Is Latin America an Optimal Currency Area? Evidence from a Structural Vector Auto-regression analysis

Foresti, Pasquale

August 2007

Is Latin America an Optimal Currency Area? Evidence from a Structural Vector Auto-regression Analysis

Pasquale Foresti

April 26, 2007

Abstract

This paper evaluates the advisability of a monetary union in Latin America applying the theory of optimum currency areas (OCA). The analysis, based on the traditional OCA criteria, suggests that there is no evidence for any monetary integration in Latin America, even at a sub-regional level. Latin American countries have evidenced a low degree of trade integration and asymmetric co-movements among their shocks. Moreover, important differences in the speed of adjustment and size of shocks are found. Higher policy coordination seems to be necessary before starting any economic integration process in Latin America.

1 Introduction

In recent years international economy has shifted from a bipolar structure (under the U.S.A. and the Soviet Union) to a multipolar world with the United States, the EU and Japan as main powers.

In this new environment other countries are trying to establish new regional economic blocs. In this sense can be view the two agreements involving Latin America countries called MERCOSUR and the Andean Community[1].

This tendency towards an economic clustering has renewed the interest for the theory of Optimum Currency Areas (OCA). It seems that the OCA criteria can be a good instrument to evaluate the costs and benefits for countries that are willing to form a currency union.

As evidenced by the EU and the EURO, the processes of monetary unification are, in general, extremely difficult. The Latin America case seems to be complicated by the different policies adopted by different countries and by the tumultuous economic history of the region. Nevertheless, the extremely high inflation rates experienced by Latin-American countries have increased the pertinence of the proposal of a unique currency for this area.

Trying to assess the road to follow for the economic integration in Latin America is beyond the aim of this paper. Rather, the paper intends to measure to what extent the actual level of economic integration in Latin America (or at least in one Southern America sub-region) fits the classical OCA criteria in order to establish a currency union [2].

The main task is to evaluate the likelihood of asymmetric shocks for the considered countries. If the shocks between two countries are positively correlated, the optimal policy choice of one country will be appropriate for the other as well. In this case, the cost of a currency union will be low. In addition, an analysis of trade openness and integration of Latin American countries is reported in order to further evaluate the level of economic integration in the area. Moreover the levels of trade openness and intra-regional integration have been necessary to explain and interpret some results of the structural shocks analysis.

[1] MERCOSUR was created by an agreement signed between Argentina, Brazil, Paraguay and Uruguay in 1991, while the Andean Community involves Bolivia, Colombia, Ecuador, Peru and Venezuela.

[2] The paper explores the ex-ante conditions for the constitution of an OCA. Although there is a part of the theory focusing on the ex-post conditions, the choice was to leave it apart, because it seemed that the arguments based on the ex-ante approach are more convincing.

The paper is organized as follows. Section 2 presents a selective survey of the literature on optimum currency areas and its application to the Latin American case. Section 3 describes the processes of trade openness and trade integration in the region. Section 4 evaluates the asymmetry and other characteristics of shocks in Latin America, implementing a Structural Vector Autoregression model (SVAR) *à* la Blanchard and Quah (1989). Section 5 concludes the study.

2 Optimal Currency Areas: Theory and Evidence from Latin America

The starting point for every literature on the OCA theory is Mundell (1961). The author defines a currency area as a " *...domain within which exchange rates are fixed...*" [3]. According to Mundell two countries are interested in establishing a monetary union if there is a high degree of factor mobility (capital and labor) between them. The author argues that this is necessary to adjust to eventual asymmetric shocks. In Mundell's framework the costs of a currency union will be lower the higher the symmetry of shocks between the countries interested by the analysis. If the shocks between two countries are positively correlated, the policy choices of one country will be appropriate for the other as well. Thus, if the same disturbance has the same effects in two areas, there is an efficiency argument for forming a currency area between these two regions[4].

McKinnon (1963) adds the size and the degree of openness as other criteria for a choice of the exchange rate regime. The country's size is supposed to be negatively correlated to its openness, and it can be argued that the more a country is open to trade, the higher is its interest of adopting a fixed exchange rate regime. Trade openness and trade interdependence, among countries willing to form a currency union, can be identified as relevant indicators for any kind of analysis on a possible OCA. Moreover, for a given group of countries, the higher the financial integration the less it needs exchange rate variations. It happens because small interest rate variations will determine the necessary flows of capital for the balance of payment equilibrium.

Kenen P. (1969) triggers the tradition of a literature focusing on the determinant elements of the incidence of shocks. The author states that the degree of product or industry diversification is a crucial element for assessing the costs and benefits of a currency union. On the other side Ingram (1973) explores the relevance of capital mobility,

[3]Mundell R. (1961) pp.657.

[4]For a clear explanation of these mechanism see De Grauwe P. (2001).

concluding that capital mobility can reallocate the resources across regions substituting any eventual lack of labor mobility.

The traditional theory focuses exclusively on the costs, ignoring the benefits analysis. Ishiyama (1975) suggests a more complete approach, in order to consider the single criteria in a multidimensional way. The hypothesis that a country will decide to shift from a regime to another, only because this shift will not be costly, seems to be not completely convincing. It seems more reasonable that such a shift can be determined because it gives some benefits.

In order to analyze costs and benefits, Krugman and Obstfeld (1999) and De Grauwe (2001) define a cost curve and a benefit curve, with both curves as functions of the degree of economic integration.

Because of its Keynesian origin, the OCA theory has focused on the demand side ignoring the supply one. In this sense the contribute of Bayoumi and Eichengreen (1993) is extremely important. The authors test, for Europe using the U.S.A. as a benchmark, not only the presence of asymmetric demand shocks but also the probability of supply shocks. In both cases, a high probability of asymmetric shocks suggests to avoid a monetary union.

Bayoumi and Eichengreen (1994) extend this analysis to other areas and conclude that there is no evidence for any common currency in Latin America using yearly data for the period 1969-89. Arora (1999) extends the sample period to 1998, including also the period after the creation of Mercosur, but reaches the same conclusion.

Other econometric studies focusing on Latin America have evidenced little or negative correlations of shocks. Licandro Ferrando (1998) states that the shocks in Mercosur are less symmetric than in Europe, but evidences that the shock correlation between Argentina and Brazil has increased over time. In the same direction are the results for Mercosur in Carrera et al. (1998), that detect an increase in correlation for the productive cycles. However both papers do not capture the Argentinean and Brazilian crisis, thus it can be argued that extremely lower or negative correlations could be found expanding the sample. Silva et al. (2003) state that the underlying asymmetries between Argentina and Brazil were exacerbated when Brazil switched to floating in 1999, increasing the divergence in the patterns of output fluctuations. Moreover, even external shocks had adverse effects in terms of synchronization in the Mercosur area. In Kronberger (2002) one of the most interesting conclusions is that from 1980 to 1995 Mercosur countries were touched by many shocks that had an endogenous nature. Then, in the second part of the 90s the Mercosur economies suffered in major part exogenous shocks. The author also states that the low degree of trade openness and integration, and the low level of

labor mobility will not compensate for the asymmetric shocks in the case of a currency union.

As preliminarily evidenced by Kronberger (2002), besides the probability and the magnitude of asymmetric shocks, many studies try to apply the OCA theory to Latin America testing also other criteria. In this direction move Yeiaty and Sturzenegger (2000), testing for OCA theory in Mercosur countries. For the classical OCA view they conclude that up to 1997 the Mercosur has not determined a reorientation of the trade but has only accompanied the openness that its countries experienced during that period. Moreover, they expect divergent unemployment rates if a common currency is established (because of labor market rigidity and low factor mobility), and no benefits from the financial openness analysis. The authors suggest that an additional indicator for the profitability of a currency union could be the increase in credibility. Concerning to credibility, they argue that the U.S.A. can be a good candidate for a monetary union, like Germany for Europe, but they point out many differences between the two cases. Germany was smaller than all the other partners together and this is not true for U.S.A. and the Mercosur, moreover Germany traded almost exclusively with its partners while this is not true for Latin American countries and the United States. Thus, it does not seem realistic that the U.S. would like to condition their monetary policy just to reduce the exchange rate uncertainty with Latin America partners.

Harroyo (2002) states that the only country that can give credibility are the U.S., but the countries experiencing asymmetric shocks with the U.S.A. and that do not trade so much with them, can suffer extremely high costs for gaining credibility. The author focuses also on the level of *de facto dollarization*, suggesting that the countries that do not trade so much with the U.S.A. (and are highly *dollarized*) should still *de-dollarize* and float their currencies even if he states that this could be a very complex and difficult process. Larrain et al. (2003) make a comparison between *dollarization* and regional currency union for three areas, including also Latin American countries. They confirm the low levels of integration showed by South America countries, and add another indicator that is the substantial heterogeneity of the effects of different factors on real exchange rate volatility, suggesting that previous studies have ignored an important dimension of countries experience.

Although from this literature overview emerges that it seems unreasonable to think about a currency union for all Latin American countries, as stated in De Grauwe (2005) "*...the literature on this question is still in its infancy...*", and the continue changes and events occurring in this area seem to give every time new opportunities for

further analysis.

3 Degree of Trade Openness and Integration

As first noted by McKinnon (1963), trade openness can reduce the costs of loosing the exchange rate as an adjustment instrument. The cost of living is highly influenced by tradable goods in open economies, so the stabilization of the exchange rate could grant a higher degree of price stability. Alesina and Barro (2002) find that the adoption of a common currency can reduce some trading costs between two countries. They conclude that, under some reasonable assumptions about elasticities of substitution between goods, countries that trade more with each other will benefit more from fixing their exchange rate.

3.1 Trade Openness

Table 1 displays 2004 data on trade openness for the countries analyzed, showing also sub-regional averages. Andean Community countries show a high average level of openness (25.1%), although Peru is rather closed. These countries score better than NAFTA on this OCA criterion, being not so far away from EU countries (which are normally considered to be examples of open economies) openness in the 1988.

Moreover, Canada and Mexico present a high degree of openness but the performance of Nafta (23.3%) is influenced by the USA that are, as expected , a closed-to-trade economy. Data on Mercosur show an overall intermediate degree (23.3%), this is slightly surprising since these countries have always showed low levels of trade openness. Brazil seems to be the only country that has not increased its openness, while Argentina and Uruguay increased their level in the last 4 years. Paraguay remains one of the most open economies in Latin America, but the increase in Argentina and Uruguay openness is what permits Mercosur to perform better than in the previous years in this OCA criterion. Chile is the country that is closer to EU level, and it is above the other countries degree of openness.

In sum, no area scores very well in this OCA criterion, being almost far away from the average openness that EU countries showed in 1988. However, this score has been increased in the last years restricting the gap with the EU area.

Table 1: **TRADE OPENNESS, 2004 (1)**

	Ratio	**Degree of Openness**
Mercosur (2)	23.3	Intermediate
Argentina	21.7	Intermediate
Brazil	15.7	Low
Paraguay	26.7	High
Uruguay	28.8	High
Andean Community (2)	25.1	High
Bolivia	28.5	High
Colombia	21.8	Intermediate
Ecuador	27.6	High
Peru	19.6	Low
Venezuela	28.3	High
NAFTA(2)	23.3	Intermediate
Canada	29.1	High
Mexico	28.55	High
United States	12	Low
Memorandum Items:		
Chile	30.9	Very High
Euro-area countries (2)	35.4	Very High

Source: IMF Direction of Trade Statistics Yearbook, 2004*; IFS,* 2006.

(1)$[(Exports + Imports)/(GDP * 2)] * 100$.

(2) Simple averages of the trade shares euro-area countries showed in 1998. Includes Greece.

3.2 Trade Interdependence

Although the overall trade openness is a useful tool, what really matters in order to infer whether a region could be an OCA is the intra-regional degree of trade openness. A monetary union is more useful for countries that have a high degree of trade interdependence, in this case it will make sense for them to stabilize their exchange rate.

Table 2 shows intra-regional trade, as a percentage of total trade, for the countries and regions under analysis plus NAFTA. The results evidence that Latin American countries have a degree of openness that is much lower than what showed by NAFTA and by the European countries before the EMU.

Mercosur performance is extremely influenced by Brazil that scores only 8.7%, on the other side Paraguay has an intense trade relationship with Mercosur countries (49.8%), and also Uruguay presents a good openness level (34.4%). An important benchmark for this analysis is the share of trade with the United States. It has to be noted that the average share of intra-community trade of Mercosur countries (29%) is higher than their share of trade with the U.S.A. (17.3%), and the latter is also lower than the one with the Euro-area (19.9%). Table 3 decomposes the results showed in table 2 for each country. It evidences that all countries of Mercosur have a low share of their exports and imports with Andean Community countries. Moreover, Paraguay and Uruguay shares of trade with the U.S. are not highly relevant, while these countries have a more intense trading activity with Argentina and Brazil. Although Brazil has a low level of trade openness, the share of trade of all Mercosur countries with it is very important, it has to be noted that this result is also determined by the dimensional differences among these economies. Hence, the situation of Brazil seems to be determined by its dimension and gives to this country a central role in the future evolution of trade relationships in Latin America.

Table 2 evidences a different situation for the Andean Community countries. On average these countries trade predominantly with the U.S. (34%), while the share of intra-regional trade is low (14%), moreover all the countries share is not far away from the total average. Then, looking at national data, table 3 shows that Bolivia is more oriented towards Brazil and Argentina and less towards the U.S.A. with respect to other Andean Community countries. In fact Ecuador, Peru, Venezuela and Colombia are closed to trade with Mercosur but have an intense trading activity with the United States, giving great importance to a possible role for the U.S. dollar in an hypothetical monetary union for these countries.

Table 2: **TRADE INTERDEPENDENCE, 2004 (1)**

	Trade Conducted with:				
		NAFTA			
	Subregion	USA	Total	EU	USA + Subr.
Mercosur (2)	29	17.3	19.4	19.9	44.5
Argentina	23	13.4	16.2	21.1	36.4
Brazil	8.7	24.2	28.6	25.1	32.9
Paraguay	49.8	14.8	15.4	10	64.6
Uruguay	34.4	9.6	15.5	17.8	44
Andean Community (2)	14	34	37.3	14.6	47.4
Bolivia	18.4	10.7	13	6.9	29.3
Colombia	15.8	37.6	43	16.8	53.4
Ecuador	16.9	31.6	35	17.3	48.5
Peru	8.5	25.9	28.9	18.7	34.4
Venezuela	10.2	61.3	66.8	13.3	71.5
NAFTA(2)	61.6	-	-	12.5	-
Canada	77.1	75.1	-	10.6	-
Mexico	76.1	73.1	-	7.1	-
United States	31.5	-	-	19.8	-
Memorandum Items:					
Chile	18.3(4)	12.3	17.7	21.8	30.6
Euro-area countries (2)(3)	55.1	-	-	-	-

Source: IMF Direction of Trade Statistics Yearbook, 2004*; IFS,* 2006.

(1)$[(Exports + Imports)/(TotalExports + TotalImports)] * 100$.

(2) Regional averages are simple averages.

(3) Averages of the trade shares euro-area countries showed in 1998. Including Greece.

(4) With Mercosur.

Table 3: **TRADE INTERDEPENDENCE, 2004 (1)**

	Argentina	Bolivia	Brazil	Chile	Colombia	Ecuador	Paraguay	Peru	Uruguay	Venezuela	Canada	Mexico	USA	Euro-area
Argentina		0.9	19.6	8.9	0.6	0.5	1.6	1.1	1.8	0.4	0.6	2.2	13.4	21.1
Bolivia	11.6		25.8	5.8	6.1	0.3	0.7	5.8	0.2	6.2	0.5	1.8	10.7	6.9
Brazil	6.9	0.8		2.1	0.8	0.4	0.9	0.6	0.9	NA	1.6	2.8	24.2	25.1
Chile	10.7	0.5	7.13		1.3	1	0.2	2.1	0.3	0.7	1.9	3.5	12.3	21.8
Colombia	0,9	0,8	3,3	1,8		4,8	NA	2,2	0.1	8	1.6	3.8	37.6	16.8
Ecuador	1.7	0,07	3.9	2.9	10.2		0.04	2.8	0.1	3.8	1.7	1.7	31.6	17.3
Paraguay	17.4	0.6	28.8	1.4	1.4	0.2		0.2	3.6	NA	0.3	0.3	14.8	10
Peru	2.1	1.1	3.9	5.5	3.9	2.3	0.04		0.5	1	1.5	2.5	25.9	18.7
Uruguay	13.9	0.09	18.2	1.9	0.6	0.26	2.3	1.3		2.7	1.8	4.1	9.6	17.8
Venezuela	0.8	0.4	5.2	0.8	7.2	1.6	0.08	1.05	0.5		1.8	3.7	61.3	13.3

Source: IMF Direction of Trade Statistics Yearbook, 2004*; IFS,* 2006.

(1)$[(Exports + Imports)/(Tot.Exports + Tot.Imports)] * 100$.

Thus, even computing the intra-community trade plus the share of trade with the U.S.A. (44.5% and 47.4%) no area is able to perform better than EU countries in 1988 (55.1%).

It has to be noted that Mercosur has experienced a sharp decline in the share of intra-trade from 2000, as showed in figure 1 in the appendix. The share of trade that Mercosur countries conduct with each other has shown a clear upward trend since Mercosur was created, but despite the fact that many observers expected this trend to continue, starting from year 2000 there has been a decline in all the countries.

The evidence from the Andean Community does not show any clear pattern at an aggregate level (figure 2), reflecting the bleak pattern of countries like Bolivia, Colombia and Venezuela.

Concluding, all the countries in Latin America after 10 years have the same level of intra-trade with their continental neighbors, and the general trend of trade integration for Latin America has remained constant over the last ten years (see figure 3). Thus it seems clear that, at a continental level, there is no evidence that supports any monetary integration. Moreover, also a sub-regional analysis of trade relationships based on the institutional sub-groups of Mercosur and Andean Community, has given little support for an intra-regional unification. In sum it seems that at least two different areas can be identified. Bolivia, Argentina, Brazil, Uruguay and Paraguay trading relationships seem to be on a good level that has just to be increased in future years. On the other side the same reasoning seems to have no sense for Ecuador, Peru, Venezuela and Colombia that have a high trade-share with the U.S.A.. Hence, it seems to be more appropriated (isolating the trade interdependence criterion) the idea of an anchoring to the U.S. dollar for these countries.

4 Likelihood of Asymmetric Shocks

As stated in the literature on OCA, the presence of pronounced asymmetric shocks between two economies makes the cost of doing away with the exchange rate, as an instrument of adjustment, more relevant.

4.1 Methodology

This framework is estimated using a procedure proposed by Blanchard and Quah (1989) that permits to decompose permanent and temporary shocks to a variable using a vector auto-regression (VAR). The theoretical model is represented by a VAR in the primitive form:

$$\begin{bmatrix}\Delta y_t \\ \Delta p_t\end{bmatrix} = B(L)\begin{bmatrix}\varepsilon_{1t} \\ \varepsilon_{2t}\end{bmatrix} \tag{1}$$

where, according with Bayoumi and Eichengreen (1993), Δy_t is the real GDP growth rate, Δp_t is the price inflation, while ε_{1t} and ε_{2t} are assumed to be demand and supply shocks. The matrix $B(L)$ represents the impulse-response functions of the shocks to real GDP growth rate and price inflation, it is as follows:

$$B(L) = \begin{bmatrix}\sum_{k=0}^{\infty} b_{11}(k)L^k & \sum_{k=0}^{\infty} b_{12}(k)L^k \\ \sum_{k=0}^{\infty} b_{21}(k)L^k & \sum_{k=0}^{\infty} b_{22}(k)L^k\end{bmatrix} \tag{2}$$

where L is the lag operator and k is the number of lags. Note that at lag $k = 0$, equation (1) can be written as follows:

$$\begin{bmatrix}\Delta y_t \\ \Delta p_t\end{bmatrix} = \begin{bmatrix} b_{11}(0) & b_{12}(0) \\ b_{21}(0) & b_{22}(0)\end{bmatrix}\begin{bmatrix}\varepsilon_{1t} \\ \varepsilon_{2t}\end{bmatrix} \tag{3}$$

or in a more compact form $X_t = B(0)\varepsilon_t$.

It has to be noted that equation (1) cannot be directly estimated because ε_{1t} and ε_{2t} are not observable. In order to construct ε_{1t} and ε_{2t} a VAR expressed in the following form has to be estimated:

$$\begin{bmatrix}\Delta y_t \\ \Delta p_t\end{bmatrix} = A(L)\begin{bmatrix}\Delta y_{t-1} \\ \Delta p_{t-1}\end{bmatrix} + \begin{bmatrix}e_{1t} \\ e_{2t}\end{bmatrix} \tag{4}$$

where $A(L)$ is the VAR coefficients matrix at various p lags, while e_{1t} and e_{2t} are the error terms that comprise a combination of the primitive shocks ε_{1t} and ε_{2t}. The model expressed in (4) can be estimated since current and lagged values of output and price are known. Rearranging the VAR in equation (4) into its moving average form it is possible to identify the underlying shocks:

$$\begin{bmatrix}\Delta y_t \\ \Delta p_t\end{bmatrix} = [I - A(L)]^{-1}\begin{bmatrix}e_{1t} \\ e_{2t}\end{bmatrix}. \tag{5}$$

Notice that at lag $K = 0$,

$$\begin{bmatrix}\Delta y_t \\ \Delta p_t\end{bmatrix} = \begin{bmatrix}e_{1t} \\ e_{2t}\end{bmatrix} \tag{6}$$

which together with (3) gives:

$$\begin{bmatrix}e_{1t} \\ e_{2t}\end{bmatrix} = \begin{bmatrix}b_{11}(0) & b_{12}(0) \\ b_{21}(0) & b_{22}(0)\end{bmatrix}\begin{bmatrix}\varepsilon_{1t} \\ \varepsilon_{2t}\end{bmatrix}. \tag{7}$$

Equation (7) can be written more compactly,

$$e_t = B(0)\varepsilon_t \tag{8}$$

Substituting equation (8) into (5), the theoretical model is obtained.

Moreover, the shocks can now be retrieved from equation (7), in order to do that the four elements of the matrix $B(0)$ have to be identified. To do this, four restrictions must be imposed. The first three are direct consequences of the assumption that the variance-covariance matrix of the shocks is an identity matrix, meaning that the variances are normalized to unity while the covariance is zero. The fourth restriction is based on the assumption that one shock has temporary effects on output [5].

Post-multiplying (8) by e_t', gives $e_t e_t' = B(0)\varepsilon_t \varepsilon_t' B(0)'$ that can be rewritten as $e_t e_t' = B(0)B(0)'$, since $\varepsilon_t \varepsilon_t'$ is an identity matrix. Moreover $e_t e_t'$ is the variance-covariance matrix of the standard form (σ) that can be estimated from (4). Hence, in scalar form, the first three restrictions are obtained from the following three equations:

$$\sigma_{11} = b_{11}^2 + b_{12}^2. \tag{9}$$

$$\sigma_{22} = b_{21}^2 + b_{22}^2. \tag{10}$$

$$\sigma_{12} = b_{11}b_{21} + b_{12}b_{22}. \tag{11}$$

The fourth restriction states that the top left-hand element of the $B(L))$ matrix has to be zero. Since substituting (8) in (5) gives $X_t = (I - A(L))^{-1}B(0)\varepsilon_t$ the fourth restriction can be written is the following scalar form:

$$\left[I - \sum_{k=0}^{p} a_{22}(k)\right] b_{11}(0) + \sum_{k=0}^{p} a_{12}(k) b_{21}(0) = 0. \tag{12}$$

Equations from (9) to (12) form a system of four equations in four unknowns, given by the bs. Once they are obtained, $B(0)$ can be identified. Thus, shocks ε_{1t} and ε_{2t} can be identified rearranging (8) in:

$$\varepsilon_t = B(0)^{-1} e_t. \tag{13}$$

Given that $B(0)$ is identified through (9) to (12), while e_t are known thanks to (4), equation (13) permits to identify both ε_t shocks.

One of the possible theoretical backgrounds that can justify this approach, is a Neo-Kenesian AS-AD model. This model permits a distinction between long-run and short-run macroeconomic equilibria, and allows to identify demand and supply shocks from observable

[5] Usually the assumption is based on the no long-run impact of the demand shocks on the level of output.

dynamics of real output and price level thanks to two particular features. A positive demand shock increases output and prices in the short run as a consequence of the assumption that capacity utilization can be varied in the short run to exploit the profit opportunities allowed by changes in aggregate demand. Since the capacity utilization is assumed to return to its normal level in the long run, after the initial impact the output level starts falling back to its initial level while prices continue to rise. Thus, demand shocks have no permanent effect on output and only supply shocks may affect real output in the long run. Moreover, positive demand shocks raise price level while positive supply shocks reduce it in long and short run, Bayoumi and Eichengreen (1994) use this as an over-identifying restriction and suggest that it can be used to verify the results.

Blanchard and Quah (1989) have adopted the standard AS-AD model to interpret their statistical model. In the case that the underlying assumptions of the model are not respected by the results, it has to be considered that the Blanchard and Quah's decomposition basically identifies a statistical model with permanent and temporary disturbances. Thus, even in the latter case the decomposition can be adopted, but alternative economic explanations and structural assumptions must be used in order to interpret and justify the results.

4.2 Data

Annual data on real gross domestic product (GDP) were collected for ten Countries in Latin America. All the data were taken from the World Bank database. The choice of the source was due to the necessity of assembling consistent data and spanning the longest possible period of time. The data cover the period from 1962 to 2003 . Moreover, in order to estimate inflation, GDP deflator series were taken from the same sources and they span the same period of time.

Before estimating supply and demand disturbances, data have been analyzed in their unprocessed form. Table 4 reports mean and standard deviation of growth and inflation [6]. A value of 0.04 implies a change of 4% in the variable.

The rough averages evidence low levels of growth for Argentina and Bolivia and medium levels for all the other countries, but the most interesting result concerns the high inflation levels experienced in this area. Moreover, for some countries the variability is also very high (Argentina, Brazil, Bolivia and Peru above the others), suggesting that the adjustment costs (especially in terms of welfare) due to the

[6]Growth is measured by the first differences of the logarithms of real GDP, while inflation is represented by the change in the logarithm of the GDP deflator

high excursions in the price level have been very high. Evidence of this phenomenon can be inferred from the consistent standard deviations that characterize growth.

Table 4: **Basic Statistics of Different Countries**

	Growth		**Inflation**	
	Mean	**Std. Dev.**	**Mean**	**Std. Dev.**
		Latin America		
Argentina	0.007	0.057	0.646	0.814
Brazil	0.043	0.042	0.769	0.895
Paraguay	0.041	0.037	0.122	0.086
Uruguay	0.014	0.045	0.378	0.225
Bolivia	0.002	0.037	0.346	0.850
Colombia	0.039	0.022	0.170	0.070
Ecuador	0.036	0.035	0.043	0.114
Peru	0.029	0.051	0.498	0.878
Venezuela	0.020	0.048	0.175	0.173
Chile	0.041	0.049	0.336	0.445

4.3 Estimation

Equation (4) was estimated for all the countries in the sample in order to recover the disturbances. Augmented Dickey-Fuller tests on log-GDP and log-GDP Deflator have evidenced the non-stationarity of these series, since the null hypothesis of unit root can not be rejected at any relevant significance level. Hence, the first differences of these variables have been used in order to have stationary series. Thus, DG represents the log-difference of GDP while DD is the log-difference in GDP Deflator. As evidenced by Table 5, in this case the null hypothesis of unit root is rejected for many series at a 5% significance level[7].

For a good specification of the VAR, the optimal lag length has been identified through the combination of different criteria. Although the available criteria were five, the Schwartz and Akaike Information

[7]All GDP growth series are $I(0)$, while the first differences in the log of GDP deflator are still $I(1)$ for Brazil and Paraguay. For Paraguay the Consumption Price Index (CP) has been used as a proxy for the inflation, while for Brazil no solution was found. Thus, every result for Brazil has to take in account that its VAR contains an $I(1)$ variable.

Table 5: **Augmented Dickey-Fuller Test**

	DG		**DD**	
	t-Statistic	**Prob.**	**t-Statistic**	**Prob.**
Argentina	-5.745392	0.0000	-3.424517	0.0157
Brazil	-3.601439	0.0099	-2.009260	0.2819
Paraguay	-3.390189	0.0169	-2.843119	0.0611
Uruguay	-4.119894	0.0024	-3.426008	0.0155
Bolivia	-4.845032	0.0003	-2.947379	0.0484
Colombia	-4.149394	0.0022	-2.805567	0.0661
Ecuador	-5.194084	0.0001	-3.780862	0.0061
Peru	-4.334626	0.0013	-2.618037	0.0974
Venezuela	-4.540819	0.0007	-3.362531	0.0182
Chile	-4.682164	0.0005	-2.843119	0.0611

For Paraguay CPI is tested instead of GDP Deflator .

Criteria have been used as the main tools for the choice of the specification. Because the optimal lag length for all countries was between three and one, the lag has been set to two for each model in order to maintain symmetry across different countries. Moreover, each VAR satisfies the stability condition given that all the inverse roots of the AR characteristic polynomial lie in the unit circle.

For all the Latin American countries the estimation is not in accordance with the over-identifying restriction. The impulse response analysis shows that for seven countries in Latin America the permanent shocks are associated with an increase in prices[8]. Hence, the results suggest that these countries have experienced permanent demand shocks. There are a number of different theories that predict a long run effect for the demand shocks and can be used to interpret this result. By a practical point of view, it can be argued that the increase in trade openness that these countries have experienced has determined permanent demand shocks thanks to the permanent shift in the potential demand for their products. Moreover, according to Keating (2006), destabilizing extreme price volatility can be another plausible explanation. Saraceno (2002) states that cumulative processes from monetary policies may be strengthened by excessive price and wage variability. High intra-trade openness levels between

[8]See Appendix.

countries in the same region may act as a partial stabilizer, but as evidenced in table 3 the degree of intra-trade openness of these countries is low. The results for Ecuador and Bolivia require a different interpretation. For these countries it seems correct to identify temporary demand shocks, but the price response to supply shocks is perverse. Ecuador and Bolivia are raw materials and primary goods exporters, in these cases the supply disturbances can be closely linked to terms of trade changes, causing the perverse price behavior. An increase in the price of unrefined petroleum could increase output through the favorable impact of terms of trade on real incomes, but also through the incentive to produce more petroleum.

Moreover, the high level of trade openness characterizing these countries, as evidenced in table 1, has amplified the impact of changes in the terms of trade on the aggregate demand.

Table 6: **Disturbances and Adjustment Across Different Countries**

	Short-Run Disturbances		**Long-Run Disturbances**	
	Size	**Speed**	**Size**	**Speed**
		Latin America		
Argentina	0.036	0.013	-0.045	0.877
Brazil	0.026	0.030	0.131	0.571
Paraguay	0.039	0.047	0.122	0.543
Uruguay	0.019	0.003	0.062	0.871
Bolivia	-0.002	-0.001	-0.065	0.814
Colombia	0.011	0.012	0.074	0.527
Ecuador	0.018	0.011	0.116	0.615
Peru	0.022	0.014	-0.095	0.934
Venezuela	0.033	0.029	0.078	0.791
Chile	0.049	0.044	0.115	0.721

The structural factorization conveys results about the dimension, the speed of adjustment of disturbances and their correlation among different countries.

For the size of long-run disturbances the cumulated seventh year impact on output has been calculated, while for the short-run the third-year impact has been chosen [9]. It has to be noted that the choice

[9]Because the Blanchard and Quah decomposition restricts the variance of the estimated shocks to unity, the impacts can be retrieved from the impulse-response function and they measure the effect on real GDP of the underling shock.

of the indicators has been determined by the high level of persistence of shocks. Table 6 suggests that the impact of short-run disturbances in Latin America in smaller than the one in the long-run, and that the dimension of the latter is extremely high. As a comparison, the long-run shocks size in Latin America is relatively large with respect to East Asia[10]. Moreover, it seems that in the short-run the size of shocks is more similar across countries, while there is a higher level of unevenness in the size of long-run disturbances also across countries belonging to MERCOSUR and Andean Community. Table 6 also shows that the size of shocks are on average higher in countries that showed a high level of trade and intra-trade openness, such as Chile, Paraguay, Ecuador and Venezuela. Since large sizes of shocks imply higher impacts, the cost of forgoing instruments that are able to offset them (such as a monetary policy) is very high for Latin American countries.

Similarly to the size effect, a slow adjustment of an economy after a shock increases the cost of loosing policy autonomy and fixing the exchange rate. Hence, the speed of adjustment has been measured thanks to the impulse-response estimation. The second and fourth column in table 5 present the results of the impulse-response analysis. A simple measure of the speed of adjustment for the long-run disturbances is the ratio of the impulse-response function in the third year to its seventh year value[11]. A high value indicates a fast speed of adjustment, a low value suggests relative slow adjustment processes. The measure of the speed of adjustment to short-run shocks is the value of impulse-response function after five years, in this case a high value represents a slow adjustment[12].

The evidence from the long-run disturbances analysis shows that all the shocks have a high level of persistence. Nevertheless, some countries still show a high speed of propagation of the shock after five years (Colombia, Paraguay and Brazil), while another group seems to be in the stabilizing part of the response path (i.e. Peru and Uruguay). Similar results characterize the speed of adjustment to temporary shocks. Countries with a slow adjustment to permanent shocks also show a strong persistence of temporary disturbances. Moreover the relative persistence is still high in other countries such as Chile, Venezuela and Paraguay.

Thus, independently of the shocks correlation, given the dimen-

[10]See Zhang et al. (2003).

[11]The choice of the seventh year as the base year instead of the fifth one has been due to the persistence of the effects of shocks, as evidenced by the impulse-response analysis.

[12]A comparison with the two years response permits to figure out the speed of absorbtion of the shock.

sion of permanent shocks, and the long persistence of temporary disturbances there is no evidence for a possible currency union in Latin America. The observed asymmetries could be a strong obstacle for any monetary integration in the region, because the size and the direction of the adjustments for any country could be different even in the case of a positive correlation of the shocks.

In order to evaluate the contribution of each shock to the two variables, a Variance Decomposition analysis is performed. Thanks to this procedure it is possible to decompose the variation in the percentage changes of the forecast error variance of inflation and growth that are due to the structural shocks[13]. In output variability the permanent shocks count for over 80% in Bolivia Ecuador, Colombia, Brazil, Argentina and Peru. The variability of growth explained by permanent shocks is less evident for the rest of the countries. No shock seems to be predominant for the variability of growth in Uruguay, Venezuela and Paraguay, at least in the short run. The shocks influence on inflation variability seems to be more homogeneous across countries. Temporary shocks consistently affects (at least in the short run) prices variability, even if their influence decreases over time. Nevertheless, the decrease of speed is different across countries. Argentina, Brazil and Ecuador seem to experience smoother reductions over time.

Moreover, the Blanchard and Quah decomposition gives the opportunity to evaluate the correlation of disturbances.

Table 7: **Temporary Shocks Correlations**

	Arg	Bol	Bra	Chi	Col	Ecu	Par	Per	Uru	Ven
Argentina	1									
Bolivia	-0.21	1								
Brazil	-0.47	0.06	1							
Chile	0.02	-0.25	0.06	1						
Colombia	0.20	0.11	0.30	-0,08	1					
Ecuador	0.05	0,26	0.11	-0.08	0.12	1				
Paraguay	-0.04	0.17	-0.06	0.08	-0.15	0.19	1			
Peru	0.53	-0.24	-0.58	0.11	-0.03	-0.05	0.12	1		
Uruguay	0.13	-0.21	0.03	0.46	0.07	0.11	0.10	0.14	1	
Venezuela	-0.38	0.13	0.16	0.11	0.06	0.15	-0.22	-0.27	0.13	1

[13]Due to space limitations no tables for this analysis are reported, but graphical results are attached in the appendix. For each country the time horizon is the same of the Impulse-Response analysis.

Table 8: **Permanent Shocks Correlations**

	Arg	Bol	Bra	Chi	Col	Ecu	Par	Per	Uru	Ven
Argentina	1									
Bolivia	0.09	1								
Brazil	-0.11	0.11	1							
Chile	-0.01	-0.04	-0.03	1						
Colombia	-0.05	-0.07	0.33	0.19	1					
Ecuador	-0.15	-0.07	-0.15	0.21	0.07	1				
Paraguay	-0.34	-0.09	0.13	0.59	0.21	0.16	1			
Peru	0.07	0.19	0.08	-0.19	-0.16	-0.08	-0.26	1		
Uruguay	-0.29	-0.11	0.04	0.11	0.16	0.18	0.22	-0.10	1	
Venezuela	-0.06	0.11	0.15	0.38	0.09	-0.09	0.34	-0.15	-0.05	1

Tables 7 and 8 report the results for temporary and permanent shocks. The results show low degree or even negative co-movements for both temporary and permanent shocks. It can be argued that the presence of permanent demand shocks has determined the higher number of negative correlations for the permanent shocks[14].

According to Silva et al. (2004), the negative co-movements between Argentina and Brazil could be a consequence of their different exchange rate arrangements. When both countries had fixed exchange rates with the U.S. dollar, the difference between Argentina and Brazil was that the former did not neutralize the impact of intra-regional capital flows, causing asymmetric adjustments due to domestic policy shocks. When Brazil switched to a floating regime in 1999 the asymmetries were exacerbated, given that also shocks had asymmetric impacts on their economic development. Argentina was touched twice by every shocks, first by the original shock and thereafter by the Brazilian currency devaluation. Silva et al. (2004) show that the coexistence of Argentina's fixed exchange regime and Brazil's more independent policies caused divergent movements in the MERCOSUR area.

Hence, the results from the structural decomposition imply relevant differences in the speed of adjustment, a very low (or negative) degree of co-movements among shocks and different sizes of disturbances. The logical conclusion in an OCA theory framework is that

[14]Demand shocks are affected by changes in the demand-management policies, and are more likely to vary with the different international monetary adjustment that can differs across countries.

every possible process of monetary integration could suffer from important obstacles. Thus, more policy coordination seems to be required prior to attempt any economic integration.

5 Concluding Remarks

This paper evaluated to what extent the actual level of economic integration in Latin America fits some classical OCA criteria in order to establish a currency union.

A two-variables VAR model was used to identify permanent and temporary shocks, using more than forty yearly observations from Latin America. Overall trade openness and regional trade integration analysis were added in order to enrich the OCA analysis and to interpret and explain some results.

Trade openness analysis evidenced a general increase in the degree of openness in Latin America. The evidence from trade integration between Latin American countries did not show any significant progress. Thus, it can be argued that these countries have not reoriented their trade even after the introduction of MERCOSUR or Andean Community, but they have only accompanied their trade openness pattern. Nevertheless, at a sub-regional level two groups can be identified with Colombia, Venezuela, Peru and Ecuador trading more with the U.S.A., while the rest of the region is more integrated, even if the degree of integration has to be increased in order to satisfy this OCA criterion.

Structural shocks in Latin America were identified thanks to a structural VAR analysis. A Blanchard and Quah decomposition was used to distinguish between temporary and permanent shocks. Raw data evidenced low levels of growth (especially for Argentina and Bolivia) and a high degree of variability of inflation.

A first important evidence from the impulse-response analysis was that Latin America countries have experienced permanent demand shocks. Nevertheless, there are some differences between single countries. Bolivia and Ecuador results showed perverse movements in prices, determined by their exports structure and overall trade openness degree.

High degrees of unevenness were evidenced in the size of permanent shocks across countries. Moreover, the dimension of impact was higher in the most open economies (Paraguay, Ecuador, Chile and Venezuela).

The analysis of the speed of adjustment evidenced more homogenous reactions, but the persistence of shocks is extremely high suggesting that the costs of fixing the exchange rate could be too high for Latin American countries.

Variance decomposition confirmed all the previous results. It evidenced a high percentage of output variability determined by permanent shocks. Moreover, the decrease in the influence of temporary shocks on short-run inflation variability has evidenced significant differences across countries with Argentina and Brazil experiencing smoother reductions over time.

Then, the structural shocks correlation between countries strengthened the impression that Latin America is a very heterogenous region with low levels of economic synchronization and integration. Correlation levels are low or negative, suggesting that the likelihood of asymmetric shocks for Latin American countries is high.

Thus, based on these OCA criteria, it can be argued that any process of integration (especially monetary) among different Latin American countries could face many obstacles. It seems that a higher degree of policy coordination and economic integration is needed prior to any attempt of further economic integrations.

References

[DeG] De Grauwe P., Economics of The Monetary Union. Oxford University Press, 2001.

[KO] Krugman P. R. and Ostfeld M., Economia Internazionale: Teoria e Politica Economica. Second Edition, Milano, Hoelpi. 1996.

[LUT] Lutkepohl H., New Introduction to Multiple Time Series Analysis. Springer, 2005.

[1] Alesina A. and Barro R. (2002). "Currency Unions", *Quarterly Journal of Economics, May, 409-36.*

[2] Alesina A. Barro R. J. and Tenreyro S. (2002). "Optimal Currency Areas", *Harvard Institute Research Working Papers, No. 1958.*

[3] Arora (1999). "Exchange Rate Arrangements for Selected Western Emisphere Countries", *International Monetary Fund, Washington, mimeo.*

[4] Arroyo H. T. (2002). "Latin America's Integration Process in the Light of the EU's Experience with EMU", *European Commission Economic Papers, No. 173.*

[5] Artis M. J. (2003). "Reflections on the Optimal Currency Area (OCA) Criteria in the Light of EMU", *Central Bank of Chile Working Papers, No. 193.*

[6] Bayoumi T. and Eichengreen B. (1993). "Shocking Aspects of European Monetary Integration". In Torres and Giavazzi (eds) *Adjustment and growth in the European monetary Union ,Cambtidge University Press.*

[7] Bayoumi T. and Eichengreen B. (1994). "One Money or Many? Analyzing the Prospects for Monetary Unification in Various part of the World ". *Princeton Studies in International Finance No. 76 (September), Princeton University Press.*

[8] Blanchard O. adn Quah D. (1989). "The Dynamic Effects of of Aggregate Supply and Demand Disturbances", *American Economic Review, 79, pp. 655-73.*

[9] Carrera J.E., Perez P.E., Antonow M., Bellingi and Panigo D. (1998). "Integral Analysis of the Macroeconomic Fluctuations in Argentina and Brazil.", *Buenos Aires, CACES, mimeo.*

[10] Cerro M. and Pineda J. (2002). "Latin American Growth Cycles, Empirical Evidence 1960-2000", *Estudio de Economia, Vol. 29 - No. 1*".

[11] Corbo V. (2002). "Monetary Policy in Latin America in the 1990s", *Central Bank of Chile*".

[12] Escaith H. and Paunovic I. (2003). "Regional Integration in Latin America and Dynamic Gains from Macroeconomic Cooperation ", *ECLAC Working Papers, No. 24.*

[13] De Grauwe P. (2005). "Are Latin America and East Asia OPtimal Currency Areas?", *mimeo.*

[14] Hawkins J. (2002). "Financial Aspects of Regional Currency Areas", *BIS Working Papers.*

[15] Ingram J. (1973). "The Case for European Monetary Integration", *Princeton Essays in International FinanceNo. 98 (April), Princeton, New Jersey.*"

[16] Keating J. (2004). "Interpreting Permanent Shocks to Inflation When Money Growth is Endogenous.", *mimeo.*

[17] Keating J. (2006). "Interpreting Permanent and Temporary Shocks to Output When Aggregate Demand May Not Be Neutral in the Long Run", *mimeo.*

[18] Kronberger R. (2002). "A Cost-Benefit Amalysis of a Monetary Union for MERCOSUR with Particular Emphasis on the Optimium Currency Area Theory", *mimeo.*

[19] Larrain F., Tavares J. and Garcia C. (2003). "Regional Currency versus Dollarization: Options for Aasia and the Americas ", *mimeo.*

[20] Licandro Ferrando I. (1998). "Is Mercosur an Optimal Currency Area?", *mimeo.*

[21] McKinnon (1963). "Optimum Currency Areas", *American Economic Review, No. 53, September, pp. 657-65.*

[22] Mundell R. A. (1961). "A Theory of Optimum Currency Areas", *American Economic Review, No. 51.*

[23] Saraceno F. (2002). "Demand Shocks and Intertemporal Cordination: A Two Country Model", *mimeo*".

[24] Silva M., Andrade J. and Trautwein H. (2004). "Structural Effects of monetary Arrangements of Argentina and Brazil", *mimeo*".

[25] Yeyati E. L. and Sturzennegger F. (2000). "The Euro and Latin America : Is EMU a Blueprint for Mercosur?", *American Journal of Economics, No. 110 , pp. 63-99.*

[26] Zhang Z., Sato K. and McAleer M (2003). "Asian Monetary Integration: A Structural VAR Approach", *CRJIE Discussion Papers, no. 212.*

APPENDIX

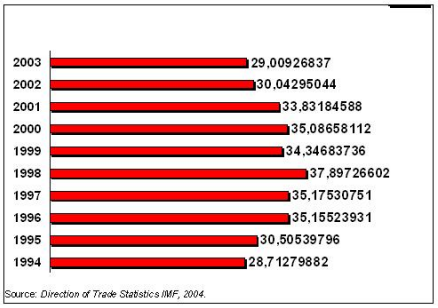

Figure 1: Mercosur Intra-Community Trade (Percentages)

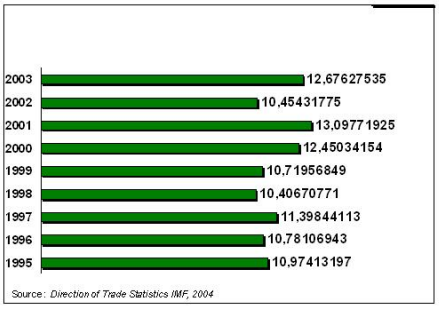

Figure 2: Andean Community Intra-Community Trade (Percentages)

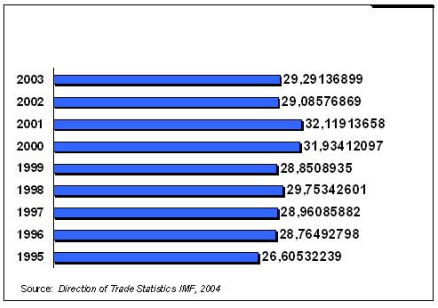

Figure 3: Trade Between Latin American Countries

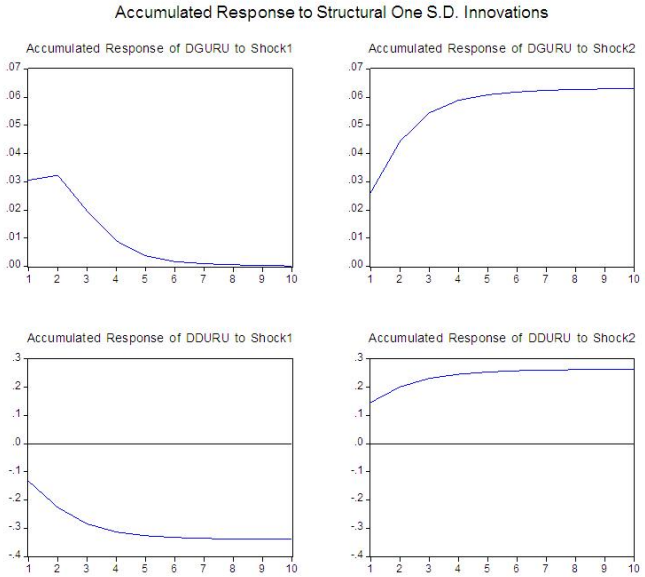

Figure 4: Impulse-Response Uruguay

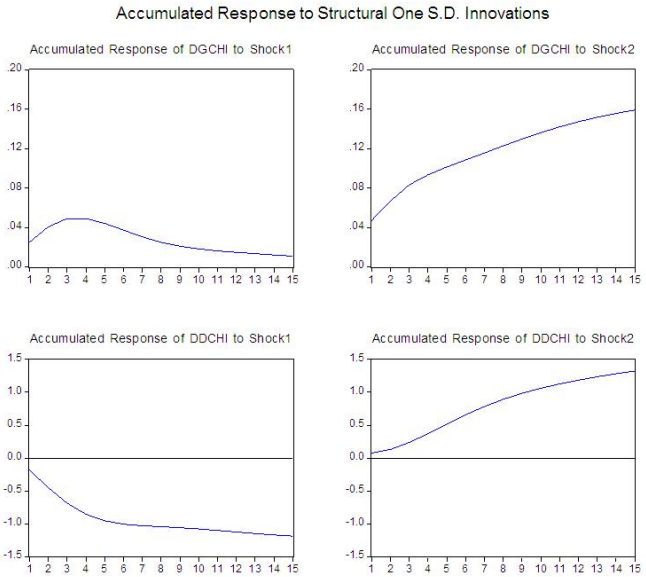

Figure 5: Impulse-Response Chile

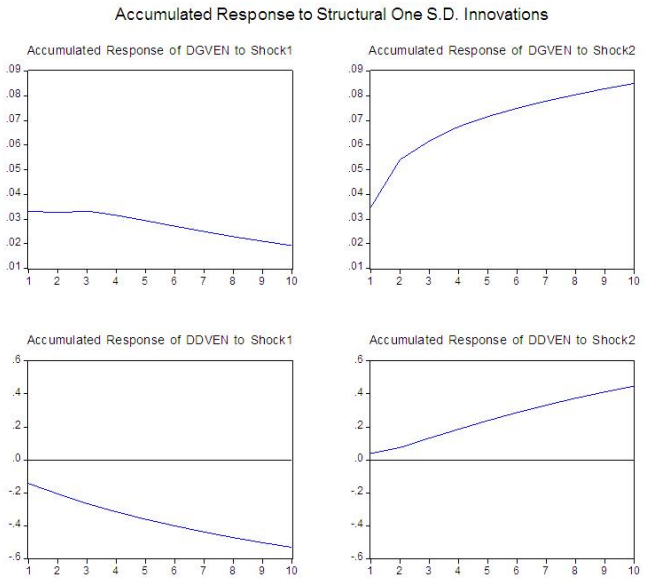

Figure 6: Impulse-Response Venezuela

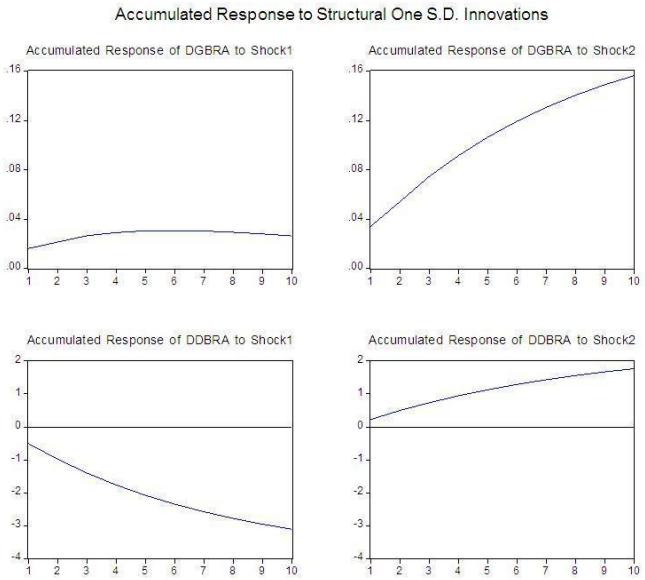

Figure 7: Impulse-Response Brazil

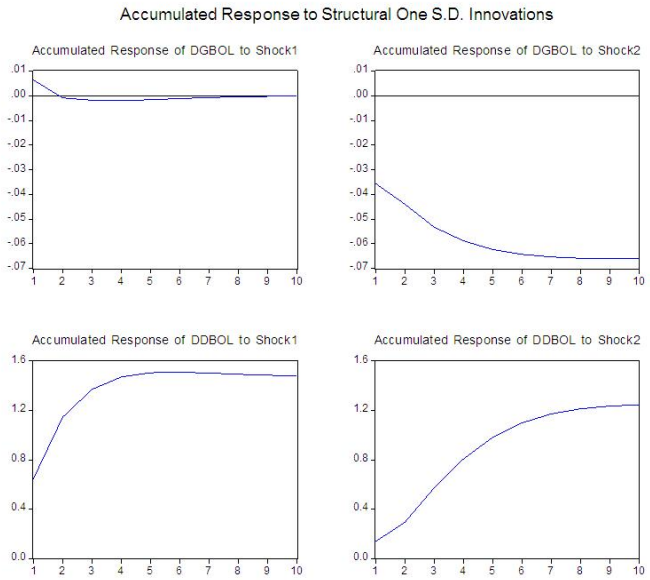

Figure 8: Impulse-Response Bolivia

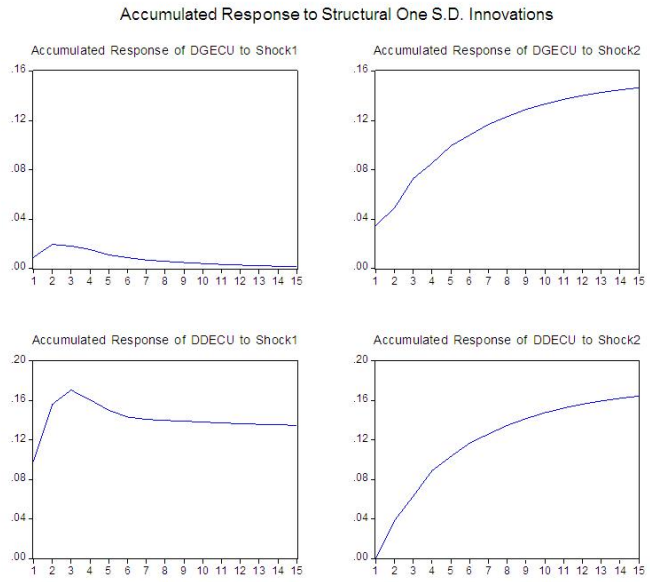

Figure 9: Impulse-Response Ecuador

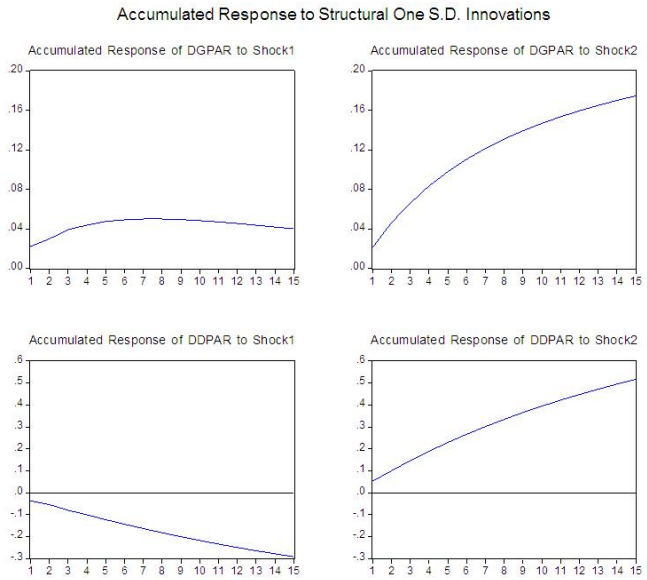

Figure 10: Impulse-Response Paraguay

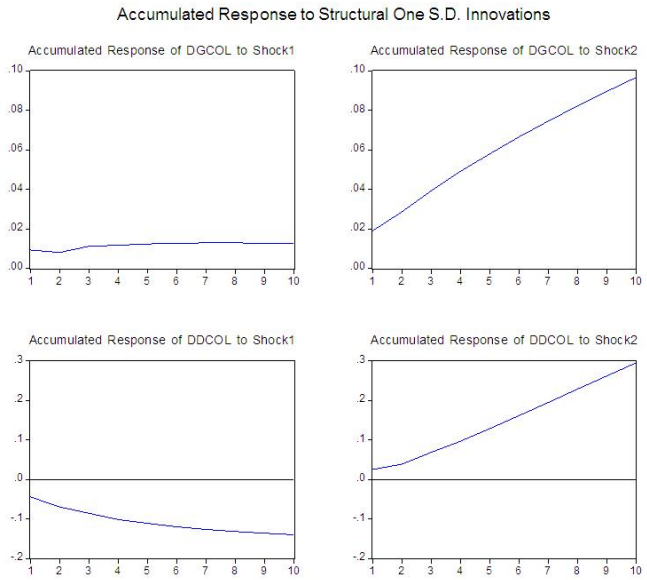

Figure 11: Impulse-Response Colombia

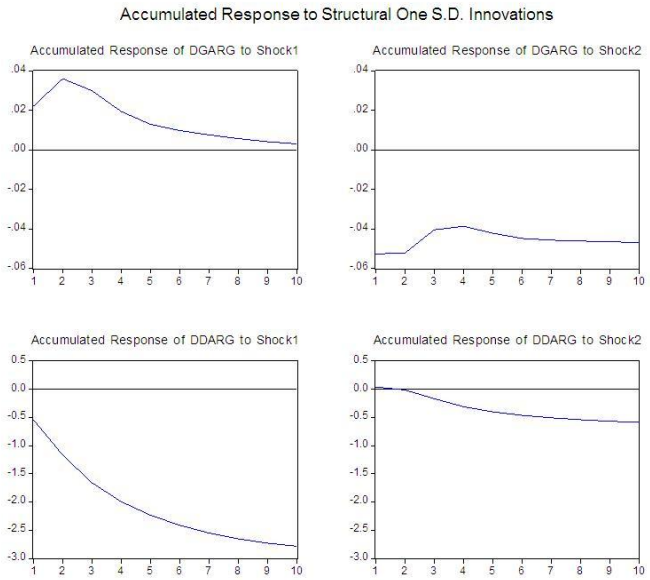

Figure 12: Impulse-Response Argentina

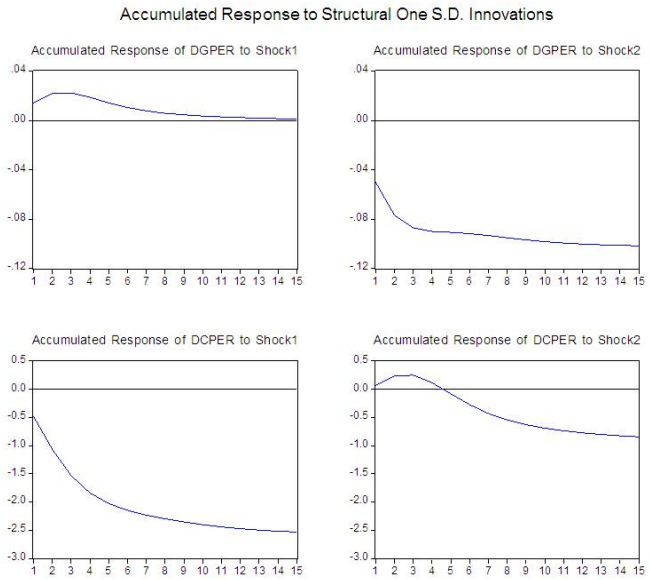

Figure 13: Impulse-Response Peru

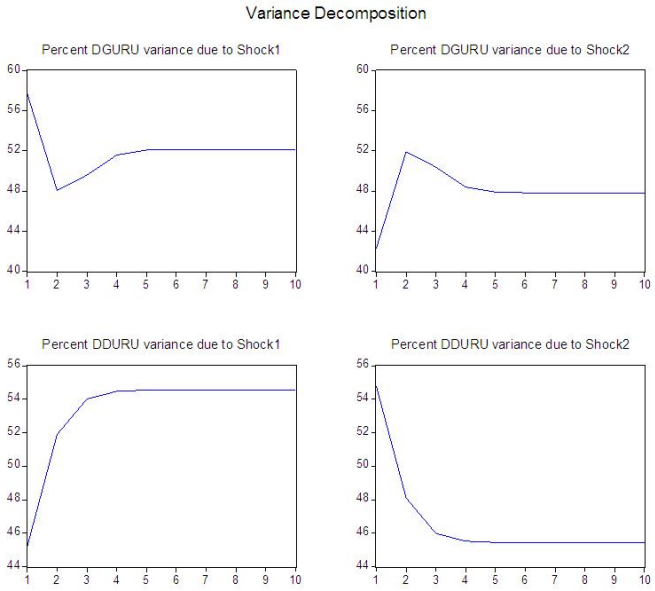

Figure 14: Uruguay

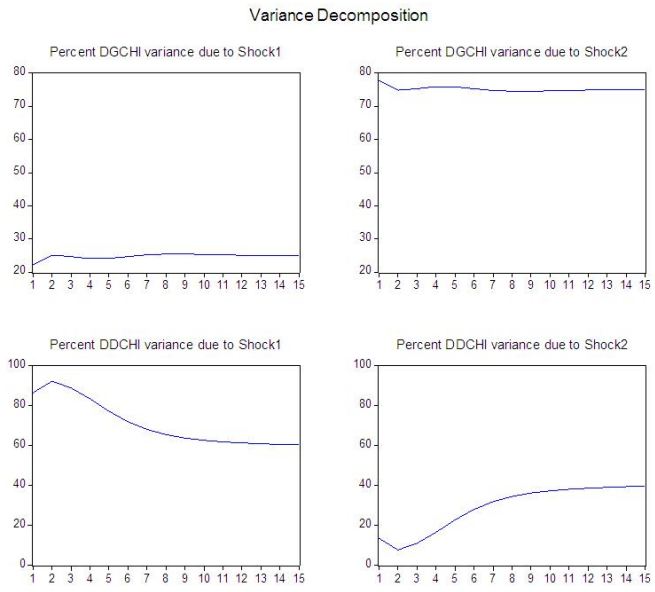

Figure 15: Chile

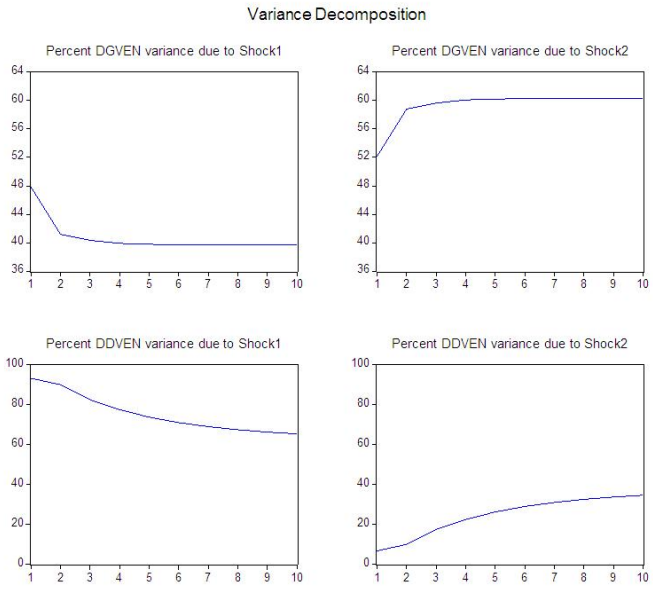

Figure 16: Venezuela

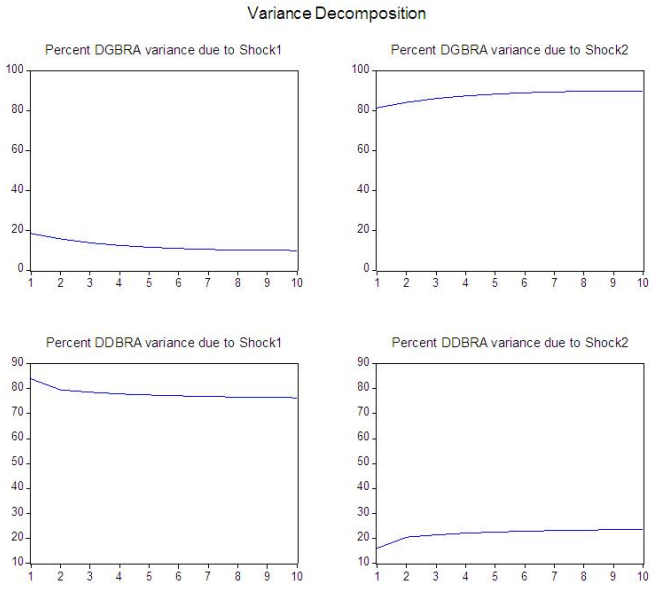

Figure 17: Brazil

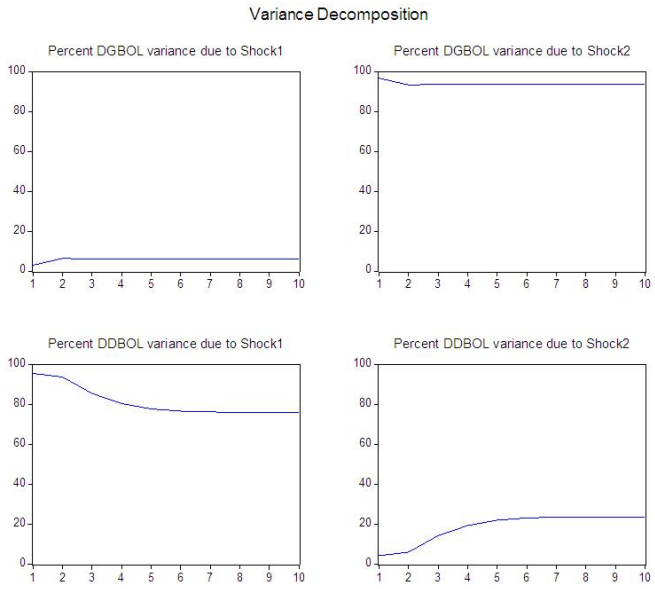

Figure 18: Bolivia

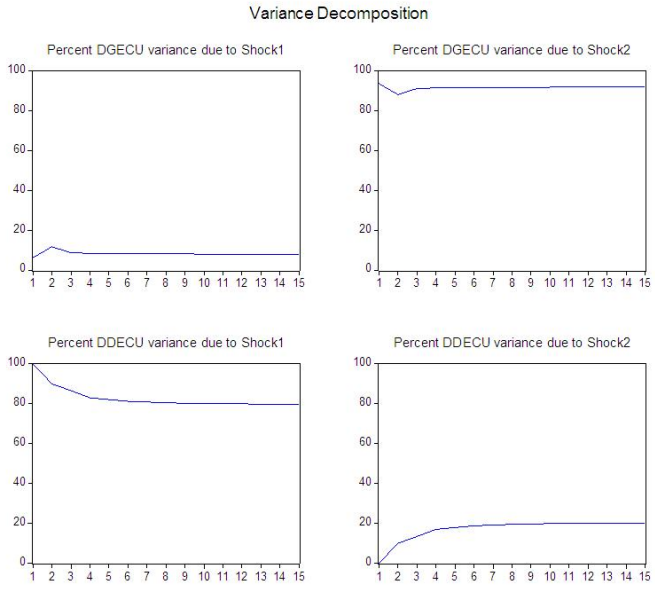

Figure 19: Ecuador

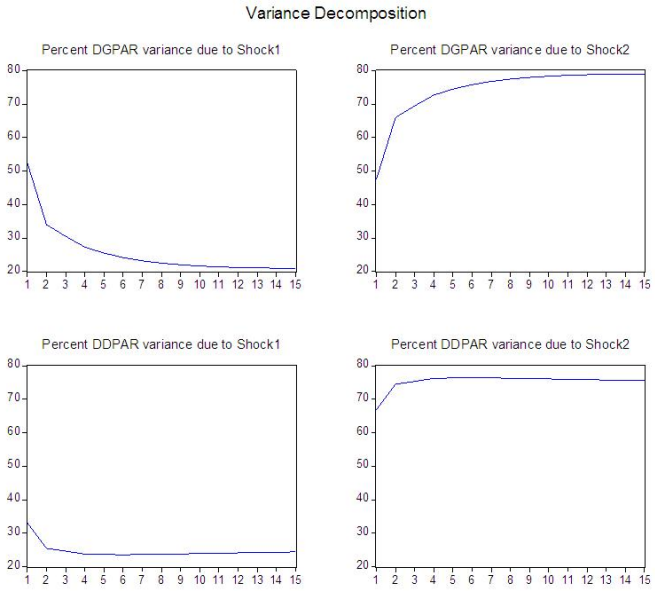

Figure 20: Paraguay

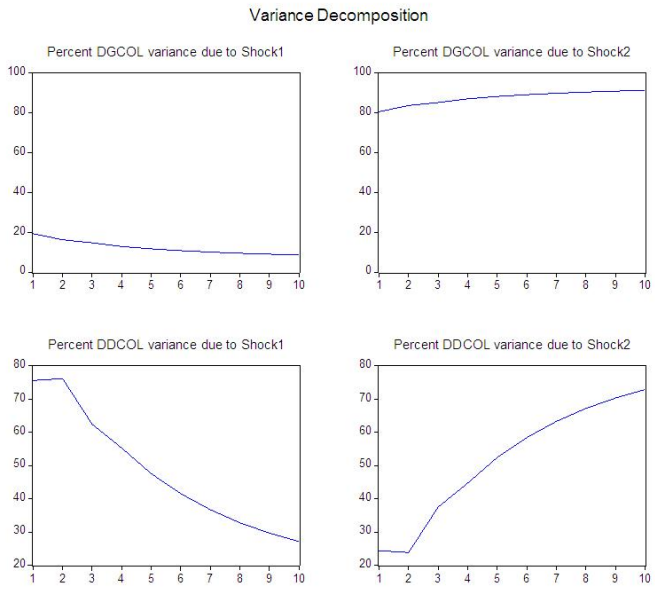

Figure 21: Colombia

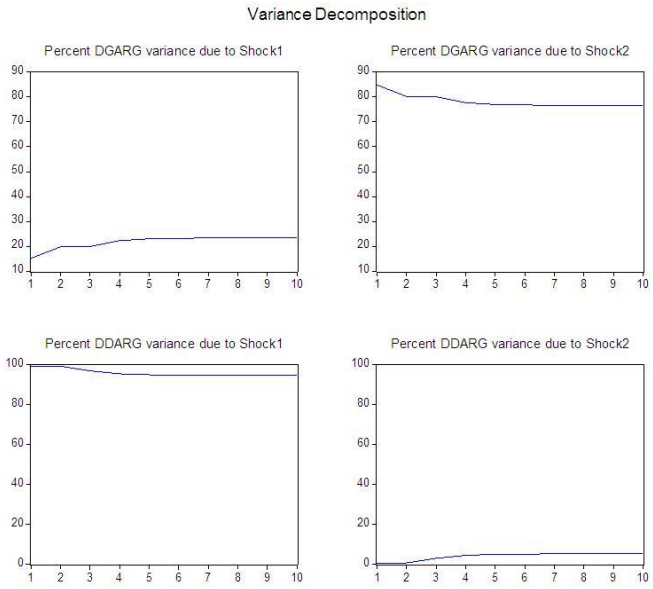

Figure 22: Argentina

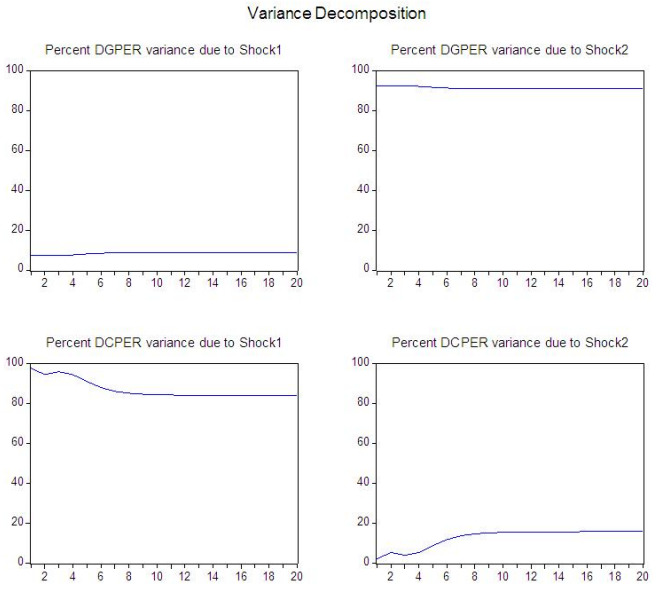

Figure 23: Peru