TRADE ELASTICITIES IN MERCOSUR

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Abstract

This paper provides estimates of trade elasticities for a group of countries that are part of Mercosur using a model of error correction. The results show a low elasticity of exported and imported volumes to changes in the real effective exchange rate. The income elasticity of imports is higher with respect to the income elasticity of exports in two of the four countries. Real effective exchange rate volatility has a negative effect on trade volumes with the greatest impact on imports.

ELASTICIDADES DE COMERCIO EN EL MERCOSUR

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Resumen

Este trabajo provee estimaciones de elasticidades de comercio para un grupo de países que son parte del Mercosur usando un modelo de corrección de errores. Los resultados muestran una baja elasticidad de los volúmenes exportados e importados a cambios en el tipo de cambio real efectivo. La elasticidad ingreso de las importaciones es más alta con respecto a la elasticidad ingreso de las exportaciones en dos de los cuatro países. La volatilidad del tipo de cambio real efectivo tiene un efecto negativo sobre los volúmenes comerciales con mayor impacto sobre las importaciones.

INTRODUCTION

Estimating trade elasticities is an old issue in international economics. Extensive literature started from Orcutt (1950) and was stimulated at the beginning by the International Monetary Fund through the Staff Papers as Blejer, Khan and Masson (1995) had expressed. Economists have paid close attention to the subject, not only through extensive literature, specifying and estimating equations, but also summarizing contributions through surveys.

Thursby and Thursby (1987) point out that there were three causes that motivated the extensive literature on the topic. On the one hand, from a positive approach, trade theories have been tested in order to understand the transmission of economic shocks between countries. On the other hand, from a normative approach, commercial, macroeconomic and alternative exchange rate regimes have been evaluated. Finally, advantage has been taken of the availability of economic data on international transactions, which have been easily accessible to academics and policy makers compared to other sources of information.

Aggregate trade elasticities are intended to quantify how the volumes of exports and imports respond to the 1% change in the different explanatory variables. Traditionally, relative price and income measures have been used.

Most academic literature on international trade elasticities has focused on advanced economies, while developing regions have received much less attention (Fullerton, Sawyer, Sprinkle, 1999).

The main objective is to analyze the response of export and import volumes to changes in GDP, the real effective exchange rate and their volatility. Specifically, we will try to provide evidence for the four countries that created Mercosur (Southern Common Market) in 1991: Argentina, Brazil, Paraguay and Uruguay, using a model of error correction based on Engle and Granger (1987) for the period 1993-2014.

The paper proposes that real devaluations would not be effective in stimulating trade, given the reduced effect of the real effective exchange rate on export and import volumes, compared to the impact of GDP on them. That is, large movements of the variable "prices" (sharp devaluations) it is also proposed, in order to achieve a growth in the quantities exported. Furthermore, that some countries would have an elasticity of imports to GDP greater than the elasticity of exports to GDP of trading partners; Therefore, these countries will tend to face trade deterioration in the case of growing at the same level as their trading partners.

The article is organized as follows. Section 2 provides a brief overview of the literature on trade elasticities. Section 3 describes the macroeconomic variables of Latin America used in this work. Section 4 presents the estimation methodology. Section 5 provides the data used and sources of information. Section 6 provides the results of the estimates and an analysis thereof. Section 7 presents the conclusions.

1. LITERATURE REVIEW

The academic literature on foreign trade elasticities is extensive and abundant. As Imbs and Mejean (2009; 2010) express, the calculation of elasticities is an old issue in international economics. After the war, one of the pioneering works was that of Orcutt (1950), which described

the main problems of the estimates at that time that caused a downward bias in the price elasticity. Devaluations might not improve the trade balance.

Goldstein and Khan (1985) and Thursby and Thursby (1987) point out that the availability of economic data on trade flows contributed to the natural advance of empirical work on trade models. From Orcutt (1950), in the next twenty years, in addition to a large number of articles, surveys have been found describing contributions in the area. Highlights of Cheng (1959), Prais (1962), Taplin (1967) and Kreinin (1967).

In the late 1950s, Johnson (1958) established a controversy over differences in income elasticities. If in a 2-country model with trade initially in equilibrium, if prices are constant and income growth is the same in both countries, the trade balance between them may change over time given income elasticities difference. If a country has an income elasticity of imports greater than its income elasticity of exports, it will experience a greater growth of its imports and a deterioration of its trade balance.

The influential work of Houthakker and Magee (1969) incorporates as explanatory variables the GDP and the trade partners and postulates the puzzle about the tendency to the United States trade deficit, because the income elasticity of imports was greater than Income elasticity of exports.

The breakdown of the Bretton Woods system from fixed exchange rate regimes in 1973 to flexible exchange rate regimes provoked a growing academic interest in the effects of exchange rate volatility on trade flows. Real exchange rate volatility was incorporated as an explanatory variable in the estimates. The standard theoretical argument expresses that the uncertainty generated by the real exchange volatility imposes costs on the economic agents adverse to the risk; especially with respect to the prices that exporters would receive and would pay in the future. This would lead to a decrease in volumes. However, the empirical evidence is ambiguous in its results (see Chowdhury, 1993; Ozturk, 2006; Zhao, 2010).

One work that has received great attention is that of Goldstein and Khan (1985), which expresses that the empirical literature on trade equations has been dominated by two types of models, called "imperfect substitutes" and "perfect substitutes". We will focus on the first one. It points out that neither exports nor imports are perfect substitutes for domestic goods, because the single price law is not fulfilled. As a result, countries would have trade in both directions.

Reinhart (1995) expressed the low effectiveness of the devaluations to correct external imbalances in a context where the developing countries carried out economic reforms and the devaluation was a central part in them. The variables "income" and "prices" are usually significant, but the latter tend to be low, and a large movement in relative prices would be required to have a positive impact on trade flows.

Focusing on Mercosur countries, Paiva (2003) analyzes the determinants of Brazil's trade flows during the period 1991-2001 using a model of error correction and estimating its elasticities. For exports, that is positive for the GDP of trading partners (close to 1.5) and negative for the volatility of the real exchange rate. For imports, the relevant variables are the GDP (with a coefficient greater than unity) and the volatility of the real exchange rate, both of which are positive.

Brunini and Mordecki (2011) examine the determinants of exports and imports for Uruguay during 1993-2010, finding a positive and significant relation between exports and external demand, but not with the real exchange rate. (1990), using a model of error correction with data for 1993-2010, obtaining a low elasticity of the exported volumes with respect to the real effective

exchange rate in relation to the GDP of the trading partners . In addition, these authors find a negative effect of exchange rate volatility on exports.

Guardarucci and Puig (2012) work with Mercosur countries using a model of error correction with data for 1993-2010, obtaining a low elasticity of the exported volumes with respect to the real effective exchange rate in relation to the GDP of the trading partners. In addition, these authors find a negative effect of real effective exchange rate volatility on exports.

For Argentina, Catao and Falcetti (2002) analyze the determinants of trade flows during 1980-1996 to explain the strong imbalances that occurred during the nineties. In the traditional approach of exports, depending on the GDP of the trading partners and the real exchange rate (they use as their variable their volatility) add a variable of relative prices, one of productive capacity and one variable of absorption. The results indicate positive and significant values for commodity prices, domestic absorption and economic activity of the main trading partner, Brazil. For the estimation of imports, in addition to the GDP and the real exchange rate, they incorporate the real interest rate. Elasticity is positive for GDP (and above unit) and negative for the real exchange rate and the real interest rate.

Berrettoni and Castresana (2009) analyze the determinants of exports during 1993-2008 using also a model of error correction. They have found that the response of exports and imports to the real exchange rate is low in relation to the sensitivity of these aggregates to the changes in the level of activity. In addition, they have stated that the real effective exchange volatility affects adversely trade flows.

Zack and Dalle (2014), analyzing data for 1996-2013, find that foreign trade elasticities condition long-run economic growth, since the real exchange rate cannot solve the obstacle to the deterioration of the trade balance. Using a model of error correction for imports and exports, they calculate their elasticities (1.81 and 0.99 for GDPs) while for price variables (the real exchange rate) they are at -0.34 and 0.07 respectively.

2. EMPIRICAL EVIDENCE IN MERCOSUR

Before calculating the aggregate elasticities, this section aims to describe the evolution of the variables used in the estimates (export and import volumes, GDPs, real effective exchange rate and its volatility).

Figure 1 shows the evolution of the real effective exchange rates of the Latin American countries (Argentina, Brazil, Paraguay and Uruguay) in the period 1993-2014, according to the sources used in section 5, and several conclusions can be drawn.

Between 1993 and 1998 there was an appreciation of the real effective exchange rate in a context of liberalization of the capital account and of capital inflows in the countries of the block. As from March 1998, a brief upward period began until January 2000 (mainly due to the devaluation of the real). Then begins another short period of decline of the real effective exchange rate that lasts until June 2001, when it begins to grow slowly until June 2002; as from this date, it registers a jump with a maximum in January 2003. From this moment, a long period of fall of the real effective exchange rate begins for all the countries with the unique exception of Argentina.

Figure 1. Real Effective Exchange Rate
(1993-2014 = Base 100)
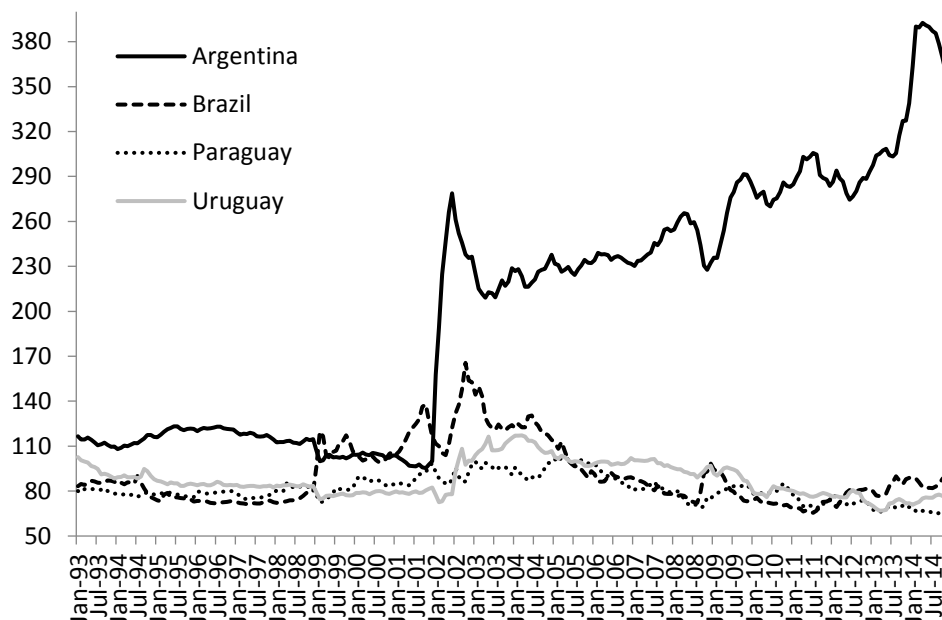
Source: Own calculations based on ECLAC and BCRA.

In addition to analyzing their evolution, it is also important to appreciate the volatility of the real effective exchange rate. Table 1 describes their behavior. The decade of greatest dispersion was the period 2000-2009, with Argentina being the country with the greatest variability. In contrast, the decade of the 1990s was the period of less dispersion in a context of major economic reforms: privatization of public enterprises, deregulation of labor markets and health, opening of the economy and capital inflows.

Table 1. Real Effective Exchange Rate Volatility
(1993-2014 = Base 100)

Countries	1993-1999	2000-2009	2010-2014
Argentina	55	141	81
Brazil	87	119	80
Paraguay	127	87	88
Uruguay	71	116	108
Average	85	116	92

Source: Own calculations based on ECLAC and BCRA

Note: to obtain real effective exchange rate volatility, the standard deviation of the monthly variation of the real effective exchange rate was calculated. For a deeper analysis, see Chowdhury (1993) and Zhao (2010).

According to Figure 2, export volumes are analyzed through their growth rates for the period 1993.Q1-2014.Q3, which were ordered from highest to lowest. The country with the highest growth in export volumes was Brazil (6.4%). The growth of export volumes average was 5.4%.

Figure 2. Annual Percent Change of Export Volumes 1993-2014
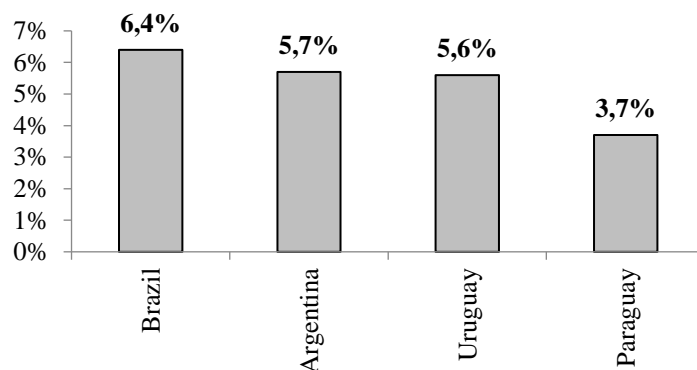
Source: Prepared by the Statistical Institutes and Central Banks.

For the analysis of import volumes, the same procedure used in exports is carried out. Considering the period 1993.Q1-2014.Q3 according to Figure 3, the country with the highest growth rates for its import volumes was Argentina (8.0%). The simple average was 6.3%.

Figure 3. Annual Percent Change of Import Volumes 1993-2014
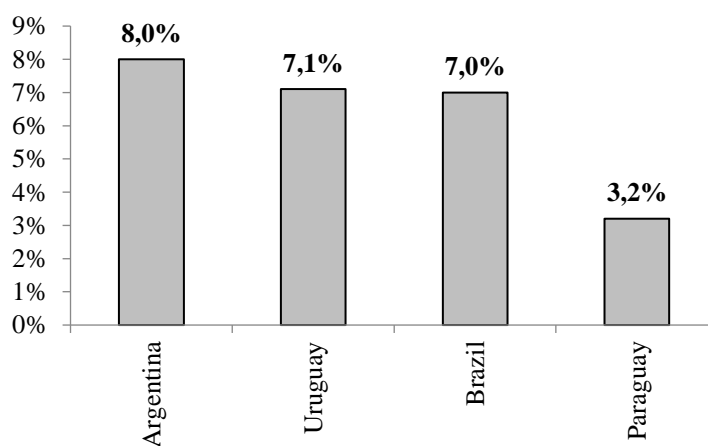
Source: Prepared by the Statistical Institutes and Central Banks.

The main determinant of imports is GDP. Figure 4 describes the behavior of this variable for the period 1993.Q1-2014.Q3. Countries are ranked from highest to lowest and the simple average of GDP growth has been 3.3%. The highest growth rate was in Argentina (3.6%).
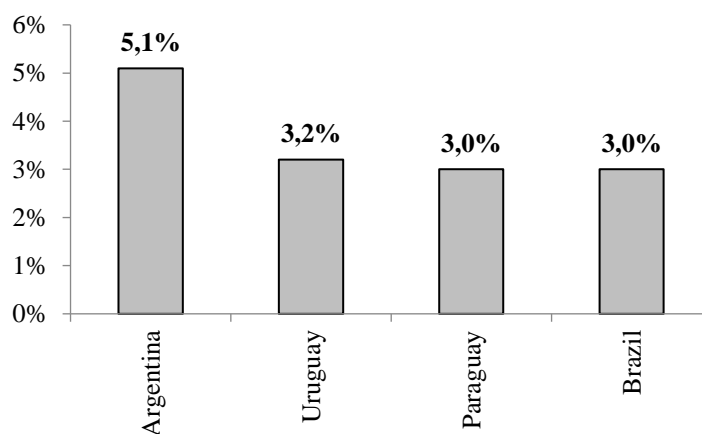
Figure 4. Annual Percent Change of GDP at constant prices 1993-2014
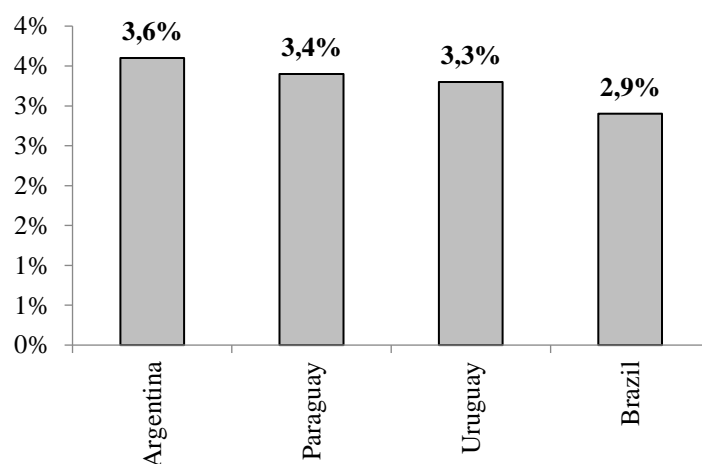
Source: Prepared by the Statistical Institutes and Central Banks.

Figure 5 aims to analyze the evolution of GDP of trading partners for each country. The simple average of GDP growth of trading partners has been 3.6%.

Figure 5. Annual Percent Change of GDP partners at constant prices 1993-2014

Source: Prepared by the Statistical Institutes, Central Banks and IMF.

The real effective exchange rates for all countries have been appreciated since 2003, with the sole exception of Argentina. Real effective exchange rate volatility declined with respect to the beginning of the decade, except for Paraguay. Imports have grown at an average rate above the increase in exports (6.3% and 5.4% respectively), while GDP of trading partners showed a more dynamic behavior with respect to GDP (3.6% and 3.3%).

3. METHODOLOGY

A model of error correction based on Engle and Granger (1987) will be used in the present work; both, for the export and import equations, choosing as the explanatory variables the GDP of the trading partners and the real effective exchange rate in the first case, and GDP and the real effective exchange rate in the second one; Together with a real effective exchange rate volatility variable in both cases. The model of error correction relates the long and short-run interactions. It is necessary for the series to have the same degree of integration, and in the case that the residues are stationary; the short-term estimates will be valid[1].

For exports, the long and short-run models are given by:

$$\ln \text{Exports}_t = a_1 + a_2 \ln \text{GDP partners}_t + a_3 \ln \text{REER}_t + a_4 \text{Volat}_t + \varepsilon_t \tag{1}$$

$$\Delta \ln \text{Exports}_t = b_0 + b_1 \Delta \ln \text{GDP partners}_t + b_2 \Delta \ln \text{REER}_t + b_3 \Delta \text{Volat}_t + \text{ECT}_t + \varepsilon_t \tag{2}$$

In which the dependent variable is given by the volumes of exports of goods and services in period t, while the explanatory variables are the real effective exchange rate in period t, the level of activity of trading partners (GDP trading partners), in period t and the variable volatility of the real effective exchange rate (Volatility). Except for the latter, all are expressed in natural logarithms to obtain their elasticities. In this case, the elasticities of long-run exports are given by the coefficients a_2 and a_3 respectively.

In the short-run estimation, the variables are differentiated once and the error correction term (called ECT) is added which is nothing else than the long term regression residuals lagged one period. This has to have negative sign and be statistically significant, which guarantees the stability of the model.

In the case of imports, the same analysis is performed, only considering the GDP instead of the GDP of the trading partners.

The models of long and short-run for the volumes of imports of goods and services are given by:

$$\ln \text{Imports}_t = a_1 + a_2 \ln \text{GDP}_t + a_3 \ln \text{REER}_t + a_4 \text{Volat}_t + \varepsilon_t \tag{3}$$

$$\Delta \ln \text{Imports}_t = b_0 + b_1 \Delta \ln \text{GDP}_t + b_2 \Delta \ln \text{REER}_t + b_3 \Delta \text{Volat}_t + \text{ECT}_t + \varepsilon_t \tag{4}$$

4. DATA AND SOURCES OF INFORMATION

The countries chosen for the analysis are Argentina, Brazil, Paraguay and Uruguay. Given their heterogeneity, the sources of information and data collection have been varied. Table 2 provides a simplified description of the reference period for each country, and of the sources of the data.

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[1] For a more detailed analysis on Time Series Econometrics, see Enders (1995).

Table 2. Summary of data and their sources

Countries	Period	Sources of Information
Argentina	1993.Q1-2014.Q1	Instituto Nacional de Estadísticas y Censos Banco Central de la República Argentina CEPAL /FMI
Brasil	1996.Q1-2014.Q3	Instituto Brasileño de Geografía y Estadística CEPAL /FMI
Paraguay	1995.Q1-2014.Q3	Banco Central de Paraguay CEPAL /FMI
Uruguay	1995.Q1-2014.Q2	Banco Central de Uruguay CEPAL /FMI

Source: Own elaboration

5. RESULTS AND ANALYSIS

The results show that both export and import volumes are more responsive to changes in income (measured by GDP and GDP of trading partners) than changes in relative prices (measured by real effective exchange rate and its volatility).

GDP was significant and with the expected sign in all countries, both for exported and imported volumes. The income elasticity of imports exceeded the income elasticity of exports in Argentina and Paraguay.

The income elasticity of exports exceeded unity in all but Paraguay (0.759). In contrast, the income elasticity of imports exceeded the value of 1.3 in all countries.

With respect to the real effective exchange rate, on the export side it was significant in all countries, but in Paraguay and Uruguay they have the opposite sign to the expected. One the import side, the standard result was obtained, except in Paraguay: devaluation contracts the imported volumes.

The results obtained for real effective exchange volatility are in line with those obtained by Berrettoni and Castresana, 2009; Guardaucci and Puig, 2012; Zack and Dalle, 2014. A negative and statistically significant impact on trade volumes, particularly for imports, can be seen.

As regards the short-run estimates, it is observed that, in general terms, the main variable that proves to be significant is the GDP. The error correction term (ECT) was negative and significant for all equations and all countries, which supports the stability of the model (it measures which percentage of the deviation from the long-run relationship is corrected in each period).

In accordance with the above, some general conclusions can be drawn. First, the real effective exchange rate has a secondary role on foreign trade volumes given its low coefficients of elasticities. Second, real effective exchange volatility would affect those countries with a history

of exchange rate instability, such as Argentina. Third, in the countries where the Houthakker-Magee finding was not observed (Brazil and Uruguay), the highest income elasticities of exports were registered.

6. CONCLUSIONS

The estimation of trade elasticities has been a fruitful area of applied research in international economics since the postwar period. The availability of data for a large number of countries, the interest in evaluating theoretical models at the empirical level and the analysis of alternative macroeconomic policies stimulated interest in the topic. During the fifties and sixties, much of the studies were supported by IMF. However, regions such as Latin America have received less interest from the Academy and policy makers compared to the abundant literature for advanced economies.

The objective of this work was to partially cover this gap and provide updated results for the countries that formed Mercosur in 1991. The results confirm what the literature shows, with GDP being a more relevant variable with respect to the real effective exchange rate on import and export volumes.

The income elasticity of imports was higher than the income elasticity of exports in most countries, which would indicate that if a country grows at the same rate as its main trading partners, it would deteriorate its trade balance as Johnson said more than fifty years ago. The low elasticity of the real effective exchange rate indicates that large movements in relative prices would be required to stimulate trade volumes, and this result is consistent with previous work.

Real effective exchange rate volatility turned out to be significant and negative, which is in keeping with part of the literature that holds that the uncertainty of the real effective exchange rate depresses the volumes of trade.

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APENDIX

Table 3. Long-run Elasticities

Exports	Argentina	Brazil	Paraguay	Uruguay
Log REER	0.166***	0.464***	-1.067***	-0.261*
	(0.041)	(0.157)	(0.188)	(0.150)
Log GDP Partners	1.025***	2.327***	0.759***	1.957***
	(0.085)	(0.187)	(0.101)	(0.128)
REER Volatility	-0.013***	-0.001	-0.019	-0.043*
	(0.003)	(0.038)	(0.021)	(0.023)
Observations	85	75	79	78
R2	0.91	0.666	0.65	0.732

Imports	Argentina	Brazil	Paraguay	Uruguay
Log REER	-0.293***	-0.465***	-0.062	-0.223***
	(0.035)	(0.068)	(0.177)	(0.077)
Log GDP	1.980***	1.788***	1.418***	1.326***
	(0.066)	(0.057)	(0.107)	(0.050)
REER Volatility	-0.033***	-0.004	-0.068***	-0.055**
	(0.004)	(0.012)	(0.021)	(0.021)
Observations	85	75	79	78
R2	0.972	0.953	0.819	0.940

Note: Standard error in parentheses.

Statistical significance *** p <0.01, ** p <0.05, * p <0.1

Table 4. Short-run Elasticities

Exports	Argentina	Brazil	Paraguay	Uruguay
Log REER	0.005	0.000	-0.304	0.263
	(0.090)	(0.170)	(0.268)	(0.246)
Log GDP Partners	0.236**	0.255*	-0.105	0.696**
	(0.112)	(0.134)	(0.108)	(0.309)
REER Volatility	-0.001	0.008	-0.025	-0.042
	(0.005)	(0.008)	(0.031)	(0.039)
ECT	-0.147**	-0.0774*	-0.113*	-0.115*
	(0.073)	(0.045)	(0.059)	(0.061)
Observations	84	74	78	77
R2	0.604	0.685	0.433	0.361

Imports	Argentina	Brazil	Paraguay	Uruguay
Log REER	-0.281***	-0.109*	-0.034	-0.118
	(0.062)	(0.061)	(0.242)	(0.186)
Log GDP	2.768***	1.133**	0.431*	-0.020
	(0.251)	(0.438)	(0.239)	(0.281)
REER Volatility	-0.009**	-0.020**	-0.039	-0.026
	(0.004)	(0.009)	(0.026)	(0.029)
ECT	-0.259***	-0.284***	-0.177***	-0.982***
	(0.070)	(0.068)	(0.059)	(0.106)
Observations	84	74	78	77
R2	0.804	0.786	0.637	0.714

Note: Standard error in parentheses.

Statistical significance *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 5. Unit Root Test (ADF)

Variables	Argentina	p-value	Paraguay	p-value	Brazil	p-value	Uruguay	p-value
Log Exports	-1.77	0.39	0.06	0.96	-1.9	0.33	-0.37	0.91
Log Imports	-0.92	0.76	-0.78	0.82	-0.69	0.84	-1.19	0.67
Log REER	-1.73	0.41	-0.55	0.88	-1.66	0.44	-1.9	0.33
Log GDP	-0.96	0.76	1.7	0.99	-1.62	0.47	-0.3	0.92
Log GDP Partners	-1.63	0.46	-1.40	0.58	2.18	0.99	-0.26	0.93
ECT Imports	-2.8	0.05	-4.01	0.00	-3.86	0.00	-4.89	0.00
ECT Exports	-4.11	0.00	-3.00	0.03	-2.03	0.27	-2.91	0.04

Table 6. Test of stationarity of residues for imports

| Residues in first differences				
	Argentina	Paraguay	Brazil	Uruguay
Residues (-1)	-0.225***	-0.296***	-0.334***	-0.387***
	(0.065)	(0.078)	(0.081)	(0.087)
Constant	0.001	-0.005	0.001	0.000
	(0.005)	(0.008)	(0.006)	(0.006)
Observations	84	74	78	77
R2	0.115	0.154	0.176	0.177

Note: Standard error in parentheses.

Statistical significance *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 7. Test of stationarity of residues for exports

Residues in first differences				
	Argentina	Paraguay	Brazil	Uruguay
Residues (-1)	-0.352***	-0.207***	-0.107*	-0.174***
	(0.097)	(0.071)	(0.061)	(0.050)
Constant	0.001	0.002	0.001	-0.001
	(0.009)	(0.009)	(0.009)	(0.010)
Observations	84	74	78	77
R2	0.181	0.098	0.050	0.082

Note: Standard error in parentheses.

Statistical significance *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Brief history of Mercosur

The Common Market of the South (Mercosur) was created in March 1991 with the signing of the Treaty of Asuncion by Argentina, Brazil, Paraguay and Uruguay. At present, Bolivia and Venezuela integrate the treaty as full members, while there are other states under the category of associates.
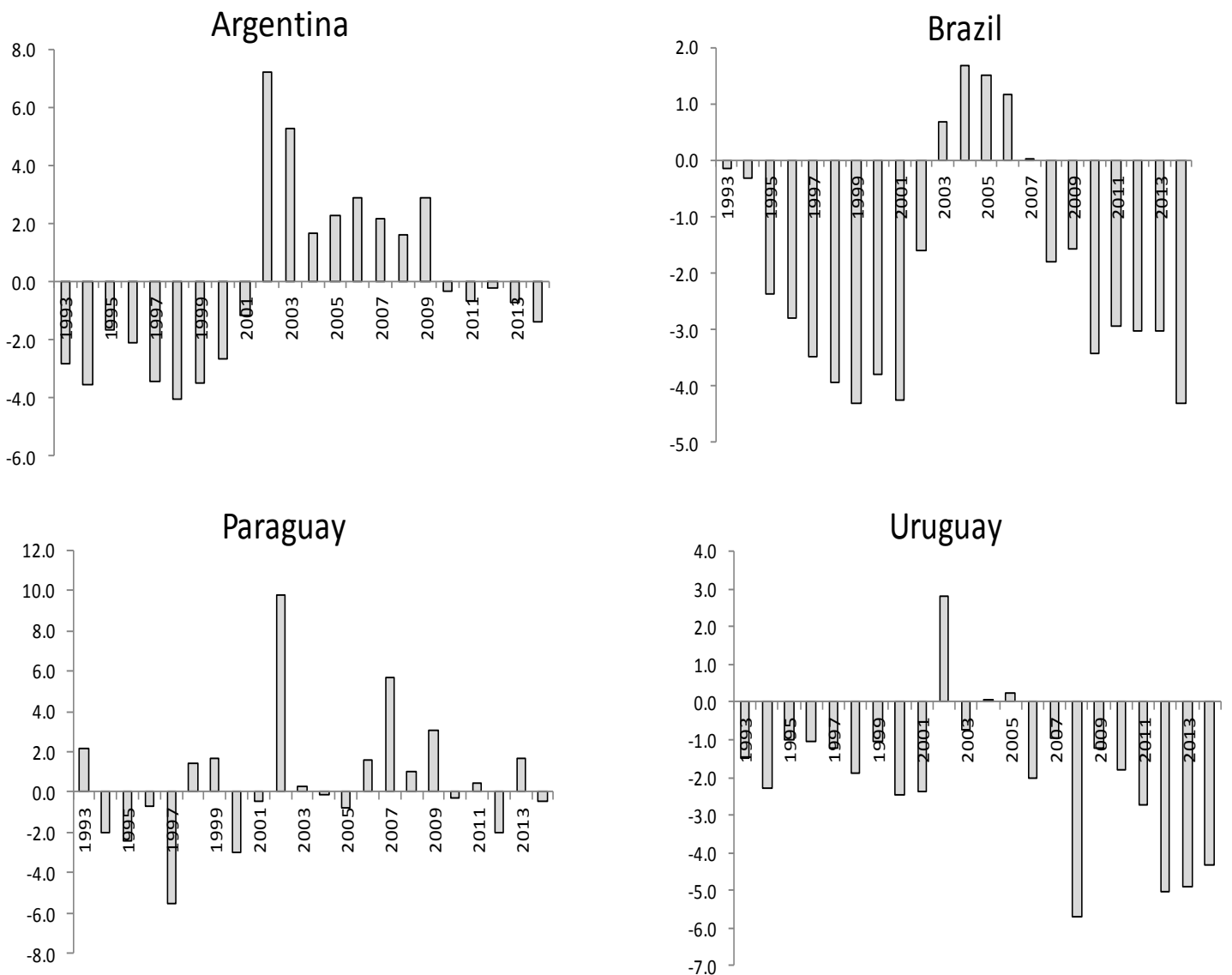
The antecedent of the regional integration dates from 1985 with the declaration of Foz de Iguazú between Argentina and Brazil under the presidencies of Raúl Alfonsín and Jose Sarney. Its operation is based on a democratic charter that established a free trade area and common tariff agreements. The countries that make up Mercosur represent 82% of the GDP of South America with a territory of 13 million square kilometers and more than 270 million people. It is considered the fifth economic block in the world and has a significant political relevance, since both Brazil and Argentina are part of the G-20.

Figure 6. Real Effective Exchange Rate Volatility
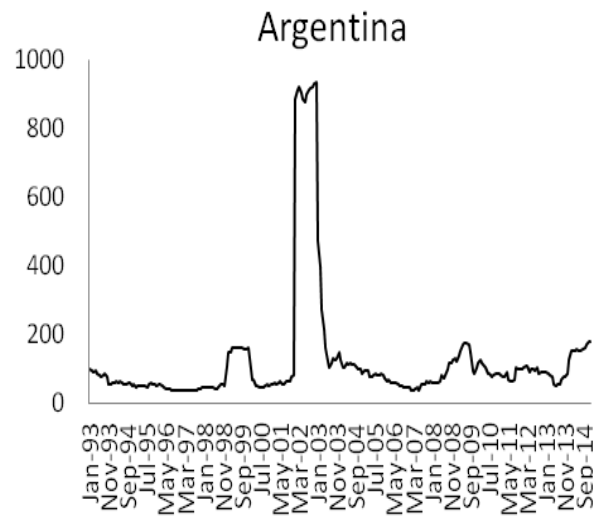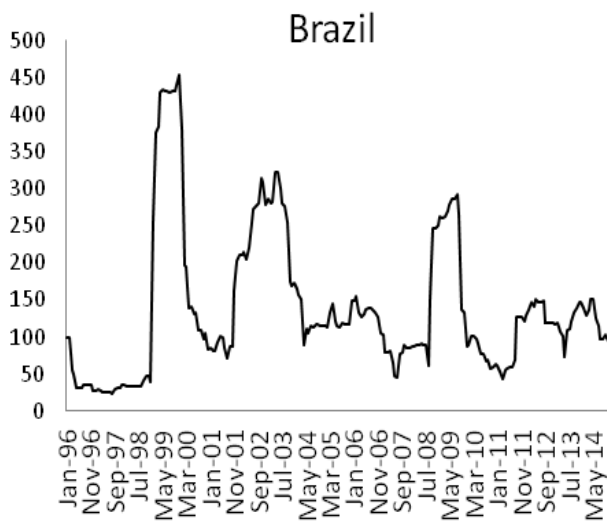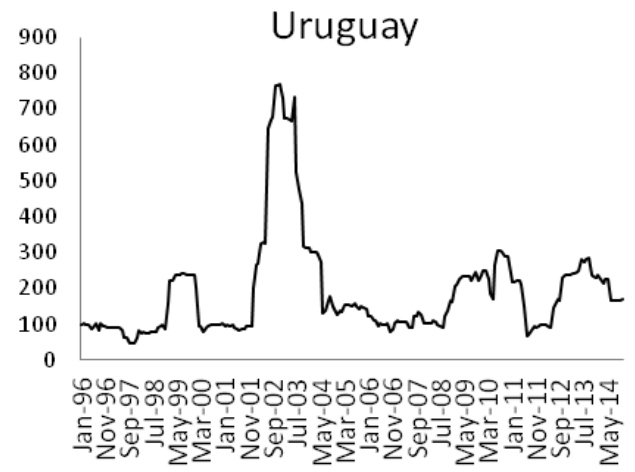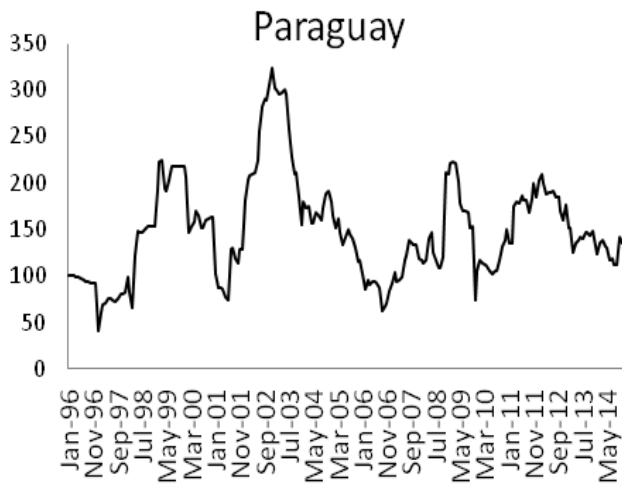
Source: Prepared by the Statistical Institutes, Central Banks and IMF

Figure 7. Current Account Balance (Percent of GDP)

Argentina

Brazil

Paraguay

Uruguay

Source: Prepared by the IMF