	0.40–0.42*	0.14–0.17*	0.62–0.65*	0.40–0.44	0.4 0.5
Region ***	0.12–0.19*	0.57–0.63*	0.73–0.79*	0.57–0.61*	0.37–0.42*	0.77–0.81*	0.88–0.91*	0.29–0.32*	0.27–0.29*	-0.03–0.02*	0.09–0.22*	0.41–0.46*	-0.42–0.33*	-0.65–0.59*	-0.86–0.76*	-0.39–0.29*	-2.01–1.87*	-1.72–1.59*	-1.58–1.49*	-1.5 1.4
Industry 1	2.01*	2.09*	2.21*	2.22*	2.02*	2.08*	2.19*	2.20*	2.01*	2.07*	2.17*	2.21*	2.02*	2.08*	2.19*	2.20*	2.12*	2.15*	2.22*	2.2
Industry 2	0.12	0.07	-0.49*	-0.44*	0.06	0.04	-0.54*	-0.45*	0.10	0.07	-0.51*	-0.45*	0.10	0.05	-0.51*	-0.45*	0.17	0.07	-0.54*	-0.4
Industry 3	1.27*	1.23*	1.15*	1.35*	1.28*	1.22*	1.16*	1.35*	1.28*	1.21*	1.15*	1.34*	1.28*	1.24*	1.16*	1.34*	1.24*	1.20*	1.11*	1.3
Industry 4	-0.51	-0.25	-0.10	0.04	-0.48	-0.26	-0.08	0.05	-0.51	-0.27	-0.10	0.05	-0.49	-0.21	-0.10	0.05	-0.57	-0.32	-0.09	0.0
Industry 5	-1.29*	-1.34*	-1.33*	-1.32*	-1.28*	-1.34*	-1.48*	-1.31*	-1.28*	-1.36*	-1.48*	-1.30*	-1.28*	-1.34*	-1.46*	-1.31*	-1.34*	-1.40*	-1.51*	-1.3
Industry 6	-2.27*	-2.20*	-2.17*	-1.85*	-2.27*	-2.19*	-2.15*	-1.85*	-2.29*	-2.23*	-2.18*	-1.88*	-2.31*	-2.28*	-2.24*	-1.89*	-2.23*	-2.19*	-2.14*	-1.8
Industry 7	-1.09*	-1.01*	-0.95*	-1.25*	-1.10*	-1.02*	-0.95*	-1.25*	-1.09*	-1.00*	-0.94*	-1.26*	-1.10*	-1.02*	-0.95*	-1.26*	-1.10*	-1.03*	-0.98*	-1.2
Industry 8	0.28	0.16	0.01	0.27	0.19	0.10	0.01	0.28	0.22	0.14	0.02	0.30	0.23	0.18	0.06	0.30	0.11	0.07	0.02	0.2
Industry 9	-1.14*	-1.06*	-0.97*	-1.01*	-1.13*	-1.07*	-0.98*	-1.01*	-1.14*	-1.04*	-0.98*	-1.00*	-1.14*	-1.05*	-0.98*	-1.00*	-1.09*	-1.03*	-0.96*	-1.0
Industry 10	0.64*	0.37*	0.59*	0.43*	0.65*	0.37*	0.58*	0.43*	0.64*	0.38*	0.59*	0.43*	0.64*	0.38*	0.58*	0.43*	0.64*	0.37*	0.60*	0.4
Industry 11	1.69*	1.71*	1.73*	1.56*	1.71*	1.71*	1.73*	1.55*	1.69*	1.70*	1.72*	1.55*	1.69*	1.70*	1.73*	1.56*	1.70*	1.72*	1.73*	1.5
Industry 12	0.03	0.10	0.30	0.28	0.02	0.10	0.32	0.30	0.02	0.11	0.34	0.29	0.00	0.13	0.28	0.29	-0.03	0.09	0.31	0.2
Industry 13	-0.18	-0.21	-0.23*	-0.52*	-0.19	-0.20	-0.24*	-0.51*	-0.18	-0.20	-0.22*	-0.51*	-0.19	-0.22	-0.23*	-0.52*	-0.16	-0.19	-0.22*	-0.5
Industry 14	-2.46*	-1.82*	-1.41*	-1.65*	-2.48*	-1.84*	-1.40*	-1.63*	-2.47*	-1.85*	-1.41*	-1.63*	-2.48*	-1.87*	-1.39*	-1.62*	-2.47*	-1.80*	-1.45*	-1.6
Trade Bias: Industry 1 **	10.80	24.29	39.25	26.84	12.43	24.78	36.23	17.46	11.13	13.74	16.78	22.20	6.55	7.77	8.00	9.68	1.39	3.00	3.00	3.4
Industry 2	1.63	3.22	2.64	1.88	1.75	3.22	2.36	1.23	1.65	1.86	1.21	1.55	0.96	1.02	0.54	0.68	0.20	0.38	0.21	0.2
Industry 3	5.16	10.28	13.60	11.25	5.93	10.49	12.94	7.46	5.37	5.81	6.05	9.30	3.13	3.35	2.86	4.10	0.58	1.16	1.22	1.4
Industry 4	0.87	2.43	3.90	3.03	1.02	2.39	3.67	2.03	0.90	1.32	1.80	2.56	0.53	0.79	0.81	1.13	0.09	0.25	0.31	0.3
Industry 5	0.40	0.79	1.14	0.78	0.46	0.81	0.92	0.52	0.41	0.44	0.45	0.66	0.24	0.25	0.21	0.29	0.04	0.09	0.07	0.1
Industry 6	0.15	0.33	0.49	0.46	0.17	0.35	0.45	0.30	0.15	0.19	0.22	0.37	0.09	0.10	0.10	0.16	0.02	0.04	0.05	0.0
Industry 7	0.49	1.09	1.67	0.84	0.55	1.12	1.54	0.55	0.50	0.64	0.79	0.69	0.29	0.35	0.35	0.30	0.06	0.12	0.15	0.1
Industry 8	1.92	3.53	4.35	3.82	1.99	3.42	4.01	2.56	1.86	1.99	2.08	3.29	1.09	1.16	0.95	1.45	0.19	0.38	0.40	0.4
Industry 9	0.46	1.04	1.63	1.06	0.53	1.06	1.48	0.70	0.48	0.61	0.74	0.90	0.28	0.34	0.42	0.39	0.06	0.12	0.15	0.1
Industry 10	2.75	4.35	7.77	4.48	3.16	4.48	7.17	1.09	2.83	2.64	3.56	1.32	1.65	1.43	1.60	1.65	0.32	0.53	0.52	0.5
Industry 11	7.85	16.61	24.29	13.87	9.12	17.12	22.87	9.12	8.08	9.49	10.70	11.47	4.71	5.31	5.05	5.10	0.91	1.95	1.84	1.7
Industry 12	1.49	3.32	5.81	3.86	1.68	3.42	5.47	2.61	1.52	1.93	2.72	1.18	0.87	1.11	1.19	1.43	0.16	0.38	0.54	0.4
Industry 13	1.21	2.44	3.42	1.73	1.36	2.53	3.16	1.16	1.25	1.42	1.57	1.46	0.72	0.78	0.71	0.64	0.14	0.29	0.32	0.2
Industry 14	0.12	0.49	1.05	0.56	0.14	0.49	1.00	0.38	0.13	0.27	0.49	0.48	0.07	0.15	0.22	0.21	0.01	0.06	0.09	0.0

* Significant at the 5% level, one-tail test. Due to space restrictions, we do not report standard errors in this table; ** Calculated as $e^{(Mercosul + Region + Industry)}$ *** Range of coefficients obtained for Mercosul and Region variables.

Notes: X_{ijk} is the dependent variable. All variables except dummies are expressed in natural logarithms; estimation by ordinary least squares. Number of observations = 3555 for 1990 data, 4192 for 1994 data, 4546 for 1998 data, and 4506 for 2000 data.

In the Vehicles and Transportation Materials industry (Industry 12), which is characterized by managed trade within Mercosur, trade biases have followed the same pattern as in the industries previously analyzed, i.e., trade biases have increased from 1990 to 1998 and fallen in 2000 (but more pronouncedly in the Southeast than in the South), and trade biases in the South have surpassed those in the Southeast. In a sector characterized by a more flexible production environment, where production can be shifted from one country to the other on a easier manner (and indeed some vehicle production has moved from Argentina to Brazil), one would expect the trade bias to fall more solidly. This has not happened due to the trade rules within the Mercosul agreement which set targets for export and import levels for Mercosul countries. The presence of those rules offsets some of the disadvantages given by the differences in exchange rate regimes among the partners.

The sector that suffered the most due to the change in exchange rate regime in Brazil was the Machinery and Equipments Industry (Industry 11). The trade biases in this sector fell significantly, specially in the South and the Southeast: they increased from 7.85 in 1990 to 16.61 in 1994 and to 24.3 in 1998, but fell to 13.9 in 2000 in the former, and they increased from 9.12 in 1990 to 17.12 in 1994 and to 22.87 in 1998, but fell to 9.12 in 2000 in the latter. As in the previous sector, it is characterized by flexible production, but the absence of a managed trade environment did not allow for a smooth fall in the trade bias. These results suggest that some intra-industry specialization accomplished in the period prior to 1999 may have been reverted by the change in exchange rate regime in Brazil.

4 Conclusions, implications and further research

In this paper we presented a model that shows the aggregate impacts of Mercosul in Brazil's regions and its industries, a model that controls for income and distance effects and concentrates on the economic integration, regional and industry effects on the Brazilian states' trading patterns. We showed that, for the regions as a whole, the most significant positive regional impacts of Mercosul between 1990 to 1998 were on Brazil's Southern and Southeastern regions, whereas the North, Northeast and Center-West regions benefitted much less from Mercosul in that period. But in 2000 all those regional trade biases declined, although to levels higher than those prevailing in 1994. That is, in spite of the lack of coordination of exchange rate policies within Mercosul, the trade biases were not reverted yet to levels prevailing before the creation of that customs union.[20]

20 Note, however, that the evolution of the trade biases after the change in the exchange rate regime is not solely due to changes in relative prices due to the devaluation of Brazil's currency, which affected positively the country's exports, for example. There is also a negative income effect, because regional GDPs have fallen in dollar terms also due to the devaluation of the currency. The observed trade biases in 2000 at levels higher than in 1994 are thus a net effect of the two effects described earlier.

For the industries within the regions, we showed that trade biases have increased from 1990 and 1998 for almost all regions and sectors, but in 2000 the Region South trade biases have declined to levels still above 1994 levels for the majority of sectors, specially those in which trade is managed within the Mercosul bloc. For the sectors where this condition did not prevail, such as the Machinery and Equipments Industry (Industry 11), the drop in its trade bias in 2000 was more pronounced for all regions. In the Southeast, trade biases have also increased from 1990 to 1998 and have fallen in 2000, but more pronouncedly than in the South (and have indeed been surpassed by the latter in most cases), to levels lower than in 1994. This is evidence that the Southeast, the region with the country's largest industry shares, was more affected than the South by the change in the exchange rate regime. Trade biases in the other three regions have, in general, followed the same pattern as in the South, but those biases were much smaller and have indeed followed an irregular pattern in some sectors.

We suggest several ways along which this study could be extended. First, we used cross-section data in this paper and we then tracked how trade bias evolved between 1990 and 2000. But there is evidence that, despite providing a high R^2, the standard estimation method of the gravity model using cross-section data tends to underestimate trade between high-volume traders, and overestimate it between low-volume traders, introducing thus a heterogeneity bias (Cheng and Wall, 1999). We tried to address this in a forthcoming paper (Sá Porto and Canuto, 2002) by estimating the same model as in this paper but using panel data instead.

Second, the use of the alternative methodology for the gravity model presented by Anderson and van Wincoop (2001) would probably increase the robustness of the results, as it was designed to minimize any possible omitted variable effects. Moreover, it is also important to extend this work to include interregional trade flows, as for some regions and states in Brazil, interregional flows are more important than international trade flows (Haddad, Domingues and Perobelli, 2001). In the case of vehicles, for examples, they are imported into the country through few ports located in a small number of states. These vehicle are then distributed within the country, so that if we do not count interregional flows we will be missing the impacts of these flows on the regional economies. We did not include Brazilian interregional trade flows as only recently these data became available to the public.

This work could also be extended to estimate the impacts of NAFTA and EU on Brazil's regions and industries; although the aggregate numbers in this paper have shown negative or negligible bias effects of these economic integration arrangements, in a more disaggregate view the numbers can probably show some important impacts of NAFTA and EU on some specific industries in some specific regions. Finally, it would be interesting to apply this methodology used here and in Sá Porto (2002) augmented by Anderson and van Wincoop's (2001) approach to see the impacts of Mercosul on the regional economies and industries of other Mercosul members, such as Argentina, although we do not have any estimates on whether the necessary data is available.

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