AN EXAMINATION OF THE IMPACTS OF EXCHANGE RATE VOLATILITY ON SECTORAL TRADE IN THE MERCOSUR

Donald W. Larson[2]

Mauricio V. L. Bittencourt[1]

Stanley R. Thompson[2]

Selected Paper prepared for presentation at the American Agricultural Economics Association Annual Meeting, Providence, Rhode Island, July 24-27, 2005

[1] Professor, Department of Economics, Federal University of Parana, Brazil (UFPR). mbittencourt@ufpr.br

[2] Professor. Department of Agricultural, Environmental, and Development Economics. The Ohio State University. larson.4@osu.edu and thompson.51@osu.edu

AN EXAMINATION OF THE IMPACTS OF EXCHANGE RATE VOLATILITY ON SECTORAL TRADE IN THE MERCOSUR

Abstract

This study captures the lack of macroeconomic policy coordination among Mercosur countries, through the impact of real bilateral exchange rate volatility on trade. A sectoral gravity model is estimated under two different measures of exchange rate volatility. Results show that the reduction in exchange rate volatility can increase bilateral trade.

JEL Classification: F13, F15, E61

Keywords: Bilateral Trade, Exchange Rate Volatility, Panel Econometrics, Gravity Models, Mercosur

AN EXAMINATION OF THE IMPACTS OF EXCHANGE RATE VOLATILITY ON SECTORAL TRADE IN THE MERCOSUR[3]

1. Introduction

The consequences of trade liberalization and market integration for developing countries have become vital issues with the creation of free trade areas such as the North American Free Trade Agreement (NAFTA), the European Union (EU) and Common Market of the Southern Cone (Mercosur). On the economic side, there have been many important changes in trade, macroeconomic policies, public sector and regulatory policies because of different trade agreements worldwide. However, the stability of the Mercosur bloc (Argentina, Brazil, Paraguay and Uruguay) is in doubt due to the many recent problems. These include major economic crises, the large devaluation of the Brazilian currency (Real) in January 1999, the worldwide recession in 2000, and the Argentinean and Brazilian crises, in 2002. The period 1999 to 2002, in particular, was a very difficult time for Mercosur countries, with many political and economic negative outcomes. Mercosur achieved one of the highest levels of integration in Latin America, but the latest economic slowdown has brought uncertainty regarding its future. The regional integration agreement is credited for increased trade and trade diversification among its members.

The integration that occurred in Mercosur might be seen as weak, largely due to a lack of actual and continuous coordination of macroeconomic policies among the four member countries. Since 1991, many different economic plans have been designed and implemented in these countries, aiming only their own economic stability and raising doubts about the future of Mercosur. In this study we investigate how the lack of coordinated

[3] The authors would like to thank Samuel Munyaneza and the United Nations Conference on Trade and Development (UNCTAD) for kindly supplying the data set used in this study.

macroeconomic policies across countries, within the same free trade area, can lead to the devastation of trade. For instance, the emphasis on stabilization programs rather than trade integration can lead to tax disagreements among free trade area countries, which would encourage capital to flow within and from outside the region to countries with lower taxes, but with less comparative advantage. According to Baer *et al.* (2001), major swings in the real exchange rate may strongly affect investment returns, resulting in changes in the location of new production plants and/or reallocation of production among existing ones.

It is our thesis that the different economic stabilization plans adopted at different times, and implemented by different countries in the Mercosur can account for much of the medium to long term real exchange rate (ER) volatility. The rationale behind this thesis is the fact that long swings in the real exchange rate, caused by country-specific economic stabilization plans, can increase the level of uncertainty among domestic and foreign (trade partners) economic agents. One would not be able to hedge against this uncertainty, since the price of this long term risk does not exist. De Grauwe and Bellefroid (1986), attribute much of this uncertainty to long swings in the real exchange rate.

We investigate Brazil's main trade determinants in the Mercosur, accounting for the possibility that the lack of stable macroeconomic policies might hurt Mercosur trade. We focus on the different effects of medium to long run exchange rate volatility on different sectors, including agricultural trade, since agriculture is the least protected sector in the Latin American countries. In the empirical trade literature, exchange rate volatility is responsible for negative effects in agricultural trade (Cho *et al.,* 2002; Maskus, 1986).

We specify and estimate a gravity trade model to evaluate:

(i) the impacts of medium to long run exchange rate volatility on different sectors in the Mercosur; and

(ii) the Brazilian trade flow pattern in the Mercosur, looking at the impacts that the changes in physical border, distance, tariffs and income have on trade flows.

2. Specification of the problem

The creation of the free trade agreement Mercosur (Argentina, Brazil, Paraguay, and Uruguay) was an important factor in consolidating the economic opening process that had started in Brazil. A gradual reduction of tariffs was agreed upon for Mercosur countries between 1991 and 1994 and trade within Mercosur countries increased substantially after 1991 (Table 1). Mercosur has been an important instrument for macroeconomic coordination and attempts for economic stabilization. At the same time that trade and integration within Mercosur increased, two of the largest countries of the region, Argentina and Brazil, experienced many domestic crises.

The lack of macroeconomic coordination among Mercosur countries seems to be one of the main causes of the divergent and numerous price and exchange rate fluctuations affecting international trade and investment allocation. Since 1999, both Argentina and Brazil have announced changes in nominal exchange rates[4], directly affecting returns on investments and inducing shifts in the location of new production plants and the reallocation of existing ones.

According to Baer *et al.* (2001), disharmonized macroeconomic policies affect international trade through two main channels: international transactions risk, and political economy. The first is characterized by the increased risk associated with international transactions, affecting producer decisions on trade and resulting in a different resource

[4] Argentina continued with its fixed exchange rate regime, and Brazil had changed from a pegged regime to a more free oriented one, with free rates between minimum and maximum values ("moving bands") defined by central bank.

allocation than what would be expected from comparative advantage. An increase in the ER volatility, leads risk-averse exporters and importers to reduce their supply and demand of traded goods because they face added risk regarding overseas profits. The second channel, also influenced by uncoordinated policies, would promote political lobbying to protect domestic markets when there is an increase in the import penetration ratio (Trefler, 1993).

A direct consequence of the previous paragraph is evident in Mercosur, whose members progressively eliminated most trade barriers between 1991 and 1995. They established a common external tariff (CET) structure in 1995, ranging from zero to 20 %, applied to almost 85 % of total trade. But the tariffs were not totally eliminated, and all countries were allowed to identify products sensitive to foreign competition, which could be protected until 1999 for Argentina and Brazil, and to 2001 for Paraguay and Uruguay[5]. Therefore, each country could have their own tariff rate on these sensitive products[6].

Country	Total Exports	Exports to Mercosur	Total Imports	Imports from Mercosur
Argentina	8.5 %	19.0 %	25.3 %	30.5 %
Brazil	6.0 %	22.9 %	11.8 %	15.5 %

Source: Ministerio do Desenvolvimento, Industria e do Comercio; Inter-American Development Bank.

Table 1: Average annual growth rate of trade in Argentina and Brazil for the period 1991-2000

[5] According to Averbug (1998), in Baer *et al.* (2001), there were 29 products in the Brazilian list, 212 in the Argentinean, 432 in the Paraguayan, and 963 in the Uruguayan one.

[6] Tariffs were supposed to converge to 14 % by January 2001 for capital goods, for Argentina and Brazil, and by January 2006 for Paraguay and Uruguay. For the other products, their tariff rates are supposed to converge to 16 % by 2006. However, by middle of July 2001, Argentina decreased its extra-regional import tariffs for goods and computer equipment, causing some diplomatic divergences between Argentina and Brazil. (Baer *et al.*, 2001)

Therefore, it is interesting to verify the consequences of such exchange rate instability on different sectors. There are many studies addressing the influence of exchange rate volatility on a country's economy. Many of them claim that exchange rate volatility reduces the level of trade (Hooper and Kohlhagen, 1978; Thursby and Thursby, 1987; Cushman, 1988; Frankel and Wei, 1993; Eichengreen and Irwin, 1995; Rose, 2000). But as pointed out by Sauer and Bohara (2001), factors such as risk aversion, hedging opportunities, the currency used in contracts, the presence of other types of business risk, and the direction and magnitude between exchange rate uncertainty and trade is an empirical question.

The main focus of this study is to estimate the trade flow patterns of Brazil in the Mercosur, and how trade flows respond to changes in exchange rates and other trade determinants such as tariffs, distance, GDP, and third country exchange rate volatility (third country effect). Some questions we address are: What would happen to the trade flows if exchange rates become more volatile? Would this volatility bring positive or negative effects on Brazilian trade? How would trade flows change as a result of a reduction in tariffs or of an increase of a country's GDP?

3. Literature Review

3.1. Gravity models

We use a gravity model (Tinbergen, 1962), to empirically assess the bilateral trade patterns among Mercosur countries. A gravity model not only accounts for trade flows, but also for border effects (such as transport costs, trade barriers, location, contiguity, etc), population, GDP, and exchange rates. Gravity models have been employed to evaluate a variety of issues related to bilateral trade flows. A gravity model, or gravity equation, is a reduced form equation from a general equilibrium system of international trade in final goods, which assumes that trade between two countries is dependent on their size, stage of development, market openness, and proximity. Trade is directly proportional to the size of the country and inversely correlated to the distance between the countries. Analogously, the "trade flow" between two countries is a function of income, distance, and other variables (population, contiguity, language, transport costs, tariffs, etc).

Deardorff (1998) shows that a gravity model can be consistent with the Heckscher-Onlin-Samuelson (HOS) model with non-homothetic preferences without any role for monopolistic competition, as in Bergstrand (1989). When Deardorff includes transport costs, the distance between two countries reduces trade; trade is sensitive to the relative distance between importer and exporter countries relative to the average of all importers distances from the exporter country.

Therefore, the success of gravity models cannot be considered as evidence of any trade theories with imperfect competition and scale economies as suggested by Helpman (1987). Deardorff (1998) and Evenett and Keller (2002)[7] conclude that since specialization is the "force of gravity" that is responsible for the empirical success of gravity models, it is not necessary to identify a trade model to derive a gravity equation. When each good is produced in each country (complete specialization) and preferences are identical and homothetic, the elasticity of trade with respect to each country's income is equal to one. This is true regardless of the theoretical basis to explain specialization, be it increasing returns to scale in

[7] This study examines the HOS theory and the increasing returns of scale theory to explain the empirical success of the gravity equation. Since both theories can predict the gravity equation, they estimated pure and mixed versions of both theories for a cross-section data for 58 countries. Their findings suggest that predictions of a model with imperfect specialization that is based only on differences on factor endowments find support in the data.

differentiated products, technology differences in Ricardian trade, large factor endowments in HOS trade, or transport costs on any type of trade based on endowments.

According to Cho *et al.* (2002), very few studies account for impacts of exchange rate variability on agricultural trade. Some of the first attempts to investigate such effects are Schuh (1974), Batten and Belongia (1986), Haley and Kissoff (1987), and Bessler and Babula (1987). Some studies deal with the impacts of short-run[8] exchange rate volatility on agricultural trade. Pick (1990) finds no effect of exchange rate risk on U.S. trade flows to developed countries, but he finds a negative effect on trade flows to developing countries. Klein (1990) finds negative impacts of short-run exchange rate volatility on U.S. agricultural trade. Cho *et al.* (2002) estimate a gravity model for many developed countries to evaluate the effect of exchange rate volatility on agricultural trade. Their results show that real exchange rate uncertainty has had a negative impact on agricultural trade for the period from 1974 to 1995.

The competitiveness of a country is reduced from an overvaluation of its currency and vice-versa. Tweeten (1989) finds that the appreciation of the U.S. dollar during the 1980s had negative effects on U.S. agricultural exports. Cho (2001) argues that, due to the loss of competitiveness, some sectors can lose domestic and foreign markets resulting in reduction of employment and output. This outcome can result in lobbying for protection by those groups that lost with the exchange rate overvaluation. If a protectionist measure is adopted by the government due to lobbying, it is not easily removed when exchange rate depreciation occurs. Countries which experience wide fluctuations in exchange rates over a long time period are likely to see a reduction in trade growth (De Grauwe, 1988). Pick and Vollrath

[8] Peree and Steinherr (1989) consider as short-run exchange rate volatility if one takes the exchange rate uncertainty for a period less than one year.

(1994) find that movements of exchange rates in developing countries have negatively affected the competitiveness of the agricultural sector.

3.2. Effects of exchange rate volatility on different sectors

The absence of a well managed and stable exchange rate system can be an important source of misalignment[9], mainly for those countries that have pegged their currencies to the US dollar. Argentina and Brazil experienced pegged exchange rate regimes during the 1990's, which brought substantial and persistent deviation of nominal exchange rates from their macroeconomic fundamentals. The size of exchange rate misalignments, in the long run is an important factor affecting international trade. The hysteresis model offers an explanation of this relationship (Baldwin, 1988; Baldwin and Krugman, 1989). The hysteresis effect of exchange rate movements predicts that an unexpected bilateral exchange rate misalignment can cause a permanent change in market structure (Baldwin, 1988; Baldwin and Krugman, 1989). The hysteresis model and empirical evidence show that exchange rate changes bring different impacts on different sectors, due to specific characteristics of each industry. These characteristics could be given by different levels of initial investment (Baldwin, 1988), the level of substitutability of goods (Dornbusch, 1987), or whether or not the products are durable (Froot and Klemperer, 1989).

Due to so many theoretical and empirical ambiguities about the relationship between long run exchange rate volatility and trade, it is not surprising that the empirical literature about this topic is so limited. However, the Baldwin and Krugman's hysteresis model may help to interpret the results obtained for the different sectors. According to this model, sectors

[9] This term means the departure of nominal exchange rates from long run equilibrium level or economic fundamentals. More detailed economic consequences of these misalignment problems can be found in Tweeten (1989). The long run exchange rate volatility can be considered as a proxy of the size of misalignment (De Grauwe and Bellefroid, 1986).

with large amounts of initial investment would be less susceptible to the shock-inducing structural change discussed before, suffering less from the exchange rate volatility. Those sectors that need little initial investment would tend to be more sensitive to the exchange rate volatility. Whether these impacts are positive, neutral, or negative, is an empirical question.

4. Data and Issues

The data used consist of bilateral trade, and average tariffs among Brazil, Argentina, Paraguay and Uruguay for the period 1989 to 2002, from the TRAINS (Trade Analysis and Information System)/WITS (World Integrated Trade Solution) package (UNCTAD)[10]. This is a panel dataset consisting of the nominal value of exports from one country to the other, for each sector (agriculture, chemicals, livestock, mining and oil, manufactured, and all sectors together), at a 2-digit SITC[11] code. The aggregated sample consists of 2,688 observations (3 countries times 64 different products times 14 years).

Since the focus of the study is to evaluate the effects of exchange rate variability on Brazilian agricultural trade within Mercosur, the data are converted into the exporting country's currency using nominal exchange rates[12] and deflated by the consumer price index (CPI) of the exporting country, from the International Financial Statistics (IFS). The nominal and real GDP (deflated by the CPI) as well as population are from the IFS. Distance is

[10] United Nations Conference on Trade and Development.

[11] SITC stands for Standard International Trade Classification.

[12] We used end-of-period exchange rate data from the International Monetary Fund (IMF) publication International Financial Statistics (IFS).

defined as the great circle distance between economic centers[13], given by Soloaga and Winters (2001). The real exchange rates[14] are calculated as:

$$(1) \qquad RER_{is,t} = NER_{is,t}\left(\frac{CPI_{s,t}}{CPI_{i,t}}\right)$$

Where $RER_{is,t}$ and $NER_{is,t}$ are the real and nominal exchange rates for country i with respect to the country's *s* currency at time t. Expression (1) shows how the real exchange rate is calculated for country i using 1995 U.S. dollars as common foreign currency from country *s* (the United States). The $CPI_{s,t}$ reflects the consumer price index in the United States at time t. The $CPI_{i,t}$ reflects the consumer price index in country i at time t. Therefore, the bilateral real exchange rate ($X_{ij,t}$) for each country can be obtained by the ratios between each of the four countries' real exchange rates and the Brazilian real exchange rate (j).

The medium to long run exchange rate uncertainty[15] is essential for our study. It can be obtained using two different procedures as *proxies* for the long run exchange rate uncertainty, the moving standard deviation (MSD) and the Perre and Steinherr (P&S) volatility measures[16].

---

[13] The great circle method is given by the weighted average of the latitudes and longitudes of the main economic centers.

[14] The main reason to use real exchange rate in this study is because the nominal and real exchange rates are expected to be highly correlated, but the real ER volatility is expected to be larger than the nominal ER movements. De Grauwe and Bellefroid (1986) explain that when a currency depreciates by some proportion, it is likely that the real exchange rate will change by a smaller amount than the initial depreciation, due to the inflation changes will in general offset the nominal initial depreciation. These differences between real and nominal exchange rates can become important when medium to long run variability are investigated, which is what we have in our study.

[15] For detailed discussion about measures of exchange rate volatility, see Lanyi and Suss (1982), Brodsky (1984), and Kenen and Rodrik (1986).

[16] Because the volatility measures are used as proxy measures for the actual long run exchange rate uncertainty, volatility and uncertainty are used interchangeably throughout this study.

The MSD of the log differences of the real bilateral ER is a modification of the standard deviation usually employed in many studies using cross-section or time-series data, such as Kenen and Rodrik (1986), De Grauwe and Bellefroid (1986) and Dell'Ariccia (1999). The MSD is used here because it has to be time varying due to the time-series feature of the panel data we have, as in Cho *et al.* (2002).

The MSD of the log differences of the bilateral real ER (S_{ijt}) is given by:

$$(2) \qquad S_{ij,t} = u_{ij,t} = \sqrt{\frac{\sum_{l=1}^{k}(x_{ij,t-l} - \bar{x}_{ij,t})^2}{k-1}}$$

Where $X_{ij,t}$ is the bilateral real exchange rate, $x_{ij,t} = \ln(X_{ij,t}) - \ln(X_{ij,t-1})$, and k = 2, 4, 6, 8, and 9 years[17]. $\bar{x}_{ij,t}$ is the mean of $x_{ij,t}$ over the past k years.

The second measure of real ER volatility is based on Peree and Steinherr (1989), which assumes that the uncertainty of the economic agents is defined by previous experiences about the maximum and minimum values, which are adjusted through the experience of the last year relative to an "equilibrium" exchange rate. Therefore, large changes in the past generate expected volatility. They proposed the following measure of exchange rate uncertainty:

$$(3) \qquad V_{ij.t} = u_{ij,t} = \frac{\max X_{ij,t-k}^{t} - \min X_{ij,t-k}^{t}}{\min X_{ij,t-k}^{t}} + \left[1 + \frac{\left|X_{ij,t} - X_{ij,t}^{k}\right|}{X_{ij,t}^{k}}\right]$$

Where k is the period length; $\min X^{t}_{ij,t}$ is the minimum value of the absolute value of the bilateral real exchange rate in the last k periods; $\max X^{t}_{ij,t}$ is the maximum value of the absolute value of the bilateral real exchange rate in the last k periods; $X^{k}_{ij,t}$ is the mean of the absolute value of the bilateral real exchange rate over the last k periods. It is a proxy for the

[17] The time period covered is arbitrarily chosen to investigate the robustness of the results.

long run bilateral real exchange rate equilibrium[18]. Each period in our analysis is equivalent to each year. The reason is that our emphasis is on effects of medium to long run exchange rate uncertainty.

Figures 1 and 2 show the two measures of bilateral real exchange rate volatility. According to the MSD measure, the bilateral real ER volatility between the Argentinean peso and the Brazilian real has relatively high levels of volatility. However, after 1997 volatility was strongly reduced due to depreciation of the Brazilian currency. We can note that the Paraguayan guarany/Brazilian real volatility is the most stable in Mercosur. The stability of the ER volatility for the period 1992 to 1997 can be due to the Brazilian exchange rate policy adopted to be an anchor to control domestic inflation (Figure 1).

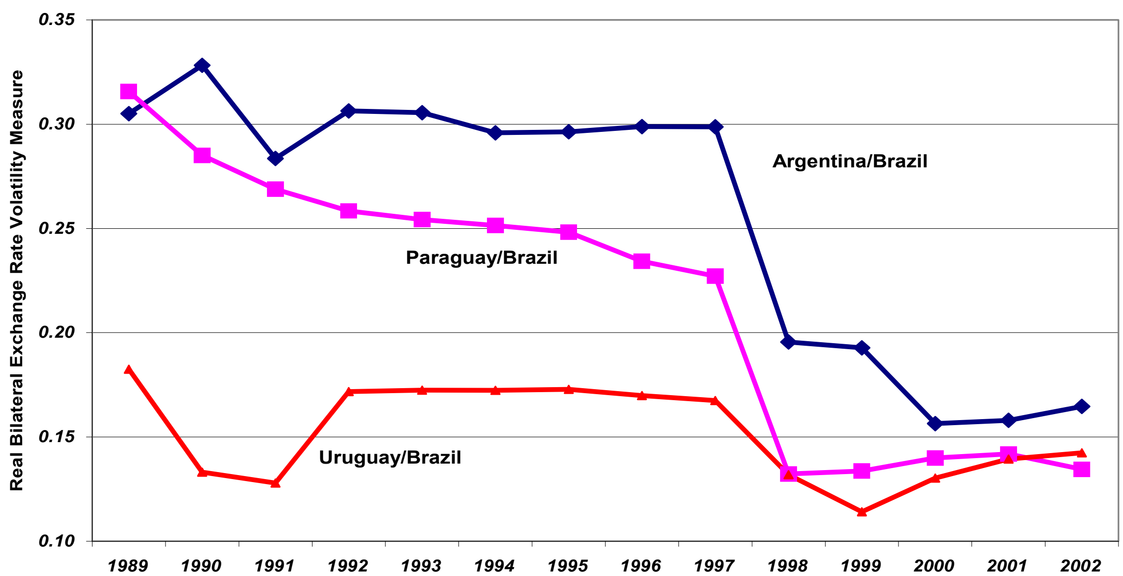

Figure 1: Bilateral real exchange rate volatility (moving standard deviation measure) in Mercosur, 1989 – 2002.

[18] According to Mark (1995), there is no way to accurately measure the long run equilibrium exchange rate. For this reason we adopted a simple mean for the whole sample period to obtain a proxy of such equilibrium measure.

The P&S measure of ER volatility (Figure 2) is characterized by a decreasing behavior from 1990 to 1999, probably because of the "accumulated experience" feature of this measure of volatility, which takes into account lagged exchange rates[19]. After the large devaluation of the Brazilian Real in 1999, the ER volatility increased mainly for the Argentinean peso/Brazilian real bilateral volatility, which became the most volatile among Mercosur countries after the Real Plan was implemented in the middle of 1994. In general, the P&S measure has more volatility than the moving standard deviation measure.

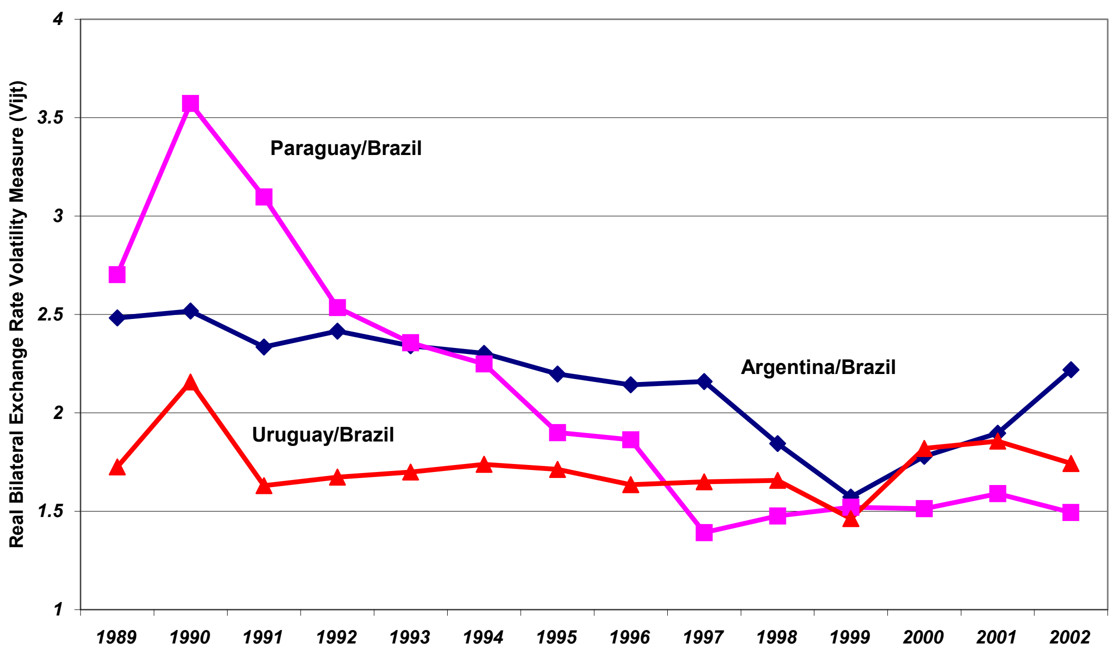

Figure 2: Bilateral real exchange rate volatility (Peree and Steinherr measure) in Mercosur, 1989 – 2002.

[19] The inflation rates were very high in the beginning of the 1990's in all these countries, which also affected the behavior of the exchange rates in this period. The relationship between inflation rates and exchange rates will be clarified later in this section through the monetary model of the exchange rates.

There are two other issues potentially important. The first is the potential presence of simultaneity bias, due to the endogeneity of exchange rate when central banks could intervene to stabilize the bilateral exchange rate with their trade partners. Exchange rate volatility and trade would remain negatively correlated, but the direction of causality would be ambiguous. We use an instrumental variable procedure to test the simultaneity bias through a Hausman test (Dell'Ariccia 1999). But the question becomes, what instrumental variable could be used for the bilateral real ER volatility? We adopt the instrument for exchange rate volatility provided by Bittencourt (2004).

$$(4) \qquad s_t = \frac{1}{1+\lambda} f_t + \frac{\lambda}{1+\lambda} E_t s_{t+1} = \frac{1}{1+\lambda} \sum_{j=0}^{k} \left(\frac{\lambda}{1+\lambda} \right)^j E_t f_{t+j} + \left(\frac{\lambda}{1+\lambda} \right)^{k+1} E_t s_{t+k+1}$$

Where *f* represents economic fundamentals, and *s* is the exchange rate.

The variability of the fundamentals is obtained through the moving standard deviation of the fundamentals, using time windows of 4 and 8 years. The variables used to construct the fundamentals were the real money supply[20] and real GDP for each country from the IMF statistics.

The second issue is the effect of the bilateral real exchange rate volatility of a third country on the bilateral trade under analysis. The "third country effect" was investigated by Wei (1996), Dell'Ariccia (1999), and Cho *et al.* (2002), using a measure that takes into account the exchange rate volatility for all other countries excluding trade between the two countries under analysis. However, our approach is slightly different from previous studies, which use total trade shares of other countries as weights to get the measure of the third country volatility effect. Our proposed measure differentiates by sector, accounting for

[20] The real money supply was obtained through the sum of the "currency money (currency outside banks)" plus the "demand deposits" deflated for the country's currency, and then converted to 1995 U.S. dollars.

sector specific trade shares as weights. Further, previous studies considered the trade shares based on a specific year with the justification that theses shares were relatively constant over time. Despite the large time and data requirements, we consider sector specific trade shares for each year, because some changes might have occurred from one year to another in the sample, characterizing different responses from trade flows to exchange rates movements.

The third country real exchange rate volatility measure ($u3_{ij,t}$) is given by:

$$u3_{ij,t}^{g} = \sum_{i \neq j} u_{ij,t} w_{ij,t}{}^{g} + \sum_{j \neq i} u_{ji,t} w_{ji,t}{}^{g} \tag{5}$$

where $u_{ij,t}$ ($u_{ji,t}$) is the measure of bilateral real ER volatility, either the moving standard deviation measure ($S_{ij,t}$) or the Peree and Steinherr measure ($V_{ij,t}$), defined by equations (2) and (3); g = 1, … , 5, where 1 is for the livestock sector, 2 is for agriculture, 3 is for chemicals, 4 is for manufacture, and 5 is for mining and oil; and the $w_{ij,t}{}^{g}$ and $w_{ji,t}{}^{g}$ are the sector specific trade shares of other countries. It is expected that the sign of the coefficient for the third effect variable will be positive as found by Wei (1996). However, Dell'Ariccia (1999) found it to be negative and not significant, and Cho *et al.* (2002) found that the coefficient was positive and negative for different sectors.

5. The econometric specification

We use the following econometric specification of the gravity equation:

(6)

$$\ln T_{ij,t}^{g} = \alpha_{i}^{g} + \gamma_{1}^{g} \ln(Y_{it} Y_{jt}) + \gamma_{2}^{g} (Pop_{it} Pop_{jt}) + \gamma_{3}^{g} (u_{ij,t}) + \gamma_{4}^{g} \ln(D_{ij}) + \gamma_{5}^{g} \ln(1 + Tariff^{g}{}_{ij,t}) + \gamma_{6}^{g} (u3_{ij,t}) + \varepsilon_{ij,t}^{g}$$

where $T_{ij,t}{}^{g}$ is the gross bilateral trade between countries *i* and *j* in each sector *g*, $Y_{it}Y_{jt}$ is the product of the two country's GDP in period *t;* its coefficient is expected to be positive.

$Pop_{it}Pop_{jt}$ is the product of two country's population in period *t*, which can be thought to reduce trade between countries as population of both countries *i* and *j* increases. Since the demand for domestic production increases, reducing the amount of goods to be traded; its coefficient is expected to be negative. The variable $u_{ij,t}$ is the measure of bilateral real ER volatility, either the MSD measure ($S_{ij,t}$) or the P&S measure ($V_{ij,t}$), defined by equations (2) and (3); it is expected to have a negative coefficient. D_{ij} is the distance between countries *i* and *j*, which represents a proxy for transportation costs and it should reduce bilateral trade[21]. Tariff is the simple mean of tariffs within the product category between countries *i* and *j*; it is expected to have a negative coefficient, implying larger trade when there are lower tariffs. The variable $u3_{ij,t}$ is the third country real ER volatility (third country effect) for all countries other than countries *i* and *j*; its expected sign is ambiguous, Wei (1996) and Cho *et al.* (2002).

The gravity equation (6) will be estimated under two different specifications according to the measure of the exchange rate volatility ($u_{ij,t}$) to be used: the MSD measure ($S_{ij,t}$) and/or the P&S measure ($V_{ij,t}$).

According to Egger (2002), the choice of the econometric set-up is of great relevance for the calculation of bilateral trade flows. Therefore, the estimation procedure in this study will be a panel data econometrics. The advantages of the panel data approach include estimates that are more reliable, reduce the multicollinearity problem, increase the degrees of

[21] Linnemann (1966) pointed out that the effect of distance on trade comes from three sources: 1) transport costs; 2) time (perishability, adaptation to market conditions, irregularities in supply, interest costs); and 3) "psychic" distance, which includes familiarities with laws, institutions, and culture. Linnemann's idea about the comprehensive meaning of the variable distance is also pointed out by Frankel *et al.* (1998), who noted that physical shipping costs may not be the most important component of costs associated with distance. Transport costs should be seen as transaction costs, which include not only the cost of physical transportation of goods, but also costs of communications and the fact that countries tend to have a better understanding of their close neighbors and institutions.

freedom, and allow for the inclusion of real exchange rate volatility in the model, not possible in a cross-section approach[22].

6. Results and discussion

We seek to capture the effects of medium to long run bilateral real exchange rate volatility on Brazilian sectoral trade, and to determine the impacts of other important factors that contribute to Brazil's total trade. The absence of macroeconomic policy coordination among Mercosur partners is proxied through the estimated exchange rate volatility coefficients. The results under many different times for such variables and using instrumental variables specifications are not reported due to space constraints.

We report econometric results for each of the five sectors plus all sectors together. We find that Brazil's trade is negatively affected not only by its own exchange rate movements, but also by those of its Mercosur partners. The population variable was not included in the final estimations due to high correlation with income.

Our results differ depending upon the specification of the ER measure (Table 2). According to the Hausman test, the instrumental variable estimators are not superior to those from the fixed (random) effects model, and the results were favorable to the latter.

GDP has an important role in agricultural trade, with a large coefficient (4.63) in the MSD specification (Table 2). An increase of 1 % in each country's GDP (Brazil and its partner) improves trade 4.63 %. Tariffs and the bilateral real ER volatility were significant but larger in size for the MSD specification. These coefficients affect negatively the bilateral agricultural trade demonstrating that a lack of stable macroeconomic policies can reduce

[22] Cho (2001) included real exchange rate variable and volatility in his cross-sectional and panel data approaches. However, the inclusion of the real exchange rate in the cross-section estimation makes no sense since it would not provide any information as to whether the currency is undervalued or overvalued.

bilateral trade in the Mercosur. In the third country effect, only the MSD specification was statistically significant, with a large positive coefficient. Although the expected sign for this coefficient can be ambiguous (Wei, 1996; Cho et al., 2002), it seems to indicate that third country exchange rate volatility increases trade between Brazil and another Mercosur partner in the agricultural sector. Not surprisingly, the random effects results for the P&S specification show an estimated coefficient for distance as negative and statistically significant at the 10 % level[23].

Variable	Exchange rate volatility measure	
	MSD specification (FE)	P&S specification (RE)
GDP	4.63*	1.84**
	(6.29)	(2.51)
Distance	-	-4.83***
		(-1.82)
Average tariffs	-7.43*	-4.97*
	(-6.49)	(-4.12)
Real ER volatility	-3.22**	-0.59**
	(-2.41)	(-2.24)
Third country real	12.74*	-0.13
ER volatility	(5.76)	(-0.33)
t = 14; n = 676; i (product groups) = 17		

Note: All values in parentheses are t- and z-values, (*) statistically significant at the 1 percent level; (**) statistically significant at the 5 percent level; (***) statistically significant at the 10 percent level. FE is the fixed effects model and RE the random effects model.

Table 2: Fixed and random effects estimations for trade in the agricultural sector between Brazil and Mercosur partners, 1989 – 2002 by exchange rate volatility measure.

[23] The use of different periods for the ER volatility variables in the MSD specification was consistent with the results from Table 2. The main changes were with respect to the magnitude of the GDP coefficient and with the statistical significance for the bilateral real ER volatility. Under specific periods, the GDP coefficient was a lot smaller, but significant, and the bilateral real ER volatility was not significant. The P&S specification was robust with different time windows used to account for the ER volatility, but some of the periods showed a significant negative third country effect, as opposite to the results from the MSD specification.

The livestock sector results (Table 3) show that the main factors contributing to trade are tariffs and a country's GDP, the only statistically significant coefficients. The ER volatility measures (MSD and P&S) produced non-significant coefficients. The bilateral real ER volatility proved not to be important for trade in this sector, and this result was robust for many different specifications under different time windows.

Variable	Exchange rate volatility measure	
	MSD specification (FE)	P&S specification (FE)
GDP	1.02*	1.09*
	(2.73)	(2.95)
Average tariffs	-5.73**	-6.22*
	(-1.97)	(-2.11)
Real ER volatility	0.30	0.10
	(0.08)	(0.24)
Third country real	0.49	0.29
ER volatility	(0.14)	(0.46)
t = 14; n = 164; i (product groups) = 4		

Note: All values in parentheses are t-values, (*) statistically significant at the 1 percent level; (**) statistically significant at the 5 percent level; (***) statistically significant at the 10 percent level.
FE is the fixed effects model.

Table 3: Fixed effects estimations for trade in the livestock sector between Brazil and Mercosur partners, 1989 – 2002 by exchange rate volatility measure.

Brazilian trade in the livestock sector seems to be very sensitive to changes in tariffs and country's income[24]. Results show that a reduction of 1% in tariffs would improve trade in this sector by approximately 6%. The livestock sector results indicate that a reduction of ER volatility through better coordination of macroeconomic policies does not contribute to improved trade among Mercosur countries.

[24] The results for the livestock sector were also robust when compared to the estimation using instrumental variables (not reported), such as the economic fundamentals, and its moving standard deviation with periods of 4, and 8 years.

The results from the chemicals and agricultural sectors were different in terms of magnitude and statistical significance of their estimations (Tables 2 and 4). GDP and bilateral real ER volatility were statistically significant in the chemicals and agricultural sector specifications. In absolute values, all coefficients were larger in the MSD specification than in the P&S one. The P&S results show that distance is not important for trade in this sector, and that the third country effect is an important trade obstacle in Mercosur[25]. According to the MSD specification, a reduction of 10% in the bilateral ER volatility would increase trade to 10.1%[26]. Under the P&S specification, the same reduction in the bilateral ER volatility would improve trade to 21% (Table 4).

The largest individual sector analyzed was the manufactured sector (23 different categories of products) with 905 observations. The fixed effects model was estimated for the MSD and P&S specifications, since the random effects model was rejected through the Hausman test[27].

Although GDP positively affects bilateral trade in manufacturing, tariffs, bilateral ER volatility, and third country effects reduce bilateral trade (Table 5). The results from the MSD specification were larger than from the P&S specification, with the third country effect being the only exception. The estimates indicate that a 1% reduction of the bilateral ER volatility would increase trade around 1.6% and 1.1%, respectively, under the MSD and the P&S

[25] The results for both specifications were consistent under different time periods. However, when using a 6-year time period the negative coefficients for tariffs and third country effects became significant. The Hausman test did not reject the fixed (random) effects coefficients as unbiased and consistent in comparison to the use of instrumental variables.

[26] The average bilateral ER volatility used to obtain this interpretation was 0.189 and 1.99, for the MSD and P&S specifications, respectively.

[27] The results (Table 5) were robust through different combinations of time periods for both specifications of ER volatility used in the estimations. The use of instrumental variables for the ER volatility measures did not improve the main results found here.

specifications[28]. The estimated coefficients for bilateral and third country real ER volatility seem to stress the idea that the lack of macroeconomic policy coordination brings adverse effects on manufactured trade among the Mercosur partners.

Variable	Exchange rate volatility measure	
	MSD specification (FE)	P&S specification (RE)
GDP	1.05*	0.80*
	(4.76)	(3.92)
Distance	-	-0.67
		(-0.92)
Average tariffs	-2.61***	0.93
	(-1.90)	(0.76)
Real ER volatility	-5.81*	-1.09*
	(-4.24)	(-4.54)
Third country real	-2.47	-1.32*
ER volatility	(-1.13)	(-3.33)
t = 14; n = 361; i (product groups) = 9		

Note: All values in parentheses are t- and z-values, (*) statistically significant at the 1 percent level; (**) statistically significant at the 5 percent level; (***) statistically significant at the 10 percent level. FE is the fixed effects model and RE is the random effects model.

Table 4: Random and fixed effects estimations for trade in the chemicals sector between Brazil and Mercosur partners, 1989 – 2002 by exchange rate volatility measure.

The mining and oil sector results do not respond to changes in tariffs (Table 6). The tariff coefficient was not significant for either specification. GDP was once more very important to explain bilateral trade in this sector. According to both specifications, a 10 % increase in a countries' income would improve trade between 11 and 16.5 %. Bilateral and third country real ER volatility coefficients were negatively correlated with bilateral trade. These coefficients were larger in the MSD specification than in the P&S one, as they were in the results from other sectors[29].

[28] To interpret the impact of the bilateral real ER volatility on total trade as elasticity, it is necessary to use the average of the MSD and P&S bilateral ER volatility measures, whose values are, respectively, 0.207 and 1.97.

[29] Although not reported, the results for the mining and oil sector were robust under different time periods and, once again, the use of instrumental variables was rejected through the Hausman test.

Variable	Exchange rate volatility measure	
	MSD specification (FE)	P&S specification (FE)
GDP	1.94*	1.48*
	(13.64)	(11.37)
Average tariffs	-4.94*	-4.04*
	(-5.71)	(-4.56)
Real ER volatility	-7.74*	-0.56*
	(-5.36)	(-3.34)
Third country real ER volatility	-0.40 (-0.28)	-1.44* (-5.94)
t = 14; n = 905; i (product groups) = 23		

Note: All values in parentheses are t-values, (*) statistically significant at the 1 percent level; (**) statistically significant at the 5 percent level; (***) statistically significant at the 10 percent level.
FE is the fixed effects model.

Table 5: Fixed effects estimations for trade in the manufactured sector between Brazil and Mercosur partners, 1989 – 2002 by exchange rate volatility measure.

The last set of econometric estimations, which considered all sectors together, was called "total trade" (Table 7). The results show that all estimated coefficients were significant at the 1% level, and they have the expected signs, in both specifications[30]. The main difference between specifications was the larger magnitude of the estimated coefficients in the MSD specification. Uncoordinated macroeconomic policies among Mercosur countries seem to be an obstacle for the total trade among these countries. A 10% reduction in the third country real ER volatility increases trade by 4.4% and 20%, respectively, for the P&S and the MSD specifications[31].

[30] The results were robust under different time periods for the two ER volatility measures (not reported). The Hausman test was not significant to reject the fixed effects model, and the instrumental variables estimation was not superior to the fixed effect model.

[31] The mean values for the third country ER volatility used to obtain this interpretation were 0.185 and 2.02, respectively for the MSD and P&S specifications.

Variable	Exchange rate volatility measure	
	MSD specification (FE)	P&S specification (RE)
GDP	1.65*	1.11*
	(7.13)	(4.74)
Distance	-	-1.86**
		(-0.91)
Average tariffs	1.88	3.02
	(0.78)	(1.24)
Real ER volatility	-7.79*	-0.89*
	(-3.00)	(-2.65)
Third country real ER volatility	-2.76 (-1.13)	-1.36* (-3.69)
t = 14; n = 334; i (product groups) = 10		

Note: All values in parentheses are t- and z-values, (*) statistically significant at the 1 percent level; (**) statistically significant at the 5 percent level; (***) statistically significant at the 10 percent level. FE is the fixed effects model and RE is the random effects model.

Table 6: Random and fixed effects estimations for trade in the mining and oil sector between Brazil and Mercosur partners, 1989 – 2002 by exchange rate volatility measure.

Variable	Exchange rate volatility measure	
	MSD specification (FE)	P&S specification (FE)
GDP	1.24*	1.15*
	(11.29)	(13.25)
Average tariffs	-4.55*	-3.02*
	(-7.43)	(-5.01)
Real ER volatility	-5.88*	-0.65*
	(-7.08)	(-5.94)
Third country real ER volatility	-2.40* (-5.69)	-0.99* (-6.62)
t = 14; n = 2440; i (product groups) = 63		

Note: All values in parentheses are t- and z-values, (*) statistically significant at the 1 percent level; (**) statistically significant at the 5 percent level; (***) statistically significant at the 10 percent level. FE is the fixed effects model.

Table 7: Fixed effects estimations for total trade between Brazil and Mercosur partners, 1989 – 2002 by exchange rate volatility measure.

Table 8 summarizes the results obtained using the MSD and P&S specifications for the ER volatility. The results for the bilateral real exchange rate were very different in terms of magnitude for all sectors in the MSD specification, except for the manufactured and mining and oil sectors, which presented a very large coefficient for the bilateral ER volatility. In the livestock sector, the bilateral ER volatility was not important in determining the trade pattern among the Mercosur partners. The bilateral ER volatility was not only very important for the chemicals sector, but also presented the largest coefficient in the P&S specification.

The results for Mercosur show that the use of the two different real exchange rate volatility measures can produce similar results in terms of signs and interpretation for the econometric estimations of the gravity equations. The results were ambiguous only when considering the third country effect.

Sectors	Exchange rate volatility measure			
	MSD specification		P&S specification	
	ER volatility ($S_{ij,t}$)	Third country ER volatility ($S3_{ij,t}$)	ER volatility ($V_{ij,t}$)	Third country ER volatility ($V3_{ij,t}$)
Agriculture	-3.22**	12.74*	-0.59**	-
Livestock	-	-	-	-
Chemicals	-5.81*	-	-1.09*	-1.32*
Manufactured	-7.74*	-	-0.56*	-1.44*
Mining and oil	-7.79*	-	-0.89*	-1.36*
Total (all sectors)	-5.88*	-2.40*	-0.65*	-0.99*

(*) statistically significant at the 1% level; (**) statistically significant at the 5% level.

Table 8: Summary of the statistically significant coefficients for the sectoral trade between Brazil and Mercosur partners, 1989 – 2002 by exchange rate volatility measure.

The use of the MSD measure of ER volatility produced not only very different estimates for the bilateral ER volatility and third country effect coefficients in comparison to the estimates from the P&S measure within sectors, but also contrasting results across sectors. The differences in magnitude between estimated coefficients in both specifications were expected since the measures of ER volatility used are very different.

7. Conclusions and implications

Brazil has been negotiating with Mercosur partners the fate of the agreements to implement the common external tariffs by 2006, and to improve their trade flows with stable and lasting multilateral actions in favor of a more integrated free trade area. The economic crisis in recent years brought new obstacles to their trade policies within Mercosur. The uncoordinated domestic macroeconomic policies, adopted mainly by Argentina and Brazil, have been a threat to the future of this economic bloc.

The main results of this study indicate that Brazil's trade is negatively affected not only by its own exchange rate movements, but also by its Mercosur partner's exchange rate volatility. The impacts of exchange rate volatility varied across sectors, but there was little evidence of the reasons for such responses being due to the Baldwin and Krugman's hysteresis model that sectors with large sunk costs were relatively in sensitive to bilateral ER volatility. The mining and oil and manufactured sectors were the ones that presented the highest coefficient for the bilateral real exchange rate volatility, which following the hysteresis model would predict that these sectors should have a small sunk cost, which is not true for these sectors.

The third country real exchange rate volatility (third country effect), had a very different set of results for both specifications across sectors. Considering the MSD as a measure of real exchange rate volatility, the third country effect was statistically different from zero only for agriculture, and for all sectors combined. In agriculture, this variable was not only large, but also surprisingly positive, which shows that the uncertainty in the other Mercosur members contributes to more Brazil trade within Mercosur. The third country effect under the P&S measure of exchange rate volatility was more stable across sectors, but in the agriculture and livestock sectors this variable was not significant. In the other sectors, this coefficient was negative and varied only from -0.99 to -1.44.

The Mercosur analysis indicates that a lack of macroeconomic policy coordination between Brazil and its trade partners, together with the role of tariffs and a country's GDP, were the main empirical findings of this study. As expected, GDP growth and lower tariffs increase trade. The fact that Argentina and Brazil, the two main partners of the Mercosur, have pursued different and divergent macroeconomic policies for many years was analyzed in this study through the impact of bilateral and third country real exchange rate volatilities. The results suggest that these disharmonized policies cause substantial price and exchange rate volatility, which bring negative impacts on bilateral trade due to the risk averse behavior of economic agents, and due to the overall protectionism caused by them. The policy implications from our results suggest that, with a common and stable implementation of policies to promote macro-coordination, it is possible to reduce the secondary impact of the exchange rate volatility in the Mercosur trade. In addition, a more stable and smooth exchange rate regime reduces political lobbying to increase barriers when the import penetration ratio increases.

Several distinguishing features of our approach are important contributions of this study: (i) the level of disaggregation and the sample size are larger than those used in other studies (we use 2-digit SITC[32], rather than 1-digit SITC trade data as in most other studies); (ii) the evaluation of impacts of medium to long run exchange rate volatility, instead of short-run volatility; (iii) the sectoral effects of exchange rate volatility, including agricultural trade in Brazil and in other Mercosur countries (literature shows that the emphasis has been on U.S. agricultural trade flows); (iv) the use of fixed (random) effects to capture the trade

[32] SITC stands for Standard Industrial Trade Classification.

flows patterns in the Mercosur. However, further research should look at more disaggregated data, and other proxies as measures of the exchange rate volatility, since some of the sectoral responses found in our empirical analysis were ambiguous in terms of sign and magnitude. The search for a better instrumental variable for the exchange rate volatility measure to test the presence of the simultaneity bias should also be included in future studies.

8. References

Averbug, A. Mercosul: conjuntura e perspectives. *Revista do BNDES,* Dezembro, 1998.

Baer, W., Silva, P. and T. Cavalcanti. Economic Integration without Policy Coordination: the case of Mercosur. Manuscript. University of Illinois, Champaign-Urbana. 2001.

Baldwin, R.E. Hysteresis in import prices: the beachhead effect. *The American Economic Review 78,* 1988, 773-785.

Baldwin, R.E. and P. Krugman. Persistent trade effects of large exchange rate shocks. *Quarterly Journal of Economics 104,* 1989, 635-655.

Batten, D.S. and M.T. Belongia. Monetary policy, real exchange rates and U.S. agricultural exports. *American Journal of Agricultural Economics 68,*1986, 422-27.

Bergstrand, J.H. The generalized gravity equation, monopolistic competition, and the factor-proportions theory in international trade. *Review of Economics and Statistics 71(1),*1989, 143-53.

Bessler, D.A. and R.A. Babula. Forecasting wheat exports: Do exchange rates matter?. *Journal of Business, Economics and Statistics 5,*1987, 397-406.

Brodsky, D. Fixed versus flexible exchange rates, and the measurement of exchange rate instability. *Journal of International Economics 16*, 1984, 295–306.

Bittencourt, M.V.L. *The impacts of trade liberalization and macroeconomic instability on the Brazilian economy*. Ph.D. Dissertation, The Ohio State University, 2004.

Cho, G. D. *Real exchange rate movements and agricultural trade*. Ph.D. Dissertation, The Ohio State University, 2001.

Cho, G., Sheldon, I. M. and McCorriston, S. Exchange rate uncertainty and agricultural trade. *American Journal of Agricultural Economics 84 (4),*2002, 932-942.

Cushman, D.O. US bilateral trade flows and exchange risk during the floating period. *Journal of International Economy 24*, 1988, 317-30.

Deardorff, A. Determinants of bilateral trade: does gravity work in a Neoclassical world?. In J. Frankel (ed.), *In the Regionalization of the World Economy*. Chicago: University of Chicago Press, 1998.

De Grauwe, P. Exchange rate variability and the slowdown in growth of international trade. *IMF Staff Papers 24,* 1988, 317-30.

De Grauwe, P. and B. De Bellefroid. Long-run exchange rate variability and international trade. In S. Arndt and J. D. Richardson (Editors), *Real-Financial Linkages Among Open Economies.* Cambridge: MIT Press. 1986.

Dell'Ariccia, G. Exchange rate fluctuations and trade flows. *IMF Staff Papers 46*, 2000, 293-314.

Dornbusch, R. Exchange rates and prices. *The American Economic Review 77,* 1987, 93-106.

Egger, P. An econometric view on the estimation of gravity models and the calculation of trade potentials. *The World Economy 25(2)*, 2002, 297-312.

Eichengreen, B. and D.A. Irwin. Trade blocs and the reorientation of trade in the 1930s. *Journal of International Economy 38*, 1995, 1-24.

Evenett, S.J. and W. Keller. On theories explaining the success of the gravity equation. *Journal of Political Economy 110(2)*, 2002, *281*-316.

Frankel, J. and S. Wei. Trade blocs and currency blocs. *NBER Working Paper 4335*, Cambridge, MA. NBER, 1993.

Frankel, J., Stein, E. and S. Wei. Continental trading blocs: are they natural or supernatural? In J. Frankel (ed.), *In the Regionalization of the World Economy*. Chicago: University of Chicago Press, 1998.

Froot, K. A. and P. D. Kemplerer. Exchange rate pass-through when market share matters. *The American Economic Review 79,* 1989, 637-654.

Haley, S.L. and B. Krissoff. U.S. grain exports and the value of the U.S. dollar. *Journal of Agricultural Economics Research 39,*1987, 12-21.

Helpman, E. Imperfect competiton and international trade: evidence from fourteen industrial countries. *Journal of the Japanese and International Economies 1*, 1987, 62-81.

Hooper, P. and S.W. Kohlhagen. The effect of exchange rate uncertainty on the prices and volume of international trade. *Journal of International Economy 8*, 1978, 483-511.

Kenen, P. and D. Rodrik. Measuring and analysing the effects of short-term volatility in real exchange rates. *Review of Economics and Statistics 68*, 1986.

Klein, M.W. Sectoral effects of exchange rate volatility on United States exports. *Journal of International Money and Finance 9,*1990, 299-308.

Lanyi, A. and E. Suss. Exchange rate variability: alternative measures and interpretation. *IMF Staff Papers 29*, 1982, 527–60.

Linnemann, H. *An econometric study of international trade flows*. Amsterdam: North-Holland, 1966.

Mark, N. Exchange rates and fundamentals: evidence on long-horizon predictability. *The American Economic Review 85*, 1995, 201-18.

Maskus, K. Exchange rate risk and U.S. trade: a sectoral analysis. *Federal Reserve Bank of Kansas Economic Review 3*, 2002, 16-28.

Peree, E. and A. Steinherr. Exchange rate uncertainty and foreign trade. *European Economic Review 33,*1989, 1241-64.

Pick, D.H. Exchange rate risk and U.S. agricultural trade flows. *American Journal of Agricultural Economics 72,*1990, 694-700.

Pick, D.H. and T.L. Vollrath. Real exchange rate misalignment and agricultural export performance in developing countries. *Economic Development and Cultural Change 42,*1994, 555-71.

Rose, A. One money, one market: the effect of common currencies on trade. *Economic Policy 30*, 2000, 7-46.

Sauer, C. and A. K. Bohara. Exchange rate volatility and exports: regional differences between developing and industrialized countries. *Review of International Economics 9 (1)*, 2001, 133-152.

Schuh, G. E. The exchange rate and U.S. agriculture. *American Journal of Agricultural Economics 56,*1974, 1-13.

Soloaga, I. and A. Winters. Regionalism in the nineties: What effect on trade?. *The North American Journal of Economics and Finance 12,* 2001, 1-29.

Thursby, J.G. and M.C. Thursby. Bilateral trade flows, the Linder hypothesis and exchange rate risk. *Review of Economics and Statistics 69*, 1987, 488-95.

Tinbergen, J. *Shaping the world economy.* Twenty-Century Fund, New York, 1962.

Trefler, D. Trade liberalization and the theory of endogenous protection: an econometric study of U.S. import policy. *Journal of Political Economy 101 (1),* 1993, 138-160.

Tweeten, L. *Farm policy analysis.* Boulder, CO: Westview Press, 1989.

Wei, S.J. Intra-national versus international trade: How stubborn are nations in global integration?. *NBER Working Paper 5531*, Cambridge, MA. NBER, 1996.