CROSS-BORDER PRICE CONVERGENCE: THE CASE OF THE MERCOSUR

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Abstract

This paper empirically examines whether there is a tendency for trade-induced price convergence - in other words if price differences among city pairs separated by a border decline with increased levels of trade. The paper examines the prices of goods in cities across Brazil and Paraguay after the implementation of MERCOSUR. Evidence of a border effect - the failure of the law of one price - between Brazil and Paraguay is found. However, the data show that since the beginning of MERCOSUR, price dispersion between Brazil and Paraguay is less for those goods that are traded more between these partners.

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CHAPTER 1 - INTRODUCTION

This paper investigates the effect of trade liberalization on the relative changes of the prices of consumer goods in the MERCOSUR area. I examine the effects of the increase in trade flows due to Free Trade Agreements (FTA) on the behavior of prices of similar goods across cities in Brazil and Paraguay. More specifically, the paper examines the time-series behavior of prices of similar goods across countries and how they have been impacted by an increase in trade by members of the FTA, and if as we expect, prices across countries tend to equalize after increasing the volume of trade.

In the context of international economics, the law of one price states that if two markets are well integrated, identical products, if traded with the same currency, should have the same price in the two locations. This paper examines this relative movement of prices across the Paraguayan and Brazilian border. This study extends the work of Engel & Rogers (1996), which examines the law of one price (LOOP). Engel and Rogers estimates the effect of the Canada–US border on prices of goods and services paid by consumers in both countries, and find that the border added the equivalent of as much as 75,000 miles to the prices among cities. In other words, the border effect led to a failure of the law of one price.

This study links the relative changes in prices to trade flows among member countries and the rest of the world as in Ceglowski (2006). Since the liberalization of trade in South America, imports and exports from the region have increased substantially. Trade flows increased rapidly from 1991 – when the MERCOSUR was signed – to 1997. This indicates that the region’s economic integration has developed quite well, giving us reason to suspect that prices of goods and services across the countries of the FTA are tending to equalize over time.

In all MERCOSUR countries except Brazil, the monetary institutions carry out only one dataset of consumer price indices based on the capitals and metropolitan areas, that is the consumer price indexes cannot be comparable within cities of each country. Brazil is the only MERCOSUR country that has consumer price index data for different cities within the country. Disaggregated consumer price data from Brazil and Paraguay as well as trade flow data from these countries are used in the analysis. The analysis employs consumer price data for nine Brazilian cities and one consumer price index for Paraguay. A panel analysis of the cross-border city price indices for a sample composed largely of food products is performed. The model also adds a geographical variable using the distance between each city pair. Evidence indicates that the relative price dispersion of goods with greater trade between the two countries is less than the dispersion of those goods with a smaller share. However, this finding does not hold when examining each good separately. These results suggest that goods that are traded more between the two countries see lower level of price dispersion. However, increased trade of an individual good does not directly impact the price of a good.

The paper proceeds as follows: first, I examine the historical background of the MERCOSUR and also the evolution of trade between the bloc members and non members. Next, the paper summarizes the relevant literature on FTA's and its effects for member, as well as non member countries is done. A review of this literature finds many interesting paradigms as a result of trade liberalization. Different views about the benefits and limitations of trading blocs are presented. This is followed by a description of the data and the theoretical framework to develop the model to be estimated is presented. The empirical results are presented in chapter VI. The last chapter concludes.

CHAPTER 2 - HISTORICAL BACKGROUND

MERCOSUR background

MERCOSUR was created following the signing of the Treaty of Asuncion in March 1991 by Argentina, Brazil, Paraguay and Uruguay. The treaty was intended to be a step toward integrating the markets and economies of Latin American countries through the free movement of goods, services and productive factors. In this light, the member countries aim at increasing markets to accelerate their economic progress and social justice. In 1994, the Treaty of Ouro Preto formalized the customs union among these South American countries to a Common Market. According to Article 1 of the Treaty of Asuncion:

> "…this common market shall involve: the free movement of goods, services and factors of production between countries through the elimination of customs duties and non-tariff restrictions on the movement of goods, and any other equivalent measures; the establishment of a common external tariff and the adoption of a common trade polity in relation to third States; The coordination of macroeconomic and sectoral policies between the States Parties in the areas of foreign trade, agriculture, industry, fiscal and monetary matters, foreign exchange and capital, services, customs, transport and communication and any other areas that may be agreed upon".

Article 3 of the Treaty of Asuncion states that the treaty between the MERCOSUR members is viewed as step further to bring about Latin American Integration, which follows the objectives set at the Montevideo Treaty. The latter treaty of 1980 provides for the creation of the Latin American Integration Association (LAIA) instead of the Latin American Free Trade Association (LAFTA) concluded in 1960.

Brazil and Argentina are MERCOSUR's largest economies. Bolivia, Chile, Colombia, Ecuador and Peru are associate members; they can become members of the free-trade agreement, but remain outside the MERCOSUR customs union. Venezuela already signed a membership agreement on June 17th of 2006, but before becoming a full member, its entry has yet to be ratified by the Paraguayan and Brazilian parliaments.

According to Article 5 of the Treaty of Asuncion, from the transition period until the formalization of the Common Market, the State Parties shall follow a trade liberalization program, which was to involve progressive, linear and automatic tariff reductions, accompanied by the elimination of non-tariff restrictions, and subsequently the elimination of tariff restrictions altogether by December 31st of 1994. There was to be an immediate reduction of the internal tariff rates by 47 percent of the most favored nation rate (M.F.N.) after the ratification of the Treaty. Then, subsequent reductions were to occur semi-annually and automatically progressively as shown in Table 1. In early 1995, there was the implementation of a Common External Tariff (CET). With the CET, member countries become, in effect, a unified regional customs union.

Trade flows after MERCOSUR

As expected after the liberalization of the market, intra-bloc trade grew continuously after the signed of the Treaty of Asuncion until 1997 (INTAL, 2006). Both exports and imports grew substantially. Between 1991 and 1995, intra-trade exports grew at an annual rate of 29.58 percent, while intra-trade imports grew at an annual rate of 28.69 percent. MERCOSUR share of total imports to the region showed a cumulative growth of 83.8 percent during the period mentioned before (INTAL, 1996). However, Table 2 shows the increase in trade flows was not equal among all member countries. Intraregional exports from Brazil to the MEROSUR countries grew 36 percent, while intraregional exports from Paraguay grew at much lower rate, 15.75 percent. According to the INTAL Report N°3 (INTAL, 1997), in 1996, MERCOSUR total exports and imports grew by 6.4 percent and 9.7 percent respectively. Intraregional exports and imports grew by 17.9% and 18.5% respectively that year.

In 1999 trade balance for the MERCOSUR countries deteriorated, both imports and exports of the four members fall. This negative result was due to the devaluation in Brazil, the increase in risk perceptions in financing emerging markets, which limited the availability of external resources for financing. Because of the devaluation of its currency, Brazil's economy, which is the largest among the MERCOSUR countries, reduced its imports from the smaller economies, Paraguay and Uruguay, constraining in this way its capacity to stimulate growth in its trade partners. The rise of oil prices in 2000 also contributed for to the decline of the terms of trade for Paraguay since it is a net oil importer.

There have been no major changes in the composition of Brazilian merchandise trade, the share of primary products in total exports declining only slightly with a corresponding increase in manufactured exports, namely aircraft and automotive products as a result of the growing industralization. Brazil remains the world's largest exporter of several agricultural products including coffee, orange juice and sugar.

Paraguay's trade balance on the other hand, has deteriorated sharply since 1989. In particular soybeans and cotton, which are the two major sources of exports of the economy, have experimented a decline in prices as the world prices of these commodities. The decline in prices of these commodities is one of the principal cases for the negative performance of the balance of trade.

General Economic Conditions

Brazil

Brazil has a highly diversified manufacturing sector. During the period under review, specific support programs in the sector were applied to steel, automobiles, aircraft, and shipbuilding industries. Also, Brazil is one of the world's major producers and exporters of agricultural products. Government intervention in the sector has decreased; support programs, mostly minimum-price supports and rural credit at preferential rates, are now targeted at assisting low-income farmers in disadvantaged areas.

Since 1990, Brazil has undertaken a process of market opening. In fact, according to the World Trade Organization reports (WTO), total trade flow of goods almost doubled since 1992 to 1995 due to an increase in imports, which more than doubled since 1992 to 1995 (WTO, 2000). Nevertheless, the situation of the Brazilian economy is different from that of its three smaller MERCOSUR partners due to the size of its economy. Brazil's level of interdependence with its partners is weak, although it grew since MERCOSUR. As a result of the increase in the total trade flow of goods mentioned before, the Brazilian productive sector has been subjected to a deep and widespread restructuring, which has accomplished efficiency and competitiveness. The Brazilian GDP has performed very well since 1993 until the 1998 crisis where the economy did not see any growth. In the year 2000 the economy was again growing at a good pace.

From 1992 on, the Brazilian economy has changed significantly. This change has been driven in large measure by a broad economic stabilization program of 1994 named the Real Plan. The Real Plan was an exchange rate based stabilization plan and it was very successful in bringing inflation down in Brazil. The Real Plan managed to reduce the high levels of inflation without price or wage freezes, breaches of contracts or recession. Previously, the acceleration of Brazilian inflation in the 1980s generated a series of economic stabilization plans which were generally based on high levels of intervention in the economy, in the form of price or wage freezes, while the fundamental question of structural reform was relegated to a position of less importance. It can be seen in Table 3 the significant drop in the inflation rate after the Real Plan (1994), before inflation rate rose up to 2477.15 percent in 1993.

The inflation behavior can also be seen in Figure 1, which shows the inflation behavior for Brazil during the time period of the sample of this database (Dec 1992-Dec 2000). It can be seen again that before 1995 Brazil experienced high levels of inflation that were only controlled after the Real Plan of 1994. Inflation shows a downward trend from 1995 on until mid 1999 when it started to go up again.

Even though, MERCOSUR partners have represented only a small share of the country's total exports, during 1997, MERCOSUR was one of the main forces behind Brazil manufacture exports, especially for some productive activities such as the automotive industry. Brazilian economy rapid recovery from the financial crises in 1997 and 1998 was attributed largely to macroeconomic policies and the liberalization pursued over the last decade, both unilaterally and in the context of international agreements: greater exposure to competition from foreign goods and services has helped contain inflation, enhanced productivity and competitiveness and attracted investment. Brazilian GDP showed an upward trend until 1997, in 1998 the economy showed 0% growth, but by the year 2000 it was recovering fast. See Table 3.

Foreign direct investment (FDI) has increased substantially since 1996, exceeding US$30 billion in 1999. Although FDI has been stimulated by privatization, an important share has been autonomous reflecting the attractiveness of a large internal market, better access to other MERCOSUR markets, and the improved market-orientation of the policy environment (WTO, 2000). FDI flows also increase as a result of privatization programs and flexibilization of State monopolies.

Export promotion has been one of the key elements of Brazil's trade policy, partly to offset domestic inefficiencies such as poor infrastructure, inefficient financial intermediation, a cascading tax system and, until 1999, an overvalued exchange rate. After Brazil’s exchange rate devaluation of 1999, its exports showed a more dynamic behavior if compared with previous years (INTAL, 2006). In summary, export promotion accompanied by policies to keep inflation stable and to make exchange rate competitive have been very positive for the largest economy of MERCOSUR.

Paraguay

As a farming country by tradition, Paraguay has historically based its economic growth on agricultural production. While this is still true, the Government has made great efforts as regards agricultural diversification and is encouraging the country's industrialization. The GDP though has remained highly sensitive to fluctuations in agricultural production.

Since 1989, Paraguay has taken a several political and economic reforms. Economic growth measured by GDP has been positive until 1997 although variable, barely keeping pace on average with population growth which raises concerns (see Table3). However, since the beginning of the 1990’s, particularly after 1993, Paraguay’s inflation underwent a downward trend which was interrupted only once before the last period of the sample of this paper, that is in 1998. Then in 2000, in the last period of the sample, inflation rose again due to the increase of oil prices, the increase in the minimum wage and utilities in the country. The annual inflation rate measured through the consumer price index was 24.23% in 1991, and ended with a 8.6 percent rate in the year 2000 (INTAL, MERCOSUR Report No.1, 1996), (INTAL, 1997), (INTAL, 1997), (INTAL, 1998-1999), (INTAL, MERCOSUR Repor No. 7, 2000-2001) .

Figure 2 shows the inflation behavior for Paraguay during the time period of the sample of this database (Dec 1992-Dec 2000). Paraguay's inflation rates have been very stable during this period as compared with Brazil.

From 1995 on, the economic performance of Paraguay was not satisfactory. During the last three years of the sample period for this study, the economy was stagnated, with very insignificant economic growth and even negative numbers for the change in GDP. See Table 3. Before, from 1995 to 1998, the country suffered a serious banking crisis which led to a severe contraction of credit and a rise in real interest rates. The Paraguayan economy was negatively affected by the Argentine recession in 1998; the devaluation of the Brazilian currency at the beginning of 1999; and the weather conditions that caused major lost in the agricultural production. The terms of trade began to deteriorate. The downward trend in trade flows also began in 1995. For Paraguay, trade among MERCOSUR partners is very significant, that is, there is a high level of dependency on the largest MERCOSUR members (Argentina and Brazil). In addition, since 1991, the Brazilian market has become the main destination for its exports with more than 25 percent share by 1995.

Paraguay's trade balance has deteriorated very fast since 1989, going from a surplus to a deficit despite of the rise in exports of electricity from the Itaipu hydro-electric (WTO, 1997). The deteriorated trade balance is due to a steady increase in imports and the decreasing world prices of Paraguay's two primary export products, which are soybeans and cotton.

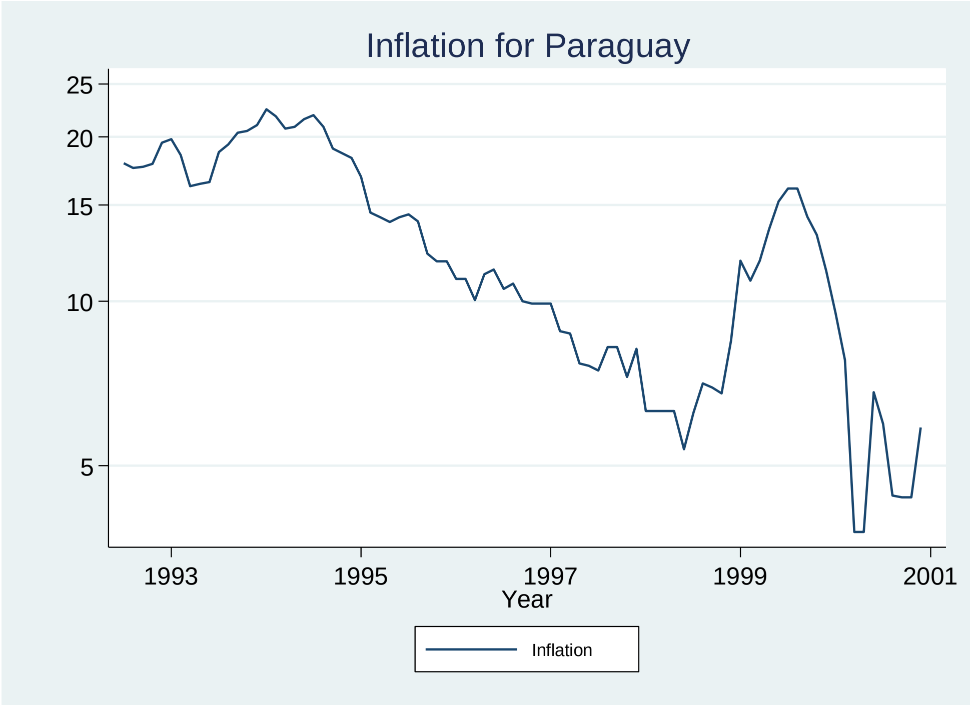
Foreign investment flows into Paraguay have been stimulated by fiscal incentives, high interest rates, the liberalization of the country's foreign exchange regime and regional integration prospects (MERCOSUR). This has led to real appreciation of the currency and has raised competitiveness concerns. Although progress in privatization has been slow, de-regulation is favored in key development sectors as electricity and telecommunications.

There is little question that intra-MERCOSUR trade has grown rapidly during the period from the signing of the Treaty of Asuncion. Also it can be seen that there is a high level of dependency for Paraguay on the largest economy of the MERCOSUR, which means that a bad year for Brazil's economy will probably lead to the same in Paraguay. Both, Brazil and Paraguay export a many agricultural products and for that reason their economy performance might depend highly on world prices for commodities and weather conditions. Brazil however, is better off mainly due to the increasing industrialization process.

Figure 2-1

Notes: The graph shows the inflation behavior for Brazil during the time period of the sample of this database (Dec 1992-Dec 2000). It can be seen that before 1995 Brazil experienced high levels of inflation that were only controlled after the Real Plan of 1994. Inflation shows a downward trend from 1995 on until mid 1999 when it started to go up again.

Figure 2-2



Notes: The graph shows the inflation behavior for Paraguay during the time period of the sample of this database (Dec 1992-Dec 2000). Paraguay's inflation rates have been very stable during this period as compared with Brazil. Inflation presents a downward trend from the last months of 1994 until almost the end of 1998 when it started to show and upward trend that showed a decline again in mid 1999.

Table 2-1 Tariff reduction schedule by MERCOSUR countries

Date	June 30th 1991	December 31st 1991	June 30th 1992	December 31st 1992	June 30th 1993	December 31st 1993	June 30th 1994	December 31st 1994
% tariff reduction	47	54	61	68	75	82	89	100

Note: As of the date of entry into force of the Treaty of Asuncion, the MERCOSUR members began a program of gradual, linear and automatic tariff reductions, benefited products classified according to the tariff nomenclature used by the Latin American Integration Association.

Table 2-2 Annual growth of trade flows after MERCOSUR

	Annual growth rate 1991/1995
Brazil	
Total exports	10.12%
Exports to MERCOSUR	27.77%
Exports to the rest of the world	8.31%
Total imports	23.90%
Imports from MERCOSUR	31.68%
Imports from the rest of the world	22.85%
Paraguay	
Total exports	2.69%
Exports to MERCOSUR	15.75%
Exports to the rest of the world	-7.20%
Total imports	21.70%
Imports from MERCOSUR	31.04%
Imports from the rest of the world	16.66%
MERCOSUR	
Total exports	11.28%
Exports to MERCOSUR	29.58%
Exports to the rest of the world	8.24%
MERCOSUR share in the total exports	83.84%
Total imports	23.72%
Imports from MERCOSUR	28.69%
Imports from the rest of the world	22.71%
MERCOSUR share in the total imports	17.06%

Source: INTAL reports.

Table 2-3 Macroeconomic indicators

Indicators	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Brazil										
GDP-Total (annual %)	1.0	-0.5	4.9	5.9	4.2	2.2	3.4	0.0	0.3	4.3
CPI(%Dec/Dec)	472.7	1119.1	2477.15	916.46	22.41	9.56	5.22	1.65	8.94	5.97
Exchange rate (National currency per US$)	406.61	4.51	88.45	0.64	0.92	1.01	1.08	1.16	1.81	1.83
Paraguay										
Indicators	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
GDP-Total (annual %)	2.4	1.6	4.1	3.1	4.7	1.3	2.6	-0.4	0.5	-0.4
CPI(%Dec/Dec)	24.23	15.19	18.21	20.57	13.4	9.81	6.99	11.53	6.75	8.98
Exchange rate (National currency per US$)	1325.18	1500.26	1744.35	1904.76	1963.02	2056.81	2177.86	2726.49	3119.07	3486.35

Source: IBGE, IFS Statistics, INTAL Reports.

CHAPTER 3 - LITERATURE REVIEW.

Evidence in international trade shows that the law of one price (LOOP) tends to fail even with free trade zones. LOOP says that in an efficient market, the price of identical or homogenous goods tends to equalize over time. However, there are many variables that may cause the law of one price to fail. This section reviews the literature on international trade focusing especially in the LOOP and price dispersion.

Engel and Rogers (1996), examine the time series behavior of prices of goods across and within countries. They find that the movement of prices of similar goods across borders accounts for much of the failure in LOOP. The basic hypothesis that the authors study is that the volatility of the price of similar goods between cities should be positively related to the distance between those cities. The authors also study the possibility that the variance of the price of similar goods in two cities in different countries could be different than the volatility of the price in two cities equally far apart, but in the same country. They find that the border plays a large role in the failure of the LOOP.

To estimate the volatility of $P^i_{j,k}$, the authors estimate the following:

$$V\left(\beta^i_{j.k}\right) = \beta^i_1 r_{j,k} + \beta^i_2 B_{j,k} + \sum_{m=1}^{n} \gamma^i_m D_m + u_{j,k},$$

where $r_{j,k}$ is the log of the distance between locations *j* and *k*, D_m is a dummy variable for each city in the sample, and $B_{j,k}$ is a dummy variable for whether locations *j* and *k* are in different countries. As in the gravity model of trade, the authors find a positive concave relationship between relative price volatility and distance. This implies that price volatility increases as distance between city pairs increase, but at a decreasing rate.

In the aforementioned article, the authors employ consumer price data disaggregated into 14 categories of goods. The data cover the period from June 1978 to December 1994. The empirical results show that both distance and the border are significant in explaining price dispersion across locations. While distance is an economically significant determinant of price dispersion, the effect of the border relative to the distance is extremely large and even more significant. The authors explore some of the possible reasons why the border is so important, such as nominal price stickiness, integration of labor markets and trade barriers. Nominal price stickiness appears to account for a large portion of the border effect, but most of the effect is left unexplained. The failure of prices of similar goods to equalize between cities is a sign that the markets are not completely integrated.

Engel and Rogers (1996) state that one reason that the price of similar goods might vary in different locations is that the markets for the goods are separated geographically. Engel and Rogers note that transportation costs may be a reason why markets are segmented. Countries are more likely to trade with neighbors because transportation costs are lower. In their 1996 paper, Engel and Rogers explore if the international failure of the law of one price could be attributed entirely to the segmentation of markets by physical distance, or if there were other factors, such as nominal price stickiness that explain the failure of the LOOP.

Geographical separation of markets as mentioned above provides yet another reason that the price of similar goods might vary across locations. Countries are more likely to trade with neighbors because transportation costs are lower. With iceberg transportation costs (Krugman, 1980) in effect, prices in different cities might not necessarily equalize.

Engel and Rogers also entertain the possibility that price variation of similar goods over time might be higher if the cities lie across national borders, holding distance constant. Much of the pricing-to-market literature has emphasized that the markup may be different across locations, and may vary with exchange rate changes. Also, marketing services are likely to be highly labor- intensive, thereby leading to variations in product costs. There might also be direct costs of crossing borders because of tariffs and other trade restrictions.

In order to estimate their model, Engel and Rogers find the log of the price of good i in location j relative to price of good i in location k, where the prices have been converted to U.S. dollars. The authors calculate the measure of the change in prices as the log of the relative prices between time t and $t-2$. They calculate the standard deviation as a measure for the volatility of prices and use it as the dependent variable of the model.

In examining the effects of free trade agreements, Engel and Rogers (1996) splits the sample at January 1990, when the Canada-US Free trade Agreement went into effect. If trade were an important reason why the border variable is economically significant in explaining price dispersion, one would expect that the magnitude of this variable would decline after 1989. However, the authors find a tendency in the opposite direction.

The major finding of Engel and Rogers (1996) is that even with Free Trade Agreements, markets are not as well integrated as one might expect. Cities within each country show much greater harmony in prices even if they are very distant markets apart compared to pairs of cities that lie across the US-Canada border, even if the cities are nearby geographically. The authors have not been able to explain fully why the border matters so much for intercity dispersion. Nevertheless, they leave the option that informal barriers may be significant. The hypothesis that wage costs are more homogeneous within countries does not seem to explain the border's importance according to the authors.

Engel and Rogers (1996) saw sticky nominal prices as an explanation for the magnitude of the border effect in their paper when studying the case of the U.S.-Canada. Their hypothesis was that if sticky nominal prices were the cause of the large border effect found in their study, then prices would fluctuate in the same way as the exchange rate. In their case of study, sticky nominal prices do seem to account for a significant portion of the magnitude of the border effect, but apparently, the sticky nominal price explains less than half of the border effect.

Engel, Rogers and Wang (2003), brings to the literature another similar model to the one discussed above. In this study, the authors use data from the Economist Intelligence Unit that includes actual prices of 100 consumer goods in 13 US cities and for Canadian cities. The data used is annual from 1990 to 2002, and is largely composed by food items - forty of the 100 goods are food or drinks. There are nine clothing items. Six of the items are consumer durables. Non-tradable services such as a men's haircut or one hour's babysitting constitute 21 of the items. The remaining 22 prices are for miscellaneous (tradable) products such as insect killer spray and aspirin.

Engel, Rogers and Wang (2003) estimate a simple model to explain price level differences between cities. The absolute value of the difference in the price between two cities is modeled as a function of the log of distance between the cities, the absolute value of the population difference, a measure of the absolute value of the difference in sales taxes between the cities, and a dummy variable that indicates whether or not the two cities are in different countries. They mention that there might be a large degree of measurement error in the prices used. The authors mentioned it because they gathered some data from the EIU (Economist Intelligence Unit), which does not publish full details of its methodology, and one suspects that the prices are not as comparable as prices collected by the official agencies. The authors also clarified that even though there might be some degree of measurement error, the price data is used as the dependent variable in the regression, so any measurement error should not affect the consistency of the parameters.

Engel, Rogers, & Wang (2003) considers $\left|\pi_{i,j,t} - \pi_{i,k,t}\right|$ as the dependent variable, where $\pi_{i,j,t} = p_{i,j,t} - p_{i,j,t-1}$. The first explanatory variable in their regression, $dist_j$ represents the log of the distance between locations j and k. The authors argue that distance is an important explanatory variable for the volume of trade between two cities following the "gravity model" of trade.

Engel, Rogers and Wang (2003) find that even accounting for distance between cities and relative population sizes, the absolute difference between prices in the U.S. and Canada is greater than 7 percent. Their estimation method is to use a measure of integration of two locations as the dependent variable in the regression. The dimensions of the panel data are 100 goods, 13 periods, and 17 cities. Hence, there are 136 city pairs.

Another explanatory variable used in the paper mentioned in the above paragraph is the absolute value difference in the log of the population between cities j and k, pop_{jk}. This model adds variables not included in Engel and Rogers (1996). The population variable is included to capture the fact that larger cities tend to have higher prices. As in papers cited before, the model also includes the variable, $bord_{jk}$ that captures the degree of integration between the U.S. and Canadian markets. This is a dummy variable that takes on the value of 1 if cities j and k lie on opposite sides of the national border between the U.S. and Canada.

Engel, Rogers and Wang (2003) also include city dummies, that is a dummy variable for each city ($citdum_j$.). This variable takes on the value of 1 if one of the cities in the city pair is city *j*. The purpose of including this variable is to capture any idiosyncratic aspects of the price of a given city that tends to make it different. The authors also perform their regression using time dummies. However, the introduction of these time dummies had little influence on the other parameter estimates. The authors estimate equations as a panel using all 100 goods. Their estimate uses panels that have prices from each of 5 categories of goods: food, clothing, durables, miscellaneous products, and services.

Another focus of analysis in the study of free trade agreements is the effect that tariff reductions or their elimination altogether might have on the on the volume and growth of trade. Clausing (2001) for instance examines the variation in tariff liberalization under the free trade Agreement between Canada and the United States to measure the impact of tariff liberalization on the growth of trade with member as well as non-members countries. The author uses data at the commodity level and shows that this Free Trade Agreement has had substantial effects on trade growth, especially for goods that suffered the largest tariff reductions. She also finds little evidence of trade diversion.

Prior to Viner's (1950) analysis, the consensus was that customs unions were welfare improving since customs unions led to a fall in tariffs, (since in general, tariffs are welfare reducing). Viner's analysis debunked this previously held hypothesis, in favor of a new idea that customs unions are not always welfare improving, since tariff reductions occur "in a world of second best". Trade creation occurs when the lowering of tariffs allows partner country imports to replace high-cost domestic production; this improves welfare. Trade diversion occurs when the removal of tariffs causes trade to shift from a third country to the partner country. This may occur because the third country would be the low cost source of imports. In Viner's analysis, welfare then depends on the extent of trade creation relative to trade diversion.

A more recent paper from Romalis (2007) examines trade between the U.S. and Canada. His paper "NAFTA and CUSFTA'S Impact on International Trade" identifies NAFTA's effects on trade volumes and prices using detailed trade and tariff data. It identifies demand elasticities from the additional wedges driven between consumption patterns in NAFTA versus non-NAFTA countries caused by tariff reductions. An analysis of worldwide trade for 5,000 commodities shows that NAFTA has a substantial impact on international trade volumes, but a modest effect on prices and welfare. Romalis finds that NAFTA increased North American output and prices in many highly protected sectors by driving out imports from nonmember countries. This paper empirically analyzes the effects of the second largest of these agreements, the North American Free Trade Agreement (NAFTA), on trade volumes, prices, and welfare of both member countries and nonmembers. The paper finds that both supply and demand are very sensitive to price changes.

Until now, we have only explored the welfare effects of free trade agreements among its members and the failure of law of one price despite it. Free Trade Agreements, however, do not only affect member countries, they also affect non-member countries. The formation of free trade areas may hurt countries outside those free areas, even without any overt increase in protectionism. Evidence from Chang and Winters (2002), shows the welfare impacts of preferential trade agreements, especially on excluded countries. The authors pay special attention to the South American case, and in particular, examine the effect that MERCOSUR (South Common Market) has had on the prices of imports from non-member countries, assuming that those countries export to two segmented markets, Brazil and the rest of the world, in an imperfectly competitive setting with differentiated products.

The authors concentrate on the Brazilian import market since Brazil is the largest market in MERCOSUR. They state that changes in Brazilian most favored nation (M.F.N.) tariff rates led to changes in price by nonmember importer firms to Brazil, and that tariff preferences offered to members, lead to strategic price responses within the Brazilian market. In their work, the authors sought to identify responses in commodity-level import data from Brazil and in export data from its major overseas suppliers. The authors focus on the effect that MERCOSUR has had on the prices of imports in Brazil since 1991.

Chang and Winters explain that in imperfectly competitive settings, a firm's pricing depends not only on the tariff charged on its own product, but also on that charged on its rivals. With that, the idea is that if a country is a member of the free trade zone, its firms receive preferential tariff concessions, thereby becoming more competitive in Preferential Trade Agreement markets, and non-member firms are likely to make compensations, reducing its prices.

Parsley and Wei (1999) exploit a three-dimensional panel data on prices for 27 traded goods, over 88 quarters, across 96 cities in Japan and the United States. Even though these cities do not share a common border, the authors found some interesting results. The authors present evidence that the intra-national good-level real exchange rates (relative prices) are substantially less volatile than the comparable distribution of international relative prices. Focusing on the dispersion of prices between city pairs, they were able to confirm previous findings that crossing national borders adds significantly to price dispersion. They also infer that distance, exchange rates, shipping costs, and relative variability in wages influence the border effect. After those variables are controlled for in their study, the border effect disappears.

The authors mentioned in the previous paragraph, find strong evidence that sticky prices in local currencies is a big part of CPI-based real exchange rate movements. Parsley and Wei (1999) present evidence on the mean absolute percentage deviation from the LOOP. They find that within each country, the mean absolute deviations are between 10-15 percent. On the other side, they find that the cross-country mean absolute deviations are several times as large, between 75-140 percent.

In their paper, Parsley and Wei (1999) regress the standard deviation of the change in the real exchange rate on the distance between locations and a border dummy. The standard deviation is used as a measure for variability. The good-level real exchange rate is calculated as the difference in the change of the log of the price in country *i* and country *j* at time t. Then, the standard deviation change in the real exchange rate estimated is:

$$V(Q_{ij,k}) = \beta_0 + \beta_1 \ln(dist_{ij}) + \beta_2 border_{ij} + \varepsilon_{ij},$$

where the dependent variable, $V(Q_{ij,k})$, is the standard deviation change in the real exchange rate, $dist_{ij}$ is the greater-circle distance between cities *i* and *j*, $border_{ij}$ is a dummy variable that equals 1 if cities *i* and *j* are in different countries, and β_0.is a constant, city, and good dummies. The results for Parsley and Wei confirm that price dispersion increases with distance and that the border effect is important for explaining cross-country price dispersion.

The last article of the literature review is titled "National Borders Matter: Canada-U.S. Regional Trade Patterns" (McCallum, 1995). There the methodology used by the author uses gravity-type equations where trade between any two countries is a function of each country's gross domestic product and the distance between the countries. The author also studies the effect that trade blocs have on trade patterns for the case of Canada and the U.S. Such effect is estimated by adding to the equation a dummy variable set equal to one for cases of intra-bloc trade and zero for all other cases. The basic estimated equation is

$$x_{ij} = \alpha + \beta y_i + \theta y_j + \delta dist_{ij} + \mu dummy_{ij} + \varepsilon_{ij},$$

where x_{ij} is the logarithm of shipments of goods from region i to region j, y_i and y_j are the logarithms of the respective region's GDP, $dist_{ij}$ is the distance from i to j, $dummy_{ij}$ is a dummy variable equal to 1 for the case of inter-provincial trade and 0 for the case of province-to-state trade, and ε_{ij} is the error term. The results obtained by the author showed that national borders matter.

This section examined literature related to the LOOP and price dispersion. The literature review findings is that distance, national borders, sticky nominal prices, non-traded inputs (e.g., labor) and transportation costs are some reasons for the failure of the LOOP. The literature review gives strong evidence of the gap between prices of similar goods in different locations and also gives a background to set up the model for this paper.

CHAPTER 4 - METHODOLOGY

This study explores the relationship between price dispersion, trade flows, distance and geographical borders. The basic hypothesis is that price differences of similar goods among city pairs separated by a border decline with increased levels of trade. It is expected that if with increasing integration due to Free Trade Agreements, which reduce trade barriers considerably, greater volume of trade would more likely occur, subsequently leading to less price dispersion among similar goods.

The methodology initially estimates the standard deviation of the absolute change in prices for the 9 Brazilian cities with the one Paraguayan city, the log of the distance and city dummies, and an index measure for trade. I then extend the analysis in a manner similar to Engel, Rogers and Wang to calculate price dispersion between similar goods sold in different countries.

The model to be estimated examines the price volatility as the dependent variable, which is calculated as the standard deviation of prices as in Engel and Rogers (1996). The dependent variable is the standard deviation of the twelve-month difference in the relative price. The equation is estimated as a panel using 9 goods. This paper, unlike Engel and Rogers (1996), limits its scope to the case where the city pairs of the observations are separated by a natural border. The cases of city pair combinations within the same country are excluded. This is done because the dataset for Paraguay only has one city as a representation for the whole country, thereby, making it impossible to make comparisons in the behavior of prices within Paraguay alongside prices of similar goods sold across the border.

Four indexes to measure trade are constructed; a yearly measure, $mshare_p$, that takes into account the trade between Brazil and Paraguay as a share of the world's trade, and another index, $mshare_m$, that takes into account the trade between all the MERCOSUR countries as a share of the world's trade. The other two indexes, $mshare_p^a$, and , $mshare_m^a$, are calculated without restricting them to being yearly; that is, adding all the amount of trade from 1992 until the year 2000. These trade index measures are included to explore the effects of MERCOSUR on trade, given that evidence from the previous literature indicates that trade volumes increased significantly after its implementation. To this end, the hypothesis that increased volumes of trade tends to make prices to converge is tested. This is done for both the price dispersion equation and the volatility equation.

The model for estimating the volatility of relative changes in prices is defined as:

$$V\left(P_{i,j}\right) = \alpha + \sum \beta_i citydum_i + \beta_n \, mshare_p^a + \varepsilon_{it} \qquad (1),$$

the model addresses variation in volatility between goods while controlling for some explanatory variables. In the above equation, the dependent variable $V\left(P_{i,j}\right)$ represents the volatility of prices calculated as the standard deviation of prices. The dependent variable is regressed on a constant, city dummies, $citydum$, and the trade index $mshare_p^a$ that takes into account the trade between Brazil and Paraguay through the years of the sample as a share of the world's trade.

$$V\left(P_{i,j}\right) = \alpha + \sum \rho_i citydum_i + \mu \; mshare_m^a + \varepsilon_{it} \qquad (2),$$

in equation (2), the regression is the same as the one above, except for the fact that now the dependent variable is regressed on an index of trade that represents MERCOSUR's contribution to world trade, $mshare_m^a$ along the years of the sample.

Prices are deflated in order to avoid the effect that sticky nominal prices might have on the city dummies. The same approach was taken by Engel and Rogers (1996). The aforementioned authors investigated in their paper whether the sticky price explanation for the importance of the border changed the size of it in a considerable amount. The price of consumer goods sold in each country might be sticky in terms of their currencies. The nominal exchange rate as described in the MERCOSUR background was in fact highly variable for Brazil. It could be then, that the prices would move along with the exchange rate, but within each country prices would be very similar.

The exchange rate as well as an aggregate price index for each city were used by the authors in order to calculate the real prices, that is the deflated prices. The authors explained that if the size of the border effect was due in part to the fact that it was picking up the effect of the fluctuating exchange rate then, estimating the regression using the real prices will avoid the sticky nominal price issue. Using an aggregated CPI for each city is another way to correct for the sticky nominal price effect.

Thereby, equations (1) and (2) are calculated for the nominal change in prices. Equations (3) and (4) below estimate the standard deviation of prices on the same variables as the previous equations with the difference that to calculate the standard deviation, the deflated prices are used. The deflated prices are calculated using two instruments – the monthly exchange rate, and the monthly aggregate CPI – for each country in the sample. The monthly exchange rate measures each country's local currency against the U.S. dollar. The monthly aggregated CPI does not differ by city of the country as in the case of the disaggregated prices nor as in Engel and Rogers (1996) paper. Instead, there is one aggregated CPI for Brazil and another for Paraguay.

$$V(\tilde{P}_e) = \alpha + \sum \beta_m citydum_i + \beta_n\, mshare_p^a + \varepsilon_{it} \quad (3),$$

in equation (3), $\tilde{P}_e$ represents the absolute value of the deflated prices by the corresponding exchange rate. That is, $\tilde{P}_e = \left|\frac{\Delta P_i - \Delta e_{ius}}{\Delta P_j - \Delta e_{jus}}\right|$, where $\Delta e_{zus} = \left(\frac{e_{z,t}}{e_{z,t-12}} - 1\right) * 100$, and $z = i, j$; $e_{z,t}$ is the exchange rate of country *z's* local currency against U.S. dollar at time *t*, and $e_{z,t-12}$ is the exchange rate of country *z's* local currency against U.S dollar at time *t-12*. The volatility of prices is estimated on the same variables as in the previous equations.

$$V(\tilde{P}_{cpi}) = \alpha + \sum \beta_m citydum_i + \beta_n\, mshare_p^a + \varepsilon_{it} \qquad (4),$$

equation (4) looks as the previous equation, but the volatility measure (standard deviation of prices) is calculated using the aggregated CPI of the corresponding country as the deflator instrument. $\tilde{P}_{cpi}$ is calculated as the absolute value of the deflated prices by the corresponding inflation rate. Mathematically, the absolute value of the deflated price can be expressed as $\tilde{P}_{cpi} = \left|\frac{\Delta P_i - \Delta cpi_i}{\Delta P_j - \Delta cpi_j}\right|$, where $\Delta cpi_i = \left(\frac{cpi_{z,t}}{cpi_{z,t-12}} - 1\right) * 100$, where $z = i, j$.

Another approach used to measure the volatility of prices is to calculate the mean of prices instead of the standard deviation as the measure for the price volatility. In the empirical results section, the results from these two approaches for calculating price volatility are presented. The mean change of relative prices is calculated as:

$$M_M(P_{i,j}) = \alpha + \beta_1 logd + \sum \beta_m citydum_i + \beta_n \, mshare_p^a + \varepsilon_{it} \qquad (5),$$

in equation (5), $M(P_{i,j})$, represents the mean of prices calculated as the mean of prices among similar goods sold in different locations instead of the standard deviation as in Engel and Rogers (1996). Equations (3), (4) and (5) are also estimated using the variable $mshare_m^a$ as the index for trade instead of $mshare_p^a$.

The following estimation models focuses on price dispersion equations. The methodology approach more closely follows Engel, Rogers and Wang (2003) by introducing the time dummies into the estimating equation. The equation includes a time variable, $time_t$. The coefficient of this variable is expected to have a negative sign since after the signing of the Treaty of Asuncion it is assumed that markets are more integrated, and therefore less price dispersion. Different variables to measure time could possibly be incorporated into the equation, for instance, the time trend variable could be used, or the years' dummies. The model could also test for seasonality effects creating dummies for each month of the year minus one since we have a constant term. For the base model for price dispersion in this paper, the time trend variable is used. The latter consists of 85 months, which is the number of months present in the sample, from December 1992 until December 2000. Equation (6) shows the first equation for price dispersion.

$$\tilde{P}_{it} = \alpha + \sum \rho_i citygood_i + \delta time_t + \varepsilon_{it} \qquad (6),$$

where $\tilde{P}$ is the absolute value of price dispersion, which is equal to the percentage change in price in city *i* divided by the percentage change in price in city *i* minus 1. That is, $\tilde{P} = \left|\frac{\Delta P_i}{\Delta P_j} - 1\right|$, where $\Delta P_z = P_{z,t} - P_{z,t-12}$ for $z = i, j$. Although equation (6) follows Engel and Rogers (1996) approach, this model does not explicitly estimate a border effect. It nonetheless provides considerable evidence to suspect that there exists a border effect. As explained before, the price data collected for Paraguay only shows one city as representative of the whole country which makes impossible to compare the behavior of prices within the country with the cross border behavior. This paper treats the observations each city pair and COICOP code as a panel, and again only the cases where the border dummy is equal to one are considered. The latter step drops number of observations considerably.

The base model for estimating price dispersion is as follows:

$$\tilde{P}_{it} = \alpha + \sum \rho_i citygood_i + \mu mshare_{p,it} + \varepsilon_{it} \qquad (7),$$

where $\tilde{P}_{it}$ is the absolute value of price dispersion for a citygood pair *i* at time *t*, α is a constant term, $mshare_{p,it}$ is the index measure for trade between Brazil and Paraguay as a share of the world's trade at time *t* for citygood *i*, and the summation of the citygood pairs variable represents the city pair and good dummy for each city and good in the data minus one since the equation includes a constant term. The constant term represent the fixed effects for city pair and good.

$$\tilde{P} = \alpha + \sum \rho_i citygood_i + \beta logd_i + \mu mshare_{m,it} + \varepsilon_{it} \qquad (8),$$

the only difference between equation (7) and (8) is that for the latter, a different trade index is used. The trade index here is the measure of trade among the MERCOSUR State Parties as a share of the world's trade.

As for the volatility of price model, the paper proceeds to estimate price dispersion using the deflated prices with the same instruments used before in order to avoid overestimated parameters due to sticky nominal prices. Deflating prices by the instruments used before gives us a better approximation of price dispersion.

Price dispersion deflated by the exchange rate is calculated as described by the volatility equation, that is $\tilde{P}_e = \left|\frac{\Delta P_i - \Delta e_{ius}}{\Delta P_j - \Delta e_{jus}} - 1\right|$, where the change in the exchange rate is measure of the country's local currency against U.S. dollars. The deflated price dispersion equations look exactly as equations (7) and (8) with the difference of how price dispersion is calculated.

$$\tilde{P}_{eit} = \alpha + \sum \rho_i citygood_i + \mu mshare_{p,it} + \varepsilon_{it} \qquad (9),$$

$$\tilde{P}_{eit} = \alpha + \sum \rho_i citygood_i + \mu mshare_{m,it} + \varepsilon_{it} \qquad (10),$$

equation (9) uses $mshare_{p,it}$ as the measure for trade, whereas equation (10) uses $mshare_{m,it}$ as the measure for trade.

The idea behind the next equations follows the same procedures as the standard deviation equations. The method used to correct for the sticky price effect is the change in the aggregate consumer price index of each city's country, that is, the change in the aggregate CPI for Brazil and the change in the aggregate CPI for Paraguay in the same way as done for the volatility equations. The deflated price dispersion is calculated as $\tilde{P}_{cpi} = \left|\frac{\Delta P_i - \Delta cpi_i}{\Delta P_j - \Delta cpi_j} - 1\right|$.

$$\tilde{P}_{cpi} = \alpha + \sum \rho_i citygood_i + \mu mshare_{p,it} + \varepsilon_{it} \qquad (11),$$

$$\tilde{P}_{cpi} = \alpha + \sum \rho_i citygood_i + \mu mshare_{m,it} + \varepsilon_{it} \qquad (12),$$

lastly, all the equations mentioned above accounted for running them considering all of the nine goods in the sample. The price dispersion equations are estimated for each good. Thus in this way, the study estimates individual coefficients for all the parameters in each equation for each one of the goods in the data. Having estimates for individual goods tells which goods' prices tend to equalize during the analyzed period. Naturally, the city pair and good dummy are changed to city pair dummy when the regressions are estimated by good. For example equation (7) becomes

$$\tilde{P} = \alpha + \sum \rho_i city_i + \mu mshare_{p,it} + \varepsilon_{it} \qquad (13).$$

The econometric approach described in this section sets the equations to be estimated. As it was mentioned before, the basis for this equations are previous papers on price dispersion and the failure of the law of one price, paying special attention to Engel and Rogers (1996) model. This paper also introduces the trade flow of the goods selected for this study and incorporates it as an explanatory variable for the price dispersion equation as well as for the price volatility one. In the next section, the data for this paper is described.

CHAPTER 5 - DATA

The data are assembled from variety of sources. The Brazilian consumer price data come from the "Instituto Brasileiro de Geografia y Estadistica" (IBGE, Brazilian Institute of Geography and Statistics), whereas the Paraguayan consumer price data come from the Central Bank of Paraguay (BCP). The study employs monthly-disaggregated consumer price data from 1992 to the December 2000. Although there exists consumer price index data up to the year 2006, limitations on other database used to construct the master database of this paper restrict this study to the year 2000. The data gathered from the sources mentioned above comprise of consumer price indexes from nine Brazilian cities and one city in Paraguay.

The IBGE provides monthly consumer price index data from nine cities: Belem, Belo Horizonte, Curitiba, Fortaleza, Porto Alegre, Recife, Rio de Janeiro, Salvador and Sao Paulo. The IBGE has an aggregated database called SIDRA that covers information for several years of many economic indicators.

Monthly consumer price data are classified according to the Classification of Individual Consumption by Purpose (COICOP), a reference classification published by the United Nations Statistics Division[1]. Although both countries have the same classification system for their goods, each country has its own code that identifies each product. The Brazilian data is organized up to the 7-digit level of the COICOP, while, the Paraguayan data is organized up to the 5-digit level of the same classification system. For this reason, in constructing the database, it was necessary to aggregate the Brazilian data up to the 5-digit level to match the category of goods across countries. The methodology used to concord these goods is described in the appendix.

The change in prices for each city is calculated as the 12-month price difference, $\Delta P_i = P_{i,t} - P_{i,t-12}$. The sample contains eleven goods because eleven goods were found in

[1] See United Nations Statistics Division at http://unstats.un.org/unsd/default.htm

the entire period covered (1993-2000) in the datasets of both countries, Brazil and Paraguay. These items consist of nine tradable goods and two non-tradable goods. Since trade flows is an explanatory variable, we omit the non-tradable goods and estimate the equations using just the tradable goods. Table 4 shows the COICOP classification of these items and the description of them.

Since the main hypothesis of this paper is that relative price changes among city pairs separated by a border decline with increased levels of trade, trade flow data are also used. The trade flow data come from Feenstra's webpage[2] and The Center of International Database at the University of California at Davis. The database available at Feenstra's webpage comprises of bilateral trade data by commodity from 1962 to the year 2000. Feenstra's database is available from the International Trade Data from the NBER-UN world trade data (www.nber.org/data) and it is organized by the 4-digit level of the Standard International Trade Classification (SITC), revision 2.

The dataset constructed by Feenstra et al updates the Statistics Canada World Trade Database, which were available for the years 1970-1992. The NBER-UN trade data on the other hand, only carries data from 1984-2000. Although that database includes 72 reporter countries, Uruguay data is not found in Feenstra's database as an exporter. There is some data available on the imports of the other MERCOSUR members from Uruguay, but the trade flows data from Uruguay with the other MERCOSUR is neither quite explicit nor thoroughly complete for the purpose needed for this study since exports and imports from Uruguay to other MERCOSUR countries and the rest of the World are also required.

The data for Uruguay is from the United Nations COMTRADE database. Since the previous trade flows data is classified with the SITC rev. 2, this classification is also used to create the trade flows for Uruguay. These trade flows are merged with Feenstra's trade flows to provide a complete accounting of trade by MERCOSUR member countries.

The model to be estimated also requires data for distance between each city, monthly exchange rates for Paraguay and Brazil, and yearly aggregated consumer price index for both

[2] See Feenstra's webpage at http://www.econ.ucdavis.edu/faculty/fzfeens/

countries. The distance data is from the Google Earth, which provides a tool to calculate the distance between each city. Table 5 shows the distance between the city pairs that are used to run the regressions.

The monthly exchange rate and monthly aggregated consumer price index data are gathered from the International Financial Statistics (IFS) database from the International Monetary Fund (IMF).

More about the data collection and construction of the master database can be found in the appendix. In the next section, the results from the equations seen in the methodology part are presented. Some comparisons between the results found in this paper and the ones in the literature review are mentioned.

Table 5-1. Description of goods by COICOP codes

COICOP	Description
11111	Bread
11112	Biscuits and cookies
11131	Fish and seafood
11141	Noodles and pasta
11211	Beef
11212	Chicken meat
11460	Eggs
11612	Citrus fruits
12210	Soft drinks

Notes: Table 4 presents the nine goods matched up with the Brazilian and Paraguayan database. These 9 goods conform the master database of this study.

Table 5-5. Distance between (Asuncion) Paraguay and Brazilian cities

City 1	City 2	Distance (miles)
Asuncion (PY)	Belem (BR)	1748
Asuncion (PY)	Belo H. (BR)	952
Asuncion (PY)	Curitiba (BR)	523
Asuncion (PY)	Fortaleza (BR)	1951
Asuncion (PY)	Porto Alegre (BR)	510
Asuncion (PY)	Recife (BR)	1941
Asuncion (PY)	Rio (BR)	924
Asuncion (PY)	Salvador (BR)	1507
Asuncion (PY)	Sao Paulo (BR)	695

Notes: Table 5 presents only the distances from Paraguay to the Brazilian cities, distances between Brazilian cities are omitted since we focus only on the cross border effect on prices due to the fact that the database for Paraguay is limited and is not possible to make within country comparisons.

CHAPTER 6 - EMPIRICAL RESULTS

In this section, the empirical results are presented making some comparisons with the results obtained by some of the authors mentioned in the literature review. But before focusing in the regression results, some summary statistics on the price volatility between Brazil and Paraguay are presented an also the price volatility within Brazil.

Table 6 presents the results for the average of the price volatility using the standard deviation of prices as the measure for volatility. It can be seen that the price volatility between Brazil and Paraguay is much larger when comparing with the price volatility within Brazil. The average price volatility between Brazil and Paraguay is 22.55% as compared with the price volatility of 6.11% that exist within Brazilian cities, that is the difference in price volatility, using the standard deviation of prices as the measure of it is almost 4 times for cities separated by a border. The average distance between Paraguay (Asuncion) and the Brazilian cities is 1204.163 miles while the average distance within Brazilian cities is 1001.255 miles. When using the mean of price deviations as the measure for price volatility (see Table 7), the average volatility gets a little bit small but the difference between price volatility between the countries and within Brazilian cities is still large. These results are consistent with the ones found by Engel and Rogers where the average price volatility was much higher when city pairs where separated by a geographical border.

Now, focusing on the regression results, it is worthwhile to mention that although some comparisons with the results found in the literature review are made, the model used in this study does not allow for too many comparisons. The model examined in this paper is different from the one mentioned by Engel and Rogers and other authors of the literature review so comparisons are not always applied.

The results for the price volatility equation using the standard deviation of prices as the measure for it can be seen in Table 8. The results show that using the trade index $mshare_p^a$ given the nominal specification (equation (1) in the methodology section), gives the expected negative sign on the coefficient, -31.71 on the variable $mshare_p^a$, this results is also significant at the one percent level with a standard error of 8.71. The result indicates that as the amount of trade between Brazil and Paraguay increases, the volatility of prices gets smaller holding everything else constant which is consistent with the theory that as trade increases prices tend to converge. Using the same specification for the standard deviation of prices, but using the variables $mshare_m^a$ gives the incorrect sign for the coefficient and surprisingly it is significant at the one percent level. The regressions use robust standard errors.

When running the regressions using the deflated prices by the exchange rate specification (equation 3 in the methodology section), none of the trade index measures present the expected negative sign for the coefficient. Even more, none of the coefficient estimated are significant using this specification (see Table 8). This could be due to the high level of inflation experienced by Brazil during the 90's. The high levels of inflation make the results untenable.

When using the deflated prices by the aggregated CPI (equation 4 in the methodology section), the results show a negative sign for the trade index measure $mshare_m^a$, but it is not significant. It can be said then that the nominal specification works better for the volatility of prices calculated as the standard deviation of prices.

The results for the volatility of prices calculated using the mean as the way to measure it indicates that using the nominal specification gives the expected sign when running the regression with $mshare_p^a$ but again, the coefficient of the parameter is not significant. Using the deflated price by the exchange rate to calculate the mean of prices (dependent variable) does not give the expected sign neither for $mshare_p^a$ nor $mshare_m^a$. Lastly, when calculating the mean of prices as the measure for volatility of prices using the deflated prices by the aggregate CPI, the results show that $mshare_p^a$ has the expected sign, the same variable that shows the right sign when running the nominal specification. Once more, although those coefficients show the correct sign they are not significant. See table 9.

In the second part of this paper, that is, when checking the results for the price dispersion equations, the presence of serial correlation is suspected since the data are collected repeatedly across time, that is, errors in a given time are carry over future periods. A test for AR(1) serial correlation in the first-differenced equation is performed as in Wooldridge (2002) for serial correlation in panel-data models. The test result, which is given by the t-statistics gives evidence of serial correlation. To correct for autocorrelation, disturbances are assumed to be heteroskedastic and contemporaneously correlated across panels. Therefore, standard errors are adjusted for both serial correlation and heteroskedasticity. In addition, a panel variable was created, which limited the explanatory variables such as city dummies and distance, that could otherwise would have been included in explaining price dispersion.

The results for the price dispersion equation can be seen in Table 10. The results from the table show that when regressing the nominal price dispersion on a constant, time and the trade share index, the index trade which fits the model better is $mshare_p$. The coefficient on the variable $mshare_p$ is -14.02 and the standard error is 4.16. The results indicate that as more trade is generated between the two countries, price dispersion between the city pairs (one Paraguayan city and one Brazilian) gets smaller. That is exactly as was expected; a negative sign for the variable $mshare_p$.The coefficient for the time variable is 0.49 with a standard error of 0.032. Although the latter is significant at the 1 percent level it does not show the expected coefficient sign. We would expected that as time goes, price dispersion would get smaller, but the positive sign on the coefficient of the time variable implies that with time, price dispersion tends not to converge as in the LOOP. The latter might be explained by the effects that the time variable might be picking up from other variables in the model or omitted variables. The expectation that time variable after the MERCOSUR was established would make prices to equalize is not supported by the data.

Using the variable $mshare_m$ as the controlling variable for the trade measure, the model gives a coefficient of 37.85 for $mshare_m$ with a standard error of 4.23. Although the variable is highly significant, it does not have the expected sign. The variable time again does not hold with the expectations. The constant show significant result but the main concern is the sign of the trade variable. The R-squared gives a result of 0.28.

When using the deflated price by the exchange rate specification, the results do not give the expected sign for the coefficient of the trade measure variables, indicating us that as trade increases price dispersion gets larger. The coefficients on the parameters though are not significant and the R-squared are very low tending to zero.

When using the deflated price by the corresponding aggregated CPI specification, the coefficient for both trade measure index, $mshare_p$ and $mshare_m$, show the expected negative sign. The coefficient for the variable $mshare_p$ is -4.42 with a standard deviation of 10.55 where as the coefficient for the variable $mshare_m$ is -9.45 with a standard deviation of 19.49. The variables though are not longer significant as for the nominal specification. Again, the nominal specification model fits better, for regression the price dispersion it works better than the specification using the deflated prices.

Using the fixed approach to correct for autocorrelation and heteroskedasticity used before for the price dispersion regressions, a linear regression with panel-corrected standard errors, allows regressing equations by COICOP codes also. The coefficient results for the trade parameter varies across goods and they also show different signs across goods. The results present the right sign for the $mshare_p$ variable only for two of the COICOP codes, 11211 and 11212, which represent beef and chicken meat. The estimate coefficient for the trade variable in the case of beef being the good is -84.19 with a standard error of 65.98. The estimate coefficient for trade being chicken meat the good regressed is -114.97, with a standard error of -58.39. While the trade variable has the right sign for these goods, they are not significant. The results can be seen in Table 11.

When running the nominal specification for price dispersion using the variable $mshare_m$ as the measure for trade, five goods present the appropriate sign, but they are not significant. The goods that show the right sign are: bread, biscuits and cookies, fish and seafood, noodles and pasta, and soft drinks. The estimate coefficients for each good can be found in Table 11.

Using the deflated price by the exchange rate equation, gives similar results as for when the nominal price dispersion is being regressed. As shown in Table 12, the estimate coefficients show the correct sign for three of the nine goods using the $mshare_p$ variable as the measure for trade. The estimate coefficient for the trade variable in the case of the good beef is -39.70 with a standard error of 13.29, and being significant at the five percent level. The coefficient for $mshare_p$ in the case of chicken meat is -97.99 with a standard error of 54.1, without being significant. The coefficient for the trade variable in the case of soft drinks on the other hand is -66.71 with a standard error of 10.58 and being significant at the one percent level.

Working still with the deflated price by the exchange rate specification but using $mshare_m$ as the trade variable gives six goods out of nine with the correct sign for the coefficient. Bread, biscuits and cookies, fish and seafood, noodles and pasta, eggs and citrus fruits are the goods with the correct sign, but only the last two of them being significant at the 1% level. The corresponding coefficients for each good can be seen in Table 11.

Lastly, when estimating price dispersion using the deflated prices by the corresponding aggregated CPI, and using $mshare_p$ as the measure for trade, the results show the expected sign for 6 out of 9 goods, being only one of them significant at the 1% level (biscuits and cookies) and another one significant at the five percent level (noodles and pasta). The coefficient for $mshare_p$ varies significantly among goods.

When using the $mshare_m$ variable instead of $mshare_p$, and following the last approach for price dispersion, the results show only two goods with the right sign, beef and chicken meat, being the latter significant at the one percent level. The variable $mshare_p$ shows a coefficient of -325.51 with a standard error of 267.06 for beef; the same variable shows a coefficient of -108.66 with a standard error of 29.61 for chicken meat. Results can be found in Table 14.

The expectation that the increasing trade between Brazil and Paraguay due to the increasing integration of markets through MERCOSUR would make price dispersion to get smaller and would make prices to converge as is the LOOP holds for the general specification of nominal prices when using the variable $mshare_p$ as the measure of trade. A possible explanation for the model to work using $mshare_p$ and not $mshare_m$ would be that this study is focusing only in the case of Brazil and Paraguay so price dispersion for the other country members are not examined here. As for the standard deviation of prices it can be see that the results indicate that again using the variable $mshare_p$ gives the expected result that price volatility tends to get smaller.

Table 6-1. Average Price Volatility using the standard deviation of prices as the measure for volatility

Goods	Brazil-Paraguay	Brazil-Brazil
Bread	26.53	5.37
Biscuits and cookies	28.27	5.51
Fish and seafood	21.04	5.21
Noodles and pasta	25.34	6.03
Beef	22.33	7.53
Chicken meat	21.16	5.50
Eggs	17.07	6.89
Citrus fruits	15.05	6.96
Soft drinks	26.18	5.95
All goods	22.55	6.11

Notes: Entries give the mean value of the price volatility across intercity combinations across Brazil and Paraguay, and within Brazil intercity combinations. As it can be seen in the table price volatility (calculated as the standard deviation) within Brazil is much smaller than price volatility than the one between Brazil and Paraguay, this leads to suspect the presence of the “border effect”. This difference in price volatility is consistent for all goods in the sample.

Table 6-2. Average Price volatility, using the mean deviation of prices as the measure for volatility

Goods	Brazil-Paraguay	Brazil-Brazil
Bread	25.31	2.50
Biscuits and cookies	28.20	2.29
Fish and seafood	19.43	1.91
Noodles and pasta	23.00	2.30
Beef	20.60	2.71
Chicken meat	17.26	2.08
Eggs	14.00	2.85
Citrus fruits	11.16	2.81
Soft drinks	26.48	2.62
All goods	20.60	2.45
Distance in miles	1204.163	1001.255

Note: Entries give the mean value of the price volatility across intercity combinations across Brazil and Paraguay, and within Brazil intercity combinations. Price volatility using the mean of the absolute value of the changes in prices as the measure of it shows the same as before using the standard deviation of prices. The table shows that the price volatility between Brazil and Paraguay is much higher than the one within Brazilian cities.

Table 6-3. Regressions relating price volatility to trade measures and city dummies (Price volatility measured as the standard deviation of prices)

	$\tilde{P}$		$\widetilde{P_e}$		$\tilde{P}_{cpi}$	
$mshare_p^a$	-31.71***	-	1517.81	-	44.21	-
	(8.71)		(1576.25)		(136.56)	
$mshare_m^a$		19.48***		-36.33		-101.39
	-	(3.17)	-	(174.11)	-	(74.21)
Constant	25.17***	9.97***	-75.59	32.69	41.70	114.23
	(1.49)	(2.33)	(91.05)	(120.46)	(22.22)	(60.35)
Citydummies	yes	yes	yes	yes	yes	yes
# of observations	80	80	80	80	80	80

Notes: (i) ***, indicate significance at the .01 level. (ii) Std. errors are in parenthesis. (iii) Std. errors are corrected for heteroskedasticity.

Table 6-4. Regressions relating price volatility to trade measures and city dummies (Price volatility measured as the mean deviation of prices)

	$\tilde{P}$		$\widetilde{P_e}$		$\tilde{P}_{cpi}$	
$mshare_p^a$	-51.44	-	-2.49	-	-23.66	-
	(31.61)		(5.28)		(58.89)	
$mshare_m^a$		34.39		146.70		9.09
	-	(18.23)	-	(149.34)	-	(23.97)
constant	35.06**	8.46	4.57***	-91.18	4.07	-3.50
	(12.15)	(15.47)	(0.91)	(100.84)	(3.42)	(16.58)
citydummies	yes	yes	yes	yes	yes	yes
# of observations	80	80	80	80	80	80

Notes: (i) ***,** indicate significance at the .01 and 0.5 levels respectively. (ii) Std. errors are in parenthesis.

Table 6-5. Regressions relating price dispersion to trade measures, time and citygood dummies

Variable	$\tilde{P}$		$\tilde{P}_e$		$\tilde{P}_{cpi}$	
$mshare_p$	-14.02***		75.94		-4.42	
	(4.16)	-	(86.70)	-	(10.55)	-
$mshare_m$		37.85***		6.53		-9.45
	-	(4.23)	-	(15.06)	-	(19.49)
time	0.49***	0.48***	0.07	0.06	0.67***	0.67***
	(0.03)	(0.03)	(0.27)	(0.27)	(0.11)	(0.11)
citygood dummy	yes	yes	yes	yes	yes	yes
constant	-187.88***	-209.78***	-31.09	-27.81	-267.30***	-292.39
	(14.30)	(14.30)	(119.53)	(116.52)	(48.73)	(46.56)
R-Squared	0.25	0.28	0.00	0.00	0.02	0.02
# of observations	5601	5601	5601	5601	5601	5601

Notes: (i) *** indicate significance at the .01 level. (ii) Std. errors are in parenthesis.

Table 6-6. Results on price dispersion by good calculated using nominal prices.

Good (COICOP code)	$mshare_p$	$mshare_m$	# of observations
11111	1183.45***	51.04	524
	(345.82)	(48.46)	
11112	1534.69***	-91.4	544
	(398.85)	(59.65)	
11131	491.35	-91.51	645
	(289.29)	(37.85)	
11141	169.67	-9.18	498
	(234.63)	(30.07)	
11211	-84.19	81.24	663
	(65.98)	(38.43)	
11212	-114.97	58.27	671
	(58.39)	(35.47)	
11460	320.23	100.63	697
	(57.91)	(7.84)	
11612	358.07	67.56***	734
	(315.64)	(10.39)	
12210	0.23	-28.89	625
	(15.16)	(13.26)	

Notes: (i) *** indicate significance at the .01 level. (ii) Std. errors are in parenthesis.

Table 6-7. Results on price dispersion by good calculated using the deflated prices by the respective exchange rates

Good (COICOP code)	$mshare_p$	$mshare_m$	# of observations
11111	426.99	-49	524
	(172.86)	(22.58)	
11112	371.87*	-28.74	544
	(137.49)	(17.93)	
11131	764.73	-64.53	645
	(382.3)	(50.94)	
11141	12148.31	-1869.96	498
	(6423.57)	(830.2)	
11211	-39.70**	13.61	663
	(13.29)	(7.16)	
11212	-97.99	37.02	671
	(54.11)	(29.96)	
11460	1246.7	-1057.51	697
	(3815.2)	(5244.08)	
11612	190.2	-41.08***	734
	(330.11)	(12.82)	
12210	-66.71***	48.72***	625
	(10.58)	(9.86)	

Notes: (i) ***, **,* indicate significance at the .01, 0.5 and 0.10 levels respectively. (ii) Std. errors are in parenthesis.

Table 6-8. Results on price dispersion by good calculated using the deflated prices by the respective aggregated consumer price indexes

Good (COICOP code)	$mshare_p$	$mshare_m$	# of observations
11111	-1344.99	183.65	524
	(730.14)	(100.35)	
11112	-1519.07***	115.77	544
	(407.22)	(59.01)	
11131	-809.18	228.21	645
	(721.1)	(95.06)	
11141	-2892.25**	160.43	498
	(1065.85)	(134.11)	
11211	316.94	-325.51	663
	(456.99)	(267.06)	
11212	127.34	-108.66***	671
	(54.39)	(29.61)	
11460	-283.19	93.85	697
	(166.57)	(237.37)	
11612	-1011.54	231.38	734
	(3720.95)	(157.7)	
12210	14.92	43.95	625
	(33.92)	(29.88)	

Notes: (i) ***, ** indicate significance at the .01 and 0.5 levels respectively. (ii) Std. errors are in parenthesis.

CHAPTER 7 - CONCLUSION

As it was explained along the paper, this paper was an effort to extend Engel and Rogers (1996), which developed a model to explain price dispersion and price volatility among countries, comparing price dispersion and price volatility of similar goods within a country and between countries. In this paper, the case of Latin America after the MERCOSUR is analyzed. It would make sense that after the better integration between the member parties, without trade barriers, the increase in trade amount between them would tend to close the gap of price dispersion and volatility among them. As it was stated in the literature review, it is know that MERCOSUR did lead to more trade between its State Parties due to the liberalization of trade with reductions of trade barriers.

The exact approach taken by Engel and Rogers (1996) is not implemented due to data limitations. A statement of the existence of a border effect cannot be made since the dataset constructed only has one city representing Paraguay. For Brazil there is data available for several cities, but for the reason mentioned before, comparisons of the behavior of prices within the country as crossing the border cannot be made.

Focusing on the trade flows, and in order to test the hypothesis made that as trade liberalization takes place, and more trade is generated between members of MERCOSUR, price dispersion of similar goods sold in different locations (countries) tends to equalize. That was found in the result using the standard deviation of prices as a measure of price volatility and running a nominal specification. The result shows that the estimate for the parameter $mshare_p^a$ is -31.71. That gives the correct sign for the explanatory variable and it is significant at the 1% level.

For the second part of the paper, when regressing time specific price dispersion on the explanatory variables of the model, the presence of autocorrelation is found. In order to fix the problem, a linear regression with panel-corrected standard errors is run. The results give a coefficient of -14.02 for the trade variable $mshare_p$. The result is significant at the 1% level and the sign of the coefficient holds with the hypothesis of this paper. The R-squared of the model is 0.25.

The expectation that the increasing trade between Brazil and Paraguay due to the increasing integration of markets through MERCOSUR would make price dispersion to get smaller and would make prices to converge as is the LOOP holds for the general specification of nominal prices when using the variable $mshare_p$ as the measure of trade. A possible explanation for the model to work using $mshare_p$ and not $mshare_m$ would be that this study is focusing only in the case of Brazil and Paraguay so price dispersion for the other country members are not examined here. As for the standard deviation of prices equations, the results indicate that again using the variable $mshare_p$ gives the expected result that price volatility tends to get smaller.

When regressing price dispersion by good, the coefficient results for the trade parameter varies across goods and they also show different signs across goods. The results also differ when changing the trade index measure. For most cases though, the goods beef and chicken meat showed evidence of price convergence.

Although some interesting results are found in this study, they are not conclusive due to the limitation of the availability of prices for more cities in the MERCOSUR region, between countries and within countries specially. The number of goods for which there was found a full time series from Dec-1992 to Dec-2000 is only 9 goods. However, the results indicate that those goods with high levels of trade between Brazil and Paraguay tend to experience a relative convergence in prices.

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Appendix A - Consumer Price Data

Consumer price data from Brazil and Paraguay are used to construct the master database. Consumer price indices are closer to being monthly average data than point in time data since an average of each product's price in the consumer's basket is calculated several times in a month across various outlets.

Consumer price data for Brazil from is gathered from the Brazilian Institute of Geography and Statistics (IBGE), "Instituto Brasileiro de Geografia e Estatística". This Institute has an aggregated database called SIDRA that covers information for several years for many economic indicators, the data is available online at http://www.sidra.ibge.gov.br. Tables 58, 655 and 1692 from the webpage mentioned before are used. The IBGE provides monthly consumer price index data from nine cities: Belem, Belo Horizonte, Curitiba, Fortaleza, Porto Alegre, Recife, Rio de Janeiro, Salvador and Sao Paulo.

Consumer price data for Paraguay is collected from its Central Bank (BCP). The CPI index for Paraguay is calculated for the area of Asuncion and nearby cities. For Paraguay, as in most Latin American countries, only one price index is calculated as a representation for the whole country, consumer price indexes are not calculated for many cities as in the case of Brazil. The price index measures the price evolution of a basket of goods and services that represent households' expenditures. The base year of the price index for Paraguay is 1992 and the basket of goods that represent a representative consumer constitute of 235 goods and 58 services.

Both monthly consumer price data are classified according to the Classification of Individual Consumption by Purpose (COICOP), which is a reference classification published by the United Nations Statistics Division.[3] The Brazilian data was organized up to the 7-digit level of the COICOP, on the other hand, the Paraguayan data was organized up to the 5 digit level of the same classification system. In an effort of the MERCOSUR State Parties to harmonize their economic indicators, a harmonized Consumer Price Index between the country members and

[3] See United Nations Statistics Division at http://unstats.un.org/unsd/default.htm

Chile was created. This harmonized document started with data from 1999 until the year 2004. It was constructed by the 3-digit level COICOP. Although the data from this harmonized document was not used, important information as the matching codes for each good by the MERCOSUR country members and Chile was found very useful.

Appendix B - Data Concordances

In order to be able to converge data from Brazil and Paraguay we had to find convergence tables that would give us the matching from the Brazilian code to the COICOP code and from the Paraguayan code to the COICOP code as well. Each country uses its own methodology to construct their price index and also their own code. Works have been done in order to harmonize these price indexes among the southern countries that form the MERCOSUR Custom Union.

Once the codes were matched for each product for both countries. The data could be converged then in a single database. Since for the Brazilian data were disaggregated at a greater level in the classification system, in the 7 digits COICOP codes, we had to aggregated the data for the Brazilian cities to a 5 digit COICOP code since the concordance table for the Paraguayan data was disaggregated up to that level.

Consumption weights for each Brazilian code are used in order to group goods in a more aggregated level when needed. The weights used are the ones presented in the Brazilian methodology at the IBGE. The Brazilian data presents the weights of each good for each city but in this paper only the weights of the city of Sao Paulo are being used since it is the largest city in Brazil, which makes it a good representative of the country. After doing this, the merging of files proceeds.

After having a unique file for the Brazilian data, this file was merged with the Paraguay CPI data. For that we create a time variable for the Paraguayan data that will match with the one used in the Brazilian data, we also did identify the observations of those products that we have in the Paraguayan and Brazilian data so that we can have our data match together and drop those observations which are not present in both files. We also drop duplicates form the Paraguayan data to do the merging. This resulted in the data for prices across the two countries.

The paper drops the observations for those years that we do not have information in both countries. An analysis and checked of the data is done in order to find out which products or COICOP codes are found in the data for all the years that we are going to cover in the research.

Forty-five variables for the distance between each city pair that could be match between the 9 cities in the sample are aggregate to the master file in order to create the explanatory variable *distance*. The distance between each city pair is calculated using the program Google Earth.

As mentioned in the data description, trade flows data comes from The Center of International Database at UC Davis at Feenstra's webpage. The database available at Feenstra's webpage comprises a set of bilateral trade by commodity from 1962 to the year 2000. Feenstra's database is available from the International Trade Data from the NBER-UN world trade data (www.nber.org/data) and it is organized by the 4-digit level of the Standard International Trade Classification (SITC), revision 2.

The data for Uruguay is from the United Nations COMTRADE database. Since the previous trade flows data was classified with the SITC rev. 2, this classification was also used to create the appropriate queries to get the trade flows from Uruguay.

After having all the trade flows data by the 4-digit level of the SITC Rev. 2 classification, the append of each year trade flows is done. In order to develop the index to measure the volume of trade volume in the MERCOSUR region and among Brazil and Paraguay, trade flows data from the World, Brazil, Argentina, Paraguay and Uruguay as exporters and trade flows data where Brazil and Paraguay as importers are kept, while trade flows from other countries are dropped. Duplicates are dropped.

To match the SITC Rev.2 codes of trades flows and the consumer price indexes for the nine goods concordance tables were obtained from the United Nations Statistics web page. A directly concordance table between the two does not exist, but, instead the more complex concordance from COICOP to CPC rev.1.0, from CPC rev.1.0 to SITC Rev.3 and from SITC

Rev.3 to SITC Rev. 2 was used. The resulting concordance allowed the trade data to be converted from SITC to COICOP.

Variables Description

The paper generates indexes for trade shares of the two countries in the MERCOSUR region and also the share of these countries in World trade. The variables related to trade flows are:

Imports_part, this variable is created by classifying the data by year importer and COICOP code and adding the trade flows for the case where Paraguay is an exporter and Brazil and importer and when the opposite trade direction occurs (Brazil=exporter and Paraguay=importer). If there happen to be any missing value, they are dropped.

Imports_merc, this variable is generated by classifying the trade flows by year, importer and coicop, then the trade flows are added for the cases where the World is not an exporter

Imports_part_all, this variable is generated by classifying the trade flows by importer and COICOP, adding the trade flows, note that for this case the year is not relevant, although, the addition is done for the case when Paraguay is an exporter and Brazil an importer or for the case where Brazil is the importer and Paraguay the importer. As for the other variables, missing values are dropped.

Imports_merc_all, this variable is generated by classifying the trade flows by importer and COICOP, adding the trade flows in the case where the exporter is World. That is this variable represents the flows from MERCOSUR countries to the World not discriminating it by year.

With the four indexes above, the trade flows share to be used as independent variables in the regressions of the model.

Mshare_Part_p and *mshare_part_b* are generated by dividing *imports_part* of both countries, Paraguay and Brazil, by imports_world.

Mshare_merc_p and *mshare_merc_b* are generated by dividing *imports_merc* of each country, by *imports_world*.

The variable $mshare_p$ is generated by adding *mshare_part_p* and *mshare_part_b*.

The variable $mshare_m$ is generated by adding *mshare_merc_p* and *mshare_merc_b*.

The variables $mshare_p^a$ and $mshare_m^a$ (where the subscript *a* stands for all, the subscript *p* stands for partner and the subscript *m* stands for MERCOSUR) are generated using the same approach, but this time using the variables that do not discriminate by year, but instead use the summation of all imports during the period of study. That is, this variable is generated using the variable *imports_part_all* and *imports_merc_all* instead of *imports_part* and *imports_merc* respectively.

By the COICOP code and year, the variables *sumworld, sumpart* and *summerc* are created. The variable *sumworld* represents the summation of imports from the world, and the *sumpart* variable represents the summation of the variable *imports_part* that was described before. That is *sumpart* represents the addition of the variable that classified the data by year importer and COICOP code and then added the trade flows for the case where Paraguay is an exporter and Brazil and importer and when the opposite trade direction occurs (Brazil=exporter and Paraguay=importer). If there happen to be any missing value, they are dropped. The variable *summerc* was created by adding imports from the MERCOSUR countries by COICOP and year.

By COICOP code, the variable *sumworld_all* is created by adding the imports from the world. In that way each COICOP code has its corresponding trade flow.

By COICOP code, the variables *sumpart_all* and *summerc_all* are also generated. The variable sumpart_all is calculated adding the *import_part* variable, which was described above. The summerc_all variable is the addition of the imports_merc variable, also described before.

Other variables generated are *mshare2_merc all, mshare2_part_all,* and *mshare2_part*. Mshare2merc_all is generated by dividing *summerc_all* with *sumworld_all*. The same approach is used for mshare2_part_all with the corresponding variables. The variable mshare2_part is generated by diving the variable *sumpart* with *sumworld.*

Having created all these new variables, the next step was to merge the trade flows data with the consumer price indexes dataset by the 3-digit level COICOP. Notice that to do so, a coicop3 variable is created in the consumer price indexes dataset.

Monthly exchange rate and inflation indexes are used as deflators for the dependent variable of the type 1 equation. To calculate inflation in each country, monthly aggregated consumer price index is used. Inflation for both countries (Brazil and Paraguay) is calculated by dividing the aggregated consumer price index of time t with the aggregated consumer price at t-12 (one year lag), subtracting 1 and multiplied by 100 to obtain the percentage change. The variables generated are: *infl_b* and *infl_p*.

To generate the exchange rate deflator, we take the month average exchange rate and divide it by one year lag of the same exchange rate, that is, the exchange rate at t-12, then subtracting this index by 1 and multiplying it by 100 to calculate the percentage change. The variables generated are: *echange_b* and *echange_p*. The monthly exchange rate and aggregated consumer price index data are gathered from the International Financial Statistics (IFS) database from the International Monetary Fund (IMF).

The exchange rate data is measured as the foreign currency per U.S. dollar, which means that an increase indicates appreciation of the U.S. dollar and a decrease means depreciation for the U.S. dollar.