Document de travail

DISENTANGLING BUSINESS CYCLES AND MACROECONOMIC POLICY IN MERCOSUR: A VAR AND UNOBSERVED COMPONENTS MODEL APPROACHES

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Abstract :

Monetary integration in Mercosur processed in a context of strong macroeconomic volatility. This paper analyzes the feasibility of a monetary union within this zone. Instead of taking in account all the criteria of the optimal currencies areas, this study focuses on the macroeconomic cycles in Argentina, Brazil, and Uruguay. First, we analyse cross-correlation to identify the degree of cycle synchronization. Second, a structural VAR model is built for each country. It allows us to determine the sources of shocks which hit these countries. Third, we decompose structural innovations -especially economic policies shocks- of domestic SVAR into unobservable common and idiosyncratic components using a state-space model. We assess in what extent economic policies are coordinated between the Mercosur countries.

Keywords : Business Cycles, OCA, Comovement, VAR, Unobserved components model, Mercosur.

JEL **Codes: C32, E32, F42.**

INTRODUCTION

The Common market of the South (Mercosur) was created in 1991 by the Treaty of Asuncion signed between Argentina, Brazil, Paraguay and Uruguay. At the beginning the formal project was just a free trade agreement. During the 90s, the signatory countries envisaged a more ambitious economic and monetary process of integration. Then, an institutional framework promoting economic policies coordination was gradually set up. In 2000, the Treaty of Ouro Preto established a permanent structure dedicated to this coordination. Targets and procedures intended to allow the convergence of public deficit and debt ratio were defined. A high-level macroeconomic Group of surveillance equivalent to the Ecofin council in the European Union was created.

This move in favor of more coordination can be partially explained by the successive shocks which hit the Mercosur countries during the 90s. Mexican (1994), Asian (1997), Russian (1998), Brazilian (1999) and Argentina (2001-2002) crises strongly increased the volatility of the macroeconomic variables: integration and coordination were though as efficient responses to financial mayhem. But in fact, it did not work. In front of shocks, economies gave priorities to national solution, weakening the economic and institutional links embodied in the Asuncion Treaty. For instance, intra-zone trade decreased over the period 2000-2004: the intra-Mercosur exports fall from 21% of total exports in 2000 to 12.6% in 2004[1].

This evolution raises the question of the feasibility of a regional monetary union between the Mercosur countries. The purpose of this study is to bring some elements of answer. Contrary to the basic optimal currencies areas (OCA) literature which proposes a costs-benefits analysis of a monetary union, our approach is exclusively based on the business cycles properties of the Mercosur countries.

A large body of empirical research focusing on symmetry and coordination issues in Mercosur has been published. Eichengreen (1998), and Eichengreen and Taylor (2004) use cross country data and panel data to address the question whether the Mercosur countries need a single money. Their analysis is focused on the determinants of bilateral exchange rates volatility and on the OCA criteria. They stressed on the lack political will as one of the main obstacle to monetary union. However, the synchronization of cycles is analyzed in a rudimentary way: Eichengreen and Taylor (2004) use as indicator of asymmetric shocks the increment of the natural logarithm of the ratio of the GDPs of each pair of countries, neglecting the propagation of shocks between countries. Fanelli and González-Rozada (2003)

[1]. For imports, shares are 19.8% and 19.1% respectively. Source: WTO, data base.

apply a structural VAR model to identify the cycles and the coordination evidences within Mercosur. They deemed "symmetry" of shocks and try to shed some light on their sources. The authors try also to identify the common and specific component of domestic cycles, a question in focus in our paper.

Using a dynamic panel setting, Ahmed (2003) analyzes the fluctuations in the main Latin American countries[2]. The author stresses mainly on two issues: it proposes to assess, on the one hand to what extent short term fluctuations of domestic variables are influenced by external shocks, on the other hand if a monetary union is relevant within Latin American countries and with the United States, from an OCA perspective.

To sum up these works, we may conclude to a weak correlation of cycles between Argentina and Brazil. Such a result suggests that the common disturbances are weak and / or that the responses to common shocks differ. As a consequence, the two main countries of Mercosur have no incentive to form a monetary union. Moreover, weak business synchronization with the United States is mentioned, suggesting difficulties of adjustments to innovation within a monetary union.

Studying Argentina, Brazil and Uruguay over the period 1991-2005, the following work shed a new light on integration and coordination issues amongst the Mercosur.

The remainder of this paper is organized in five Section. Section two presents and analyzes business cycles in Mercosur: Cross-correlations are used to bring to light evidences of propagation mechanisms and comovements. Section three presents the outcomes of the estimates of a structural VAR model for each economy; it identifies the interdependence between domestic macroeconomic variables, and with external ones, and the sources of disturbances. Section four proposes to breakdown structural innovations of domestic SVAR into unobservable common and idiosyncratic components using a state-space model. These results are used to check evidences of economic synchronicity, and convergence of macroeconomic policy. Section five concludes.

Our results confirm partially the recent literature. Cycles synchronicity within the Mercosur countries is weak. We show that these economies are hit mainly by nominal shocks rather than real shocks. Beyond, the fact that the shocks seem similar in their nature while the common components are weak suggests that there is a low degree of coordination of economic policies between these countries.

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[2]. Argentina, Brazil, Chile, Columbia, Mexico, and Venezuela.

CYCLICAL COMOVEMENTS IN MERCOSUR: SOME EVIDENCES ON EMPIRICAL REGULARITIES.

To investigate the issues of business cycle synchronization and propagation mechanisms of shocks we will begin the study identifying some stylized facts relative to the three main partners of the Mercosur, and the United States.

Reporting in Table 2.1 the average quarterly industrial production index (IPI) growth rate of the three countries from 1991Q1 to 2005Q3, we can give a first conclusion about the dynamic of Mercosur countries for the period.

Table 2.1 Quarterly IPI Growth and Volatility (average quarterly growth rate in percentage for 1991:1 to 2005:3)

	Argentina	Brazil	Uruguay
Mean	0.003837	0.005532	0.000687
Median	0.008998	0.008397	-0.004677
Maximum	0.069170	0.078137	0.161532
Minimum	-0.146305	-0.109355	-0.147168
Std. Dev.	0.037041	0.032248	0.062580

Source: author's calculations using IMF data base.

As a whole, average growth rates are very low. Brazil exhibits the highest with the lower volatility; at the opposite, the Uruguayan IPI growth rate is both low and volatile. The wide gap between the observed maximum and minimum values of the growth rate reveals a high degree of instability. To conclude, real volatility is fairly high for the three countries (but it is the case of emerging countries in general, and of the Latin American one in particular!).

Choice of the Frequency and the Industrial Production Index

We use quarterly data from 1990Q1 to 2005Q3 for two reasons:

- on the one hand, annual data are generally available for long periods, even for emerging countries; but in this case their quality is low. Besides, during the 80s the three economies were very instable, mainly due to the debt crisis and the sequences of hyperinflation: such disturbances make the data processing very complex and instable.

- on the other hand, quarterly data are more appropriated to identify the business cycle dynamic and the links between short et medium terms. Unfortunately, quarterly data are available and comparable since only 1990 for the three countries.

We conclude choosing quarterly frequency for the period 1990-2005.

As index of production, we opted for IPI (and not GDP) for it is a monthly index while GDP is an annual one: although IPI is more volatile, we keep more information quarterizing a monthly IPI than picking a quarterized (yearly) GDP. Beyond, as IPI includes mainly output of tradable goods, it excludes an agricultural sector too sensible to seasonality and climatic shock, and a service sector characterized by the importance informal activities (Agenor, McDermott and Prasad, 2000).

Stationarity and Cointegration Investigation

We begin checking - for each country - the stationarity of interest rates, and of the logarithm of all the other variables[3]. Standard Augmented Dickey Fuller tests are largely perturbed by numerous shocks, periods of high inflations, stabilization programs, and change in monetary, currency, or fiscal regimes. But even after correction of structural breaks (Perron, P.,1989), all data are I(1), except interest rates I(0). Finally, tests of cointegration (Johansen) failed to find any cointegrating vector[4].

To stationarize this series I(1), we use two detrending method:

1) first differentiation of the logarithm of variables;
2) decomposition trend/cycles by an HP filter. Investigating business cycles in developing countries, Agenor, McDermott, and Prasad (2000) assess cycles length between two and four years. In another study, Rand and Tarp (2002) confirm that the usual length for industrialized countries -between 24 and 32 quarters– is not relevant for emerging market: the duration of business cycle is clearly shorter, between 7.7 to 12 quarters. So, we deduce a parameter "lambda" of 1600 for the United States and 400 for our emerging economies.

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[3]. Our model contains eight variables: world oil price, US industrial production index, Fed Funds interest rate, and for each Mercosur country: industrial production index, price production index, money market interest rate, monetary aggregate M2, and the real exchange rate. All the data are quarterly and stemming from International Financial Statistics of the IMF. For a detailed analysis of these variables, see our SVAR model below.

[4]. All the tests are available upon request to the authors.

In the following section, we just present the conclusions inferred from times series detrended by HP filter[5].

Cycles and Synchronization on the Mercosur Area

We measure the degree of business comovements of quarterly IPI growth by pairs of countries. We will mainly focus on the magnitude of cycles synchronization in the OCA perspective, looking at the cross-correlation of conjuncture between the three LA countries, and between them and the United States. For each L.A. country, we computed also the cross-correlation between a set of key macroeconomic variables. We consider here only results about IPI cross-correlations[6].

Following Agenor, McDermott and Prasad (2000), we measure the degree of comovement of the stationary component y_t with another x_t, derived from our series using the same filter H.P., by the magnitude of the correlation coefficient $\Delta(j), j \in \{0, \pm1, \pm2, ...\}$. We will consider the series "y_t" to be procyclic, acyclic, or contercyclic if the contemporaneous correlation $\Delta(0)$, is positive, zero, or negative, respectively. In addition, we deem the series y_t to be strongly correlated if $0,27 \leq |\Delta(j)| \leq 0,27$, weakly correlated if $0,13 \leq |\Delta(j)| \leq 0,13$, and uncorrelated in the other cases[7]. We say that y_t leads the cycle by "j" periods if $|\Delta(j)|$ is a maximum for a positive "j", is synchronous with the cycle if $j=0$, and lags the cycle if $|\Delta(j)|$ is a maximum for negative j.

We distinguish the cycles with the United States on the one side, and the cycles between the Mercosur countries on the other side.

Cross-correlations Between the United States and the Mercosur Countries

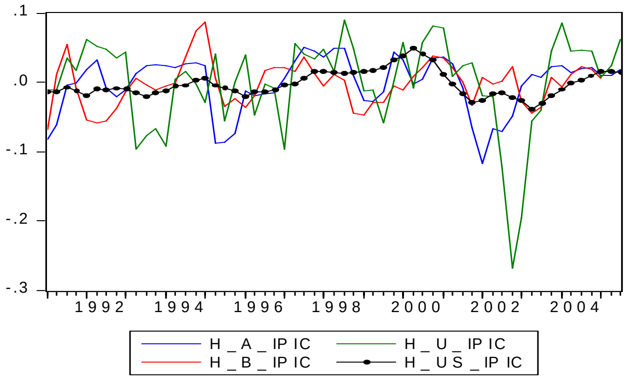
Figure 2.1 exhibits business cycles estimated with HP filter for the United States and our three emerging countries.

[5] A similar analysis realized with log differenced data, but not presented here, converges to the same conclusion.

[6]. Results concerning prices production index and real exchange rates are available with the authors.

[7]. The approximate standard error of these correlation coefficients, computed under the null hypothesis at the true correlation coefficient is zero and given a number of observations per country in it sample, is about 13,5.

Figure 2.1 Cycles in the United States, Argentina, Brazil, and Uruguay



NB: the prefix "h" and the suffix "c" indicate that the matter is about cycles stemming from the filtered (by HP) IPI. Letters A, B, U, US, indicate the three countries of Mercosur and the United States respectively.

Source: author's calculations using IMF data base.

The figure confirms a different periodicity, (not fundamentally modified by the choice of the lambda). Peaks and troughs of cycles of the Mercosur countries correspond to peaks and troughs of the American cycles, but the difference of periodicity involves a higher number of fluctuations in the first group of countries. Indeed, these are subjected to numerous shocks which increase their macroeconomic volatility. Thus the lagged correlations lose a part of their meaning as driven forces. The contemporaneous cross-correlations, presented in appendix 1, show very significant links between the United States on one side, and Argentina and Uruguay of the other one (0.39 in both cases) and lesser influence of the American cycles towards Brazil (0.27). We thus have here a first illustration of the greater autonomy of this economy, as will be confirmed below.

However, the figure 1 seems to reveal two regimes: one before 1999, period for which the cycles are little synchronized, one after 1999 for which situations are more synchronized with the United States. The following explanation can fit with these facts: the first period is marked by a new phase of massive capital inflows which increased the autonomy of the conjuncture of these countries with respect to that of industrial countries. The decrease of capital inflows during the second period made more dependent the conjuncture of these countries of that of the USA.

In terms of the relevance a dollar area with the United States, we can thus conclude that the conditions are not gathered. The three Mercosur countries and the United States do not form an optimal currencies area.

Cross-correlations Between the Mercosur Countries

As reported in the appendix 1, the cross-correlations are sharply less significant than those obtained usely for the countries of the European Union and for the various states of the United States. However, the correlation between the cycles of our three countries is not nil. Indeed, the contemporaneous correlations are significant except within Brazil and Uruguay. The lagged correlations confirm a common cycle with a three years periodicity for Argentina and Brazil: so, the figure in appendix 1 exhibits a fairly significant negative cross-correlation for six quarters, and again a strong positive correlation for twelve / thirteen quarters. At least, the Argentina cycle precedes the Uruguayan one.

MODELING DOMESTIC CYCLES AND PROPAGATION MECHANISMS

Traditional literature about regional integration and OCA stresses on the identification of common innovations and on the magnitude of convergence in the adjustment process and in the policy packages. This section aims at deepening the previous study on comovement, shedding a special light on propagation mechanisms. As explained above, in the context of strong links of macroeconomic variables with complexes feed back linkages, VAR approach constitutes a useful tool: it allows to assess the consequences of structural (orthogonal) shocks on endogenous external and policy variables. The choice of a simple VAR in difference is deduced to the lack of cointegration vectors (any other solution would lead to greater forecast errors, as showed Allen, P.G., and Fildes, R., 2004).

VARs are “a-theoretical”: the usual way to introduce theory passes by the inclusion of restrictions in the structural VARs (SVARs), leading to specific predictions relative to the time path of endogenous variables as consequences of shocks.

Variables selections

Our choice of variables is the traditional one for VARs analyzing external shocks, and macroeconomic packages in open economies (Favero, C., 2001, Lütkepohl, H., & Krätzig, M., 2004). For the external variables, we chose the international oil price (notes WOP), the US Industrial Product Index (US_IPI) and the US Federal Fund Rate (US_R), a way to account for the main real supply and financial shocks. For the domestic variables (for each country “i”, I= A, B, U) , we took Industrial Product Index (i_IPI), Producer Prices Index (i_PPI), money market interest rate (i_R), money aggregate (i_M2), and real exchange rate (i_R). The domestic interest rate is the money market one: it is not exactly equivalent of the Federal Fund Rate… but it is the only available for this sample.

One of the first characteristic of this model is to build an identical VAR for each of our three economies, building-in the same elementary three variables US model (including: world oil price, US IPI, and US Federal Fund Rate). We chose this option instead of adding external variables as purely exogenous to underline interaction between these three variables in each of our national models. Thus, each national VAR is an 8 variables model, with 3 external variables and 5 domestic variables, close to the seven variables model of Kim, S. and Roubini, N., 1997, for the generic non-US country (it just lacks US product index).

As usual in literature, we suppose that structural (orthogonal) shocks are linear combinations of the residuals in reduce form VAR models. The identification of structural shocks of interest is carried out using contemporaneous restrictions based on the Choleski ordering of a recursive economic structure (with the most exogenous variable ordered first, i.e. here the external variables: international oil price, us product index, and Federal Fund). It means that contrary to numerous similar works, we don't apply the "BQ" decomposition identification procedure (Blanchard, O., and Quah, D., 1989). Assuming a long term neutrality of nominal shock would seem widely arbitrary for a work covering about twelve or so years, even if business cycles are – as showed above - shorter for these countries than for the industrialized one. *In fine,* the ordering follows the following order: world oil price, US IPI, US FFR, Domestic IPI, Domestic PPI, Domestic Interest Rate, Domestic Money Aggregate, and Real Exchange Rate, with a just identified scheme: contrary to Kim, S., and Roubini, N., 1997, we consider here domestic interest rate as more exogenous than money demand (in their paper, both authors proposed an over-identified model, with a simultaneous feed back between money demand and central bank rule).

Then, we deduce (orthogonal) structural innovations from residuals of the reduced form VAR, using identification restriction scheme (presented above). They are used to perform impulse response experiment and variance decomposition analysis of forecast errors. At least, a state-space model will carry out a decomposition of structural shocks to extract the eventual common component.

The model

The first step was estimating our VAR (in first difference of logarithm) for the three countries. The number of lags was selected using the common set of criteria and tests (available on the software Eviews). In presence of contradictory results, we followed the parsimony principle and chose the shorter lag (one lag for every country case). For each country "K", the standard (reduced) form of our VAR with constant is the following :

$$\begin{pmatrix} \Delta\ln\_WOP(t) \\ \Delta\ln\_US\_IPI(t) \\ \Delta\ln\_US\_R(t) \\ \Delta\ln\_K\_IPI(t) \\ \Delta\ln\_K\_PPI(t) \\ \Delta\ln\_K\_R(t) \\ \Delta\ln\_K\_M2(t) \\ \Delta\ln\_K\_ER(t) \end{pmatrix} = \begin{pmatrix} C_{wop} \\ C_{us\_ipi} \\ C_{us\_r} \\ C_{K\_ipi} \\ C_{K\_ppi} \\ C_{K\_R} \\ C_{K\_M2} \\ C_{K\_ER} \end{pmatrix} + \begin{bmatrix} C_{(1,1)} & \dots & \dots & \dots & \dots & \dots & \dots & C_{(1,8)} \\ \dots & & & & & & & \\ \dots & & & & & & & \\ \dots & & & & \dots & & & \\ \dots & & & & & & & \\ \dots & & & & & & & \\ \dots & & & & & & & \\ C_{(8,1)} & \dots & \dots & \dots & \dots & \dots & \dots & C_{(8,8)} \end{bmatrix} \begin{pmatrix} \Delta\ln\_WOP(-1) \\ \Delta\ln\_US\_IPI(-1) \\ \Delta\ln\_US\_R(-1) \\ \Delta\ln\_K\_IPI(-1) \\ \Delta\ln\_K\_PPI(-1) \\ \Delta\ln\_K\_R(-1) \\ \Delta\ln\_K\_M2(-1) \\ \Delta\ln\_K\_ER(-1) \end{pmatrix} + \begin{pmatrix} e_{wop} \\ e_{us\_ipi,t} \\ e_{us\_r,t} \\ e_{K\_ipi,t} \\ e_{K\_ppi,t} \\ e_{K\_R,t} \\ e_{K\_M2,t} \\ e_{K\_ER,t} \end{pmatrix}$$

In order to account for specific country shocks during the period, we added dummies:

- for Brazil, from 1990Q1 to 1994Q2, i.e. for the period of accelerated inflation, up to the Stabilization Real Plan,
- for Uruguay, from 2001Q3 to 2003Q1, a period perturbed by Argentinean and Brazilian instability.

Curiously, tests for a dummy variable for the Argentinean currency board crisis didn't reveal a significant effect. So, we did not keep it in our model.

We have to keep in mind that our three economies have adopted different exchange rate regime. Beyond, they have evolved, following independent paths for the period:

- from 1991 to 2001, Argentina has adopted a currency board (hard peg), then an independent regime of floating;
- from 1991 to 1997, Brazil has adopted a crawling band regime (a kind of real exchange rate targeting) more or less "de jure" and more or less narrow, according to the context. After the strong currency crisis, in January 1999, Brazil implemented flexible exchange rate regime combined with inflation targeting.
- From 1991 to 2001, Uruguay adopted a crawling band, substituted in june 2002 by a flotation regime.

Results

Our purpose is twofold. On the one hand, we identify what kinds of shocks, real or nominal, produce higher fluctuations in the three countries. On the other hand, we deem the similarity of the reactions of macroeconomic variables to these shocks in our sample. We aim at obtaining a first outline of the behavior of these economies shocked by the structural innovations (notably in terms of speed of adjustment); moreover, we are waiting for information concerning economic policies responses to shocks.

We account for various kinds of shocks:

- two external real shocks: the world oil price as an international shock, and the U.S. industrial production index as a regional shock;
- one domestic real shock with the industrial production index compiled for each Mercosur country;
- four domestic nominal shocks including production price index, money market interest rates, monetary aggregate M2 and the real exchange rate. As the real and nominal exchange rates produce similar effects on countries, we classify the first ones in the nominal shocks[8].

In addition, over the studied period, the real exchange rate is strongly determined by the evolution of production prices. Nominal interest rates and real exchange rates are our policy variables. As in Eichenbaum and Evans (1995), M2 represents here the money demand (we don't consider it as a policy instrument). In spite of this assumption, responses of M2 to shocks remain difficult to interpret for the following reasons:

- in some case (for instance, Brazil), this aggregate includes liquid public debts. As a result, the behavior of M2 does not necessarily follow a transactional logic;
- evolution of M2 are partly linked to the dollarization of countries. More exactly, it is advisable to take into account the facts that the degree of dollarization is not the same among studied countries, and that M2 eventually includes deposits in foreign currencies. Let us clarify this point.

Using the classification proposed by Reinhart, Rogoff and Savastano (2003), Argentina and Brazil belong to Type I dollarization –in which domestic and external liability dollarization co-exist- while Uruguay is a dollarized economy of Type II where dollarization is predominantly of a domestic nature. The degree of dollarization is different between these countries: high in Argentina (index 20 on a scale that goes from 0 to 30) and Uruguay (21), but moderate in Brazil (7). By exhibiting the share of foreign deposits in percent of total deposits, Table 3.1 confirms these facts.

[8]. This observation is valid also for industrial countries. See Favero (2000).

Table 3.1 Foreign Currency Denominated Deposits (in percent of total deposits)

	1990	2001	2004
Argentina	47.2	71.5	10.7*
Brazil	0.0	6.1	6.5
Uruguay	88.6	83.0	83.0

* the decrease results from the forced "pesification" of the economy after the exchange rate crisis in January 2002.

Source : Rennhack and Nozaki (2006).

Finally, we end observing that in Argentina, M2 includes some deposits in dollars, in opposition with Brazil and Uruguay. In the Brazilian case it is not really important given its moderate degree of dollarization of the economy. But in Uruguay; we observe that the demand for money measured by M2 does not respond exclusively to the traditional factors as predicted by monetary theory: it also depends on (external and domestic) events influencing the confidence in the domestic currency. For instance, during the Argentina crisis, the M3 growth (which includes dollars deposits) balanced the M2 decrease in Uruguay, as a consequence of a greater dollarization of the economy. Indeed Argentinean crisis raises doubt on the sustainability of the exchange rate regime in Uruguay[9].

External Real Shocks: Responses of Domestic IPI

The world oil price shock brings about two major influences on domestic economies. First, as a negative supply shock, it ought to carry a negative effect on the activity. But in the case of the studied countries, this expected effect will be balanced by the fact that Brazil and Argentina produce oil and other raw materials: as such they benefit from increasing oil and raw material prices (in many cases, the prices of these last ones used to follow oil prices fluctuations). Second, oil price increase is also an inflationary shock, leading to higher domestic production prices. In the following lines, we just consider the first effect.

The observation of IPI responses to WOP and US_IPI shocks shows a prevailing short term impact (about one-two quarters), with fluctuations of small magnitude. For instance, as result of a WOP innovation, we observe an increase of the growth rate of IPI for producers of gas and oil (Argentina and Brazil), and a limited drop in Uruguay. However, in every case, the equilibrium is restored within one year.

[9]. The exchange rate regime of Uruguay collapsed in June 2002. The country adopted a floating regime.

Variance decomposition confirms these results. Innovations on WOP or the US_IPI never explain more than 10% of the variance of the IPI for our sample of three countries.

External Real Shocks: Responses of Domestic Nominal Variables

In three countries, a WOP shock leads to a price increase, either on the impact, or at the end of the first quarter. The adjustment of production prices is quite fast in the three countries. The shock is absorbed after five – six quarters. The prices fluctuations are particularly marked and significant in Argentina. These facts can find two different interpretations.

On one side, it is an indication of higher flexibility in Argentina, with regard to the other countries. The fact that the adjustment in Argentina is a little faster consolidates this interpretation. On the other side, the strong fluctuations in prices can be the consequence of the currency board. This monetary regime reduces the smooth adjustments of the economy to shocks. As a consequence, either the adjustments are fast, but costly in term of short-run instability, or on the contrary they are very slow and painful.

The short-term prices increase following a shock on US_IPI is in accordance with the expected effects. The similarity of the effects with the shock on WOP does not mean that transmission mechanisms are identical. Higher oil prices increase the production costs, while the supply increase due to the shock on US_IPI entails a price increase of raw materials, and possibly wage costs, with an impact on the PPI.

We find again differences from the point of view of the size of the fluctuations. The Argentinean prices react very strongly while the Uruguayan prices little. Also, the adaptation is longer in the first country with regard to the second. The two main economies of our sample have a significant price decrease after three quarters in Argentina and six in Brazil.

Variance decompositions confirm partially the previous results. The innovations on US_IPI explain a significant share of the prices variance in Argentina and Uruguay, but not in Brazil.

About the interest rates reaction to external shocks, two policy cases must be distinguished. For countries having adopted an intermediate exchange rate regime on the greater part of period, i.e. Brazil and Uruguay, the world oil price shock is followed by a decline of the interest rate on three – four quarters. We can interpret this reaction as a traditional counter-cyclical answer to a negative shock. In both economies again, the interest rates increase few time after the US_IPI shock, and then decrease. This path rests on the pro-cyclical behavior of international capital flows: risk premium decreases while the American conjuncture improves, under the influence of better financial conditions in international financial markets. For Argentina - only country of our sample with hard peg - the reactions of the interest rate path seem much more struck. Indeed, the currency board reduces in a very strong way the ability of the economy to respond smoothly to shocks.

However, the interest rates reactions to previous shocks are little significant. The interpretation can be the following one: whatever the exchange rate regime, the rooms for maneuver of monetary policies were weak on the main part of the period. Indeed in the three countries, the interest rate was used to enforce the nominal anchor (where the exchange rate appears every time) in a context of disinflation policies. The counter-cyclical responses to shocks are thus limited. This analysis seems to be confirmed by the variance decompositions: none of the external real variables exerts any influence on the interest rates, except Uruguay with the US_IPI. The innovations on this variable explain between 11 and 12% of the variance of U_PPI after eight quarters.

For the three countries, the responses of M2 to real external shocks are either not significant, or of very short term, with the exception of Uruguay. The responses of M2 in Brazil seem to follow those of the interest rate to the various shocks. More precisely, the fall in money demand on the impact of WOP shock is the consequence of the interest rate decrease. The higher money demand following the shock on US_IPI is explained by the interest rate increase consecutive to this external shock. Let us remind that in Brazil, the aggregate M2 includes liquid public debt. In Argentina, the adaptation of M2 to external shocks follows a transactional logic. It is linked to the adjustment of the prices.

We find the weak influence of the external variables in the analysis of the variance decompositions. The innovations on the American production explain between 10 and 16% of the variance of the Uruguayan monetary aggregate. Neither the innovations on WOP, nor those on the US_IPI, explain the variance of M2 in the two other countries.

In the three countries, the real exchange rates have a similar reaction to a WOP shock: strong contemporaneous depreciation and then appreciation. The responses are just significant in Argentina and Uruguay for one quarter; the effect is shorter for Brazil. Variance decompositions confirm this outcome: WOP innovations explain 14% of the real exchange rate variance in Argentina after two quarters, and 9.4% of the contemporaneous variance in Uruguay. No results are significant for Brazil.

The responses of the real exchange rates to shocks on the American industrial production lead us to a similar analysis. Indeed, the disinflation period implies that prices in the United States as in the Latin American countries remained relatively stable during the 90s. As a result, the real exchange rates react weakly to US_IPI shocks. One more time, variance decompositions confirm theses observations.

External Nominal Shock: Response of Domestic Real and Nominal Variables

The US interest rates shocks are interpreted as monetary policy ones. After one quarter, the output falls slightly following the monetary contraction in the United States. The prices do not show significant responses. The interest rates increase in Brazil and in Uruguay (what seems in accordance with the traditional financial links), but decrease in Argentina. However, this effect is a very short one (less than one quarter) and according to common knowledge about the currency board running, interest rate adjusts very quickly in Argentina. The responses of the aggregate M2 are weakly or not significant with the exception of the Uruguay: we observe a decline of M2 on the impact of the shock explained by a monetary substitution process in favour of the dollars deposits not included in M2. In the three countries however, the adjustment is fast. And the real exchange rates exhibit an over-shooting process, appreciating on the impact of the shock, to depreciate in a second time (as expected). The fluctuations exhibits short run duration.

Overall, responses of domestic variables are weakly significant and produce only short term effects. This does not imply that Latin American countries are not influenced by US interest rates. However, over the sample period, except 1994-1995 and the period after the second quarter of 2004, the main trend has been an US expansive monetary policy. As a result, the size of interest rates shocks looks relatively weak over the period.

Variance decompositions confirm the weak influence of US interest rate. The innovations of this variable explain the variance of the Argentinean interest rate (as expected for a currency board country) but without persistence effect (15% of the contemporaneous variance; 9.5% at quarter two), the variance of Uruguayan aggregate M2 (9.6% of the contemporaneous variance without persistence), and the variance of the Uruguayan real exchange rate with a strong persistence effect (17.1% of the contemporaneous variance; around 15% after).

Domestic Real Shocks

Shock on domestic IPI generates a very fast adjustment for Brazil and Uruguay (less than one year), and a slower one for Argentina (two years). This sluggish adjustment is logical in a currency board. Prices and interest reactions are not significant in Uruguay. Prices responses in the two other countries are explained by supply effects: weak pressures on market imply lower prices. This expected response is instantaneous in Brazil and lagged in Argentina (one quarter). Monetary aggregates in Argentina and Uruguay exhibit a path conform to the cash transaction approach: M2 increases after the IPI shocks. On the contrary, the weight of short term public debt titles in M2 turns difficult the interpretations in term of instability of money demand in Brazil in reaction to IPI shock. In fact M2 seems to follow the evolution of interest rate which decreases on the impact of the shock. At last, real exchange rates react weakly, and for a very small period.

In short, for the three economies of Mercosur, the responses to the domestic supply shocks are thus of short duration and are weak or not significant, except for Brazil,. Moreover, the variance decompositions of the various domestic variables show that the innovations on the IPI explain the other variables only for Brazil (but without long term effect). For instance, the innovations on B_IPI (Industrial Production Index of Brazil) explain 15% of the contemporaneous prices variance… but just 9% after two quarters. Other nominal variables weakly influenced by B_IPI are interest rate (11.3% and 8.3%) and M2 (9.7% and 8.7%) for the contemporaneous and quarter two variances respectively.

Domestic Nominal Shocks

We consider shock on PPI (Production Prices Index) as a demand one. Argentina shows a rapid adjustment with strong fluctuations of production index. In the other countries, the adjustment is smooth, and without major fluctuations. The responses of production are weak or not significant in the three countries. Interest rates increase in reaction of inflationary pressures. They follow the prices adjustments. In countries with "intermediate" exchange rate regimes, interest rates responses are strong at short term, and the adjustment is slow. This path is explained by a weaker credibility of monetary policy. Monetary authorities are constrained to react quickly in order to prevent the development of indexation mechanisms. Real-balances effect explains the increase of M2 after shock on domestic prices. On real exchange rates, we have a significant appreciation over some relevant time horizon (four quarters in Argentina, six in Brazil, and eight in Uruguay), but the effects are really significant only in three countries, for approximately two quarters.

The analysis of variance decompositions allows us to stress the influence of prices in these economies. Innovations on prices do not explain the variance of production, but they exert a significant influence on other nominal variables. In the three countries, the effect on interest rates is important and persistent (over 30% in Argentina after two quarters; between 27 and

38% pour Brazil; from 33 to 49% in Uruguay). The reaction of authorities to any pressure on prices rests on the inflationary history in these countries. We find also a significant influence on the monetary aggregates M2 (particularly for Brazil). The impact is less important in both dollarized countries (Uruguay and especially Argentina). Innovations on prices explain around 25% of the variance of the real exchange rate in Brazil and Uruguay, suggesting a limited adjustment of the nominal exchange rate linked to the fear of floating. The extreme rigidity of nominal exchange rate under a currency board explains the fact that prices exert a strong influence on the real exchange rate in Argentina (more than 55% of its variance).

The innovations on interest rates are monetary policy shocks. In the three countries, IPI decreases after the shock, but the effect is particularly significant in Argentina. The production in countries with intermediate exchange rate regimes reacts less to the interest rate shock. Prices responses exhibit a traditional puzzle: prices increase on the impact of the shock, then decrease. Prices movements can also be interpreted as a Cavallo-Patman effect where higher interest rates increase production costs *via* the financing needs of working capital, leading to inflationary pressures (Taylor, 1981). A liquidity puzzle is observed for the responses of M2 in Brazil and Uruguay: money demand increases after the interest rate shock. As stressed above, money demands are unstable in these countries. In Argentina, the responses of M2 are consistent with the expected effects in traditional money demand functions: the opportunity cost to hold money increases with the interest rate. As a result, money demand falls. The responses of the real exchange rates in Argentina and Uruguay are consistent with prices. In Brazil, we observe an immediate depreciation followed by an appreciation.

In some ways, the adjustments after an interest rates shock seem fairly fast in the three countries: the main part of adjustment for the set of endogenous variable lasts four quarters for Argentina, seven for Brazil and six for Uruguay. Interestingly, variance decompositions suggest that innovations on interest rates are not relevant explicative variable. They explain a part of the variance of prices in Brazil, but only at long run (sixteen quarters), and their influence is moderate (10%). Interest rates innovations explain around 10% of the contemporaneous variance of M2 in Argentina (but the effect diminishes quickly), and 14% of the variance of M2 in Brazil (with a persistence effect). The weak influence of the interest rates results partially from the historical constraints weighting on monetary policy: a long run fight against inflation has reduced the monetary activism in the three studied countries.

A shock on M2 is interpreted as a nominal demand shock. The monotonous Argentinean money path converges smoothly in about six quarters. For Brazil and Uruguay, the path exhibits a negative overshooting, and then converges in about three quarters. These schemes can be explained by the difference of nominal anchor, linked to the exchange rate regime: in Argentina, the hard peg stabilizes a money demand (which stays instable in both the other partners of Mercosur). Innovations on M2 induce a very short duration in macroeconomic fluctuations: two quarters in Uruguay, less that six in Brazil and six quarters in Argentina. The impact in Argentina is stronger. Variance decompositions show that innovations on M2 explain from 16% to 18.5% of the variance of IPI in Argentina, but they do not exert any influence in the two other countries. Innovations on the monetary aggregate explain 10% of the variance of Argentinean prices after one year. The variance of interest rates in Argentina and Brazil is explained at the level of 12% and 10% respectively after four quarters. The long term influence of the interest rate rests on the monetarist approach of the monetary policy in the three countries. Indeed, a risk of excessive liquidity is synonymous of monetary tensions. Last, innovations on M2 explain between 12 and 10% of the real exchange rate variance in Uruguay.

Shock on real exchange rate is a depreciation followed by a slight and short re-appreciation, in the three countries. The effects on other variables have as short duration, between two and three quarters. The responses of Uruguayan variables are particularly weak. These responses could be explained by the fact that the standard-deviation of the real exchange rate in Uruguay is the weakest of the three countries. On the contrary, the standard-deviation is the highest in Argentina: but it is probably due to the exchange rate crisis of January 2002.

Variance decompositions confirm this weak influence of the real exchange rate over the sample period... But we must remember that during the main part of the period, monetary authorities had smoothed its volatility, either because its adoption as "official" nominal anchor, or to avoid "pass through" effects (even after the adoption of inflation targeting and flotation regime).

Preliminary conclusions

The previous results show that the studied countries react to nominal shocks rather than to real shocks. On the one hand, innovations on nominal variables produce the most significant fluctuations. On the other hand, they exhibit the strongest persistence effect.

In the three countries – and more particularly in Argentina, the only country of our sample with a hard peg regime during the main part of the period - we observe a weak monetary activism. However, our results show that even if countries were hit by rather similar shocks, their adjustments and their reactions were different. In other words, VARs suggest some similarities in the nature of the shocks, but they show clearly that the domestic dynamics were different after the shocks. From this point of view, Argentina, Brazil and Uruguay do not constitute an optimal currencies area. Our last study will confirm this outcome.

IDENTIFICATION OF COMMON AND COUNTRY SPECIFIC COMPONENTS OF STRUCTURAL SHOCKS USING STATE SPACE MODEL

The main purpose of the VAR estimation is to obtain non-recursive orthogonalization of the error terms for impulse response analysis and variance decompositions of forecast errors. Whatever the identification restrictions (short or long run), and their theoretical (or "a-theoretical") foundations (choice of an "ad-hoc" scheme of identification, or decomposition " à la Blanchard and Quah" contrasting demand and supply shocks on the basis of long run neutrality on supply side), these experiments don't allow the distinction between common and specific components of fluctuations and shocks. However, this distinction, and overall the weight of common component, are the fundamental criteria of judgment in the choice of economic and monetary integration. Following the OCA theory, a too light weight of common component implies significant adjustment of exchange rates in case of strong shocks. Such adjustments are difficult to endure in a simple free trade area. Moreover, it becomes impossible in case of common monetary zone. In short, any integration process implies symmetry, i.e. a large common component.

The model

In order to assess the share of the common and idiosyncratic components in the variability of the structural shocks, we propose a breakdown in two unobservable stochastic components using Kalman filter (Harvey, A.C., 1989, Kim., C.J., Nelson, C.R., 1999). The same method has been used by Bosco N'Goma (2000) for members of CFA Zone, by N.Chamie, A.Desserres, and R.Lalonde, 1994 for a comparison between Europe and USA, or by Lalonde and St-Amand (1993) for ALENA.

We report here an adaptation of the explanations proposed by N.Chamie, A.Desserres, and R.Lalonde, 1994 for the two countries case.

Consider a model breaking down shocks - affecting two regions A and B designing respectively Argentina and Brazil - into two unobservable components: a common and an idiosyncratic components. A state-space model is composed of two blocks.

The first block calls "measurement equation" (or system) of the state space model links the (known), dependant variables of the model, here ε_t^A, ε_t^B, to the (unknown) unobservable variables, n_t^C, n_t^A, n_t^B:

$$\begin{bmatrix} \varepsilon_t^A \\ \varepsilon_t^B \end{bmatrix} = \begin{bmatrix} \alpha_C & \alpha_A & 0 \\ \beta_C & 0 & \beta_B \end{bmatrix} \begin{bmatrix} n_t^c \\ n_t^A \\ n_t^B \end{bmatrix}$$

Let us keep in mind that ε_t^A, ε_t^B are the structural innovations estimated by our VARs (in fact, they are also unobservable[10]!). We decompose these structural innovations in a common component, the country A specific component, and the country B specific component.

The second block called transition equation generates these components n_t^C, n_t^A, n_t^B, departing from some assumptions regarding the stochastic proprieties of ε_t^A, ε_t^B and n_t^C, n_t^A, n_t^B. Using the Software Rats, structural innovations ε_t^A, ε_t^B were normalized with unit variances. This normalization allows us to compare more easily structural shocks relative to a specific variable across our three systems (one by country).

In order to respect an adding up constraint (for each country, the weighted sum of the variance of idiosyncratic component and common component n_t^C, n_t^A, n_t^B must be equal to the unity), we will restrict them imposing the variance to be equal to unity. So,the transition system will be:

[10] Curiously, authors using this approach, like N.Chamie, A.Desserres, and R.Lalonde, 1994, or Bosco N'Goma, J.M.,2000 qualified the structural shocks as observable variables, forgetting that they are the outcome of the assumptions concerning the specification of the VAR and of the identification matrix!

$$\Omega = \begin{bmatrix} Var(n_t^C) & 0 & 0 \\ 0 & Var(n_t^A) & 0 \\ 0 & 0 & Var(n_t^B) \end{bmatrix}$$

with $\begin{cases} Var(n_t^C) = 1 \\ Var(n_t^A) = 1 \\ Var(n_t^A) = 1 \end{cases}$

The solutions of the system will be the weights: α_i **, *i*=*A*, *B*, *C*.** Regarding to the assumption of unity variance of structural shock, and components, the estimated parameters of the **idiosyncratic components α_A = 1-α_C, and β_B= 1-β_C** represent the proportion of variance of country-shocks that are explained by the country specific-component, and **α_C, and β_C the relative weight of common component**. For purposes of identification, the common and specific components are assumed to be uncorrelated in the estimation process.

We can give an example of the program with the decomposition of each domestic IPI shock in common and country specific components: (A, B, U, indicate the countries, CC the common component, SAC, SBC, and SUC the country specific components, C1, C2, C3 the parameters indicatint the weight of common component):

$$A\_choc\_ipi = c1 * CC + (1\_c1) * SAC$$

$$B\_choc\_ipi = c2 * CC + (1\_c2) * SBC$$

$$U\_choc\_ipi = c3 * CC + (1\_c1) * SAC$$

$$SAC = [\text{var} = 1]$$

$$SBC = [\text{var} = 1]$$

$$SUC = [\text{var} = 1]$$

$$CC = [\text{var} = 1]$$

We have printed in Appendix 4 the outcomes of our results (performed with Eviews). Specification tests are derived using a maximum likelihood approach (Harvey, A.C., 1989).

Foreign shocks

In all our results, C(1), C(2), and C(3) point out the weight of common component in the structural shocks for Argentina, Brazil, and Uruguay respectively.

Shocks on foreign variables give us an assessment of the method pertinence. These variables, are presents in the three VAR models (and thus endogenous).I the Choleski matrix allowing the identification of structural shocks, they are ordered as following (from the less to the more endogenous): Oil Price (WOP), US Industrial Production Index (US_IPI), US interest on the Fed. Funds (US_R). We can assume that the series of structural innovations for this foreign variables - deduced from the three equations of the three country models - embody a significant common component for the three countries: the origin of these shocks is exogenous and common for the domestic bloc of the three country models!

In spite of the poor performance of oil price estimates, we can check that the oil price shock common in the three systems… is effectively recognized as common by our program! It is a way to check that the UCM (Unobservable Component Model) identifies common components. In less degree, it is also the case for the two other external variables (US_IPI and US_R). In table A.4.1., A.4.2., and A.4.3., the common component represents between 70 and 80% of the variance for oil shock, a little less for both the other shocks.

We can note also that the score for Brazil is always lower (a confirmation of the larger autonomy of Brazilian economy regarding to US conjuncture?)

Domestic shocks

The first shock is represented by domestic series of structural innovations in the IPI in the three VARs. (Table A.4.4). The Argentinean cycle is taken as bases (i.e. as reference for the other countries). The Brazilian real cycle is not significantly linked to any common trend, on the contrary of the Uruguayan one. But even in this last case, the weight of the common component in lower that 10%.

We try to estimate a common component by pairs of countries in Mercosur: the experiment is consistent with the previous outcomes: Uruguay shares probably the same proportion of common component than in the three country model (even if the test here is less significant), and the Brazilian shock doesn't share any common component neither with Argentina, nor with Uruguay.

We got identical results than in the case of PPI shocks, with evidences of a common component between Argentina and Uruguay (Table A.4.5.). In the case of other shocks -

domestic interest rates, money aggregate, real exchange rates – we did not find any hints of common trend (Tables A.4.6, A.4.7, A.4.8). As the three last shocks account more or less for the economic policy, it is once more a proof of the lack of coordination between the three main partners of Mercosur. In short, these outcomes confirm the conclusions of Eichengreen and Taylor (2004) outlining the lack of policy coordination within the Mercosur. The lack of common component for M2 confirms also the conclusion of our VAR: the money demand in the three countries follows idiosyncratic patterns!

CONCLUSION

Our results converge to indicate that the Mercosur countries are not predisposed to form a monetary union either between them, or with the United States. First, cross-correlations show that the weak synchronization of cycles suggests the presence of asymmetric shocks and/or different economic policy responses to shocks. Second, the VARs confirm the weak coordination of the economic policies between these countries identified in other studies. While these countries seem all to be hit essentially by nominal shocks, the adjustments are different. Third, our state-space model shows the weak common component of shocks representing economic policies. It suggests again the weak coordination within the area.

However, we must interpret with caution these results. On the one hand, the period of study is relatively short. On the other hand, the strong sensibility of these countries to international capital flows was not explicitly taken into account here. So, a future research has to concern a more precise modelling of the financial instability of these countries and its consequences as for the costs-benefits of a monetary union[11]. It is thus advisable to integrate into our analysis EMBI spreads and implications of the dollarization, notably from the point of view of the presence of balance-sheet effects following the currency depreciations.

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[11]. Edwards (2006) uses probit panel regressions to investigate if countries forming a monetary union have a lower occurrence of sudden stop episodes and of current accounts reversal episodes, and if they are more able to absorb external shocks. His answers are negative: belonging to a currency union has not lower the probability of facing a sudden stop or a current account reversal, and external shocks have been amplified in currency union countries.

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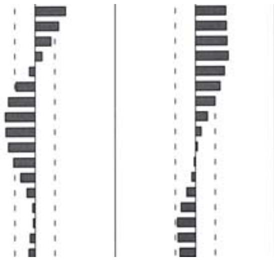
Appendix 1 IPI Cross-correlations

Argentina – United States

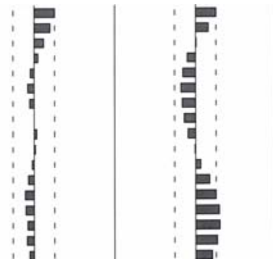
US before US after lag lead



	lag	lead
0	0.3935	0.3935
1	0.3084	0.4070
2	0.2092	0.4150
3	0.0946	0.4291
4	-0.0708	0.3786
5	-0.2390	0.3198
6	-0.3430	0.2611
7	-0.3818	0.1637
8	-0.3734	0.0788
9	-0.3438	0.0273
10	-0.2748	-0.0102
11	-0.1823	-0.0478
12	-0.0985	-0.1128
13	-0.0307	-0.1828
14	-0.0222	-0.2335
15	-0.0602	-0.2256
16	-0.0774	-0.2047

Brazil – United States

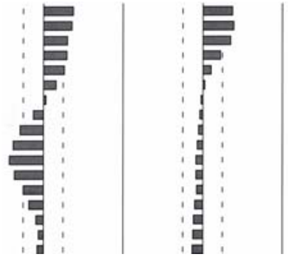
US before US after lag lead



	lag	lead
0	0.2678	0.2678
1	0.2125	0.1690
2	0.1291	0.0092
3	0.0542	-0.1046
4	-0.0483	-0.1610
5	-0.0751	-0.1880
6	-0.0493	-0.1713
7	0.0056	-0.1458
8	0.0359	-0.0956
9	0.0242	-0.0079
10	-0.0171	0.0731
11	-0.0714	0.1826
12	-0.1103	0.2661
13	-0.1012	0.3043
14	-0.0765	0.3185
15	-0.0882	0.2816
16	-0.0567	0.2145

Uruguay – United States

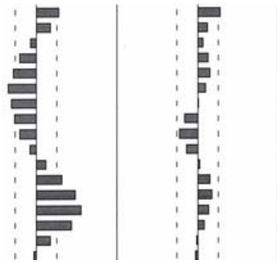
US before US after lag lead



	lag	lead
0	0.3862	0.3862
1	0.3766	0.4051
2	0.3191	0.3610
3	0.3062	0.2304
4	0.2771	0.1114
5	0.1689	0.0269
6	0.0401	-0.0213
7	-0.1277	-0.0397
8	-0.2953	-0.0562
9	-0.3893	-0.0737
10	-0.4354	-0.0858
11	-0.3760	-0.0849
12	-0.2547	-0.0778
13	-0.1877	-0.1049
14	-0.0906	-0.1197
15	-0.0602	-0.1304
16	-0.0787	-0.1363

Argentina - Brazil

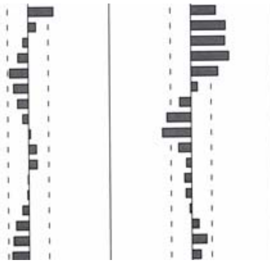
Brazil before Brazil after lag lead



	lag	lead
0	0.2928	0.2928
1	0.1837	0.1237
2	-0.0691	0.0718
3	-0.2069	0.1347
4	-0.2917	0.1565
5	-0.3539	0.1060
6	-0.3124	0.0115
7	-0.2726	-0.1688
8	-0.2112	-0.2304
9	-0.0793	-0.1450
10	0.1307	0.0304
11	0.3341	0.1595
12	0.5013	0.1823
13	0.5772	0.1422
14	0.4583	0.0843
15	0.1856	-0.0087
16	-0.0324	-0.0285

Argentina - Uruguay

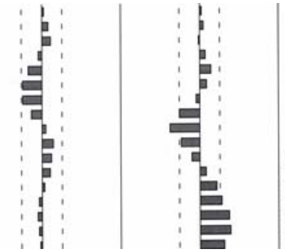
Uruguay before Uruguay after lag lead



0	0.3245	0.3245
1	0.0985	0.4427
2	-0.0655	0.4384
3	-0.1295	0.4840
4	-0.2346	0.3451
5	-0.1858	0.0849
6	-0.1390	-0.1416
7	-0.0700	-0.3109
8	0.0248	-0.3630
9	0.1032	-0.1604
10	0.1080	-0.0614
11	-0.0003	-0.0880
12	-0.0134	-0.0688
13	-0.0765	-0.0245
14	-0.1578	0.0930
15	-0.1955	0.1941
16	-0.2050	0.1187

Brazil – Uruguay

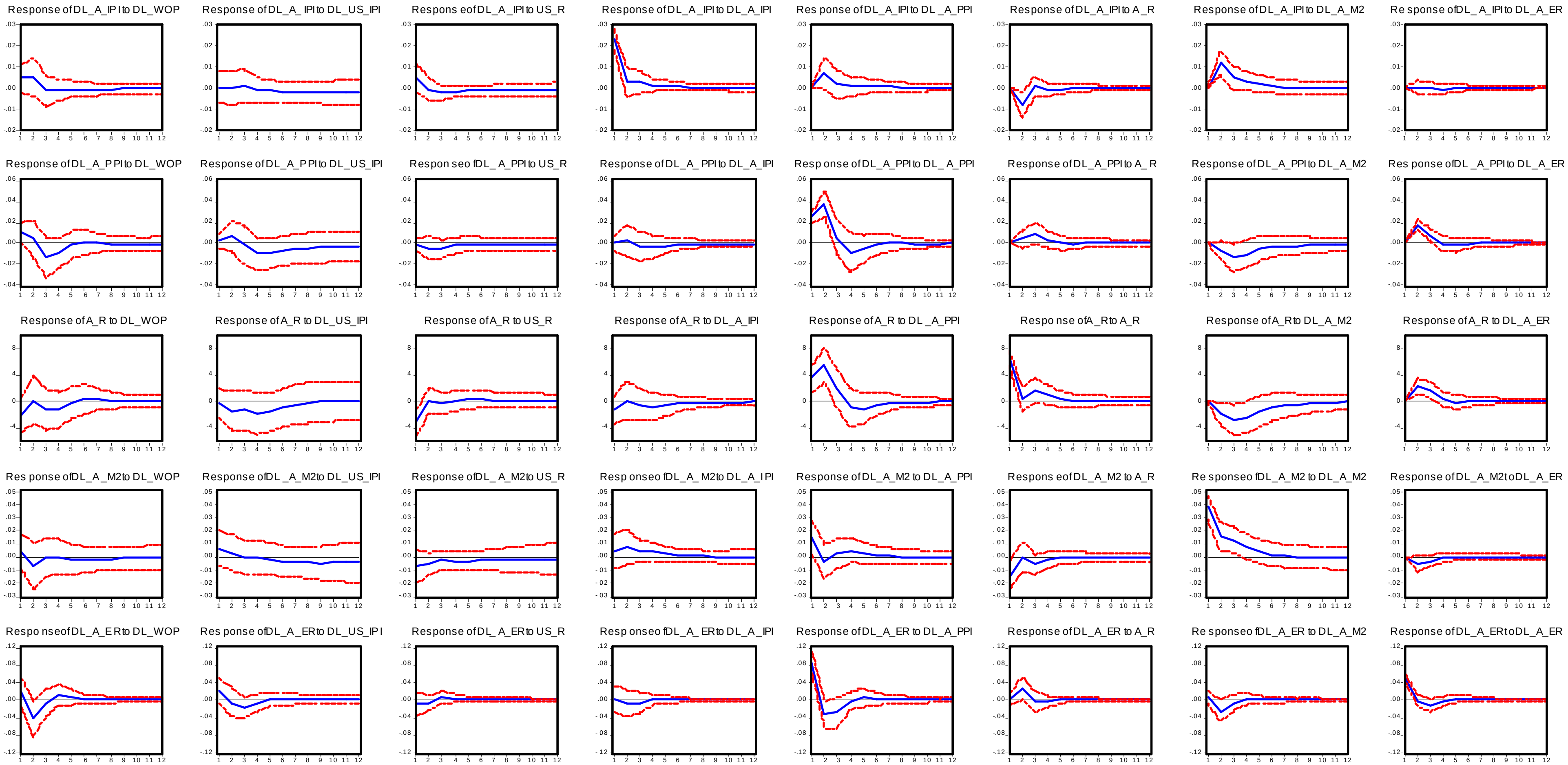
Uruguay before Uruguay fter lag lead



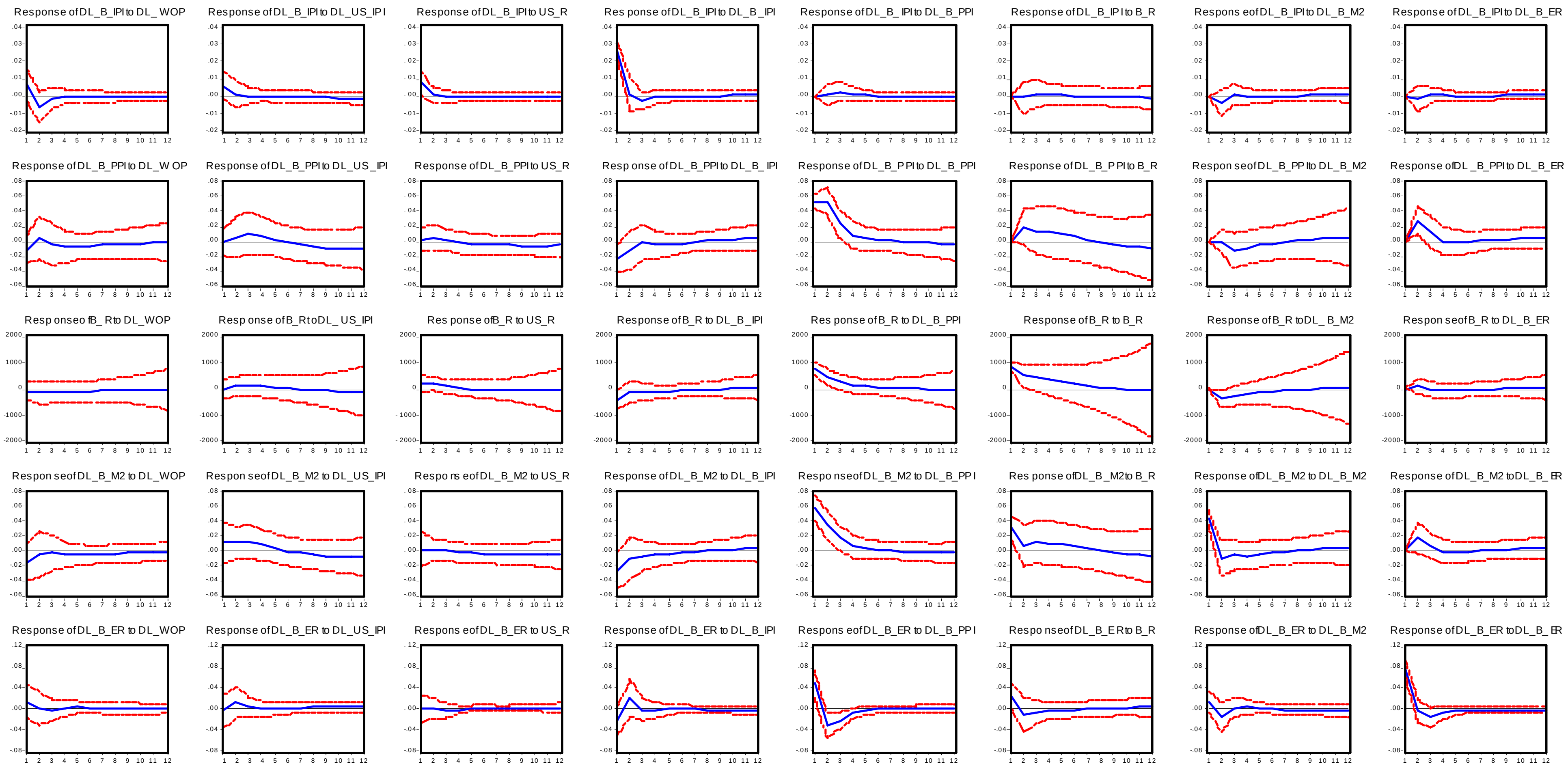
	lag	lead
0	0.0292	0.0292
1	0.0881	0.0548
2	0.1177	-0.0104
3	-0.0430	0.0764
4	-0.1779	0.1490
5	-0.2517	0.0954
6	-0.2523	-0.0440
7	-0.1360	-0.2656
8	0.0522	-0.3881
9	0.1495	-0.2422
10	0.1301	-0.0990
11	0.1088	0.0887
12	0.0397	0.2271
13	-0.0344	0.2935
14	-0.0540	0.3914
15	-0.0406	0.4042
16	-0.0206	0.3251

Appendix 2 Impulse responses

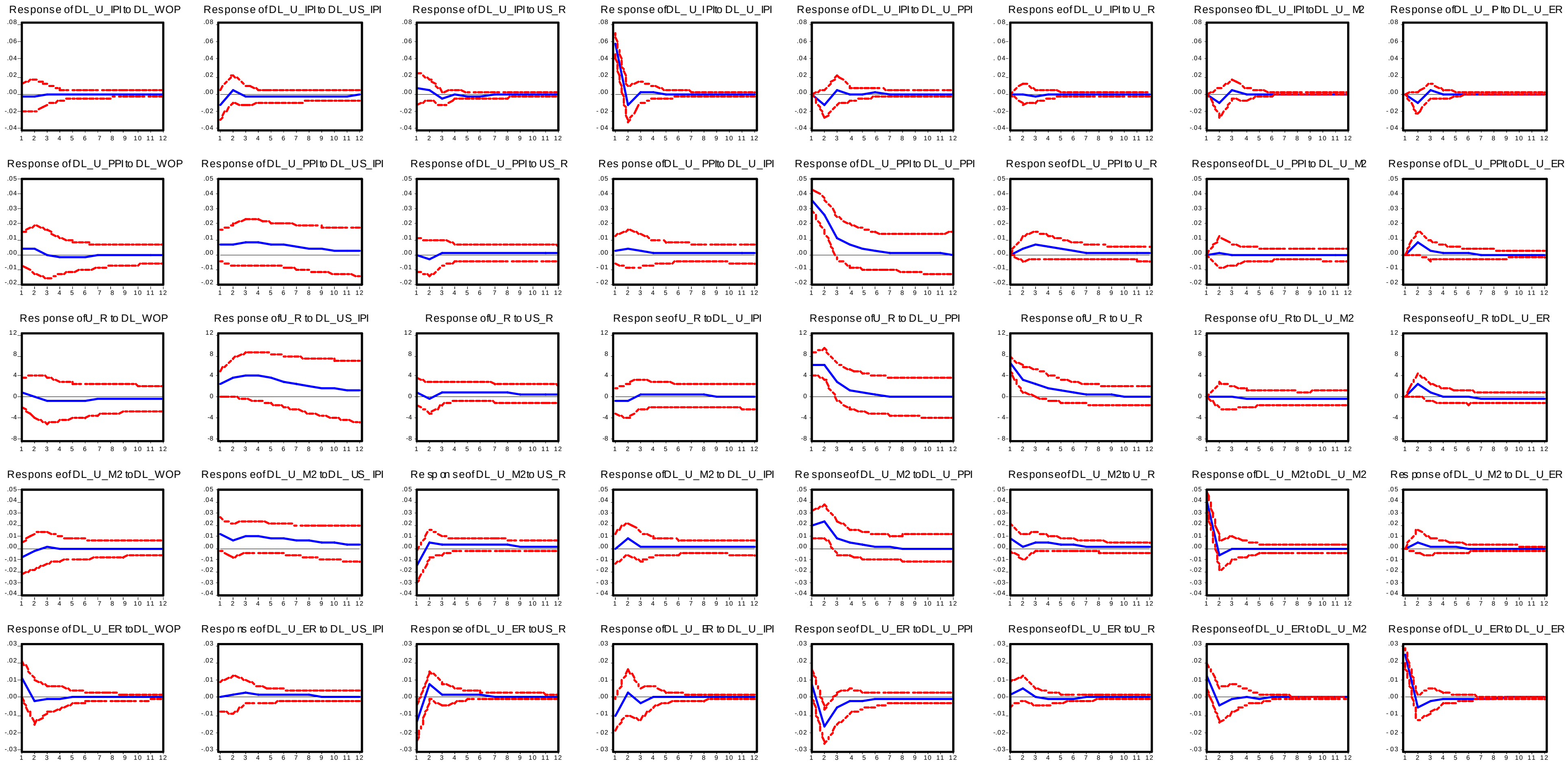
A.2.1. Argentina: Responses to Cholesky One S.D. Innovations ±2 S.E.



A.2.2. Brazil: Responses to Cholesky One S.D. Innovations ±2 S.E.



A.2.3. Uruguay: Responses to Cholesky One S.D. Innovations ±2 S.E.



Appendix 3 Variance Décomposition

A.3.1. Argentine

Variance decomposition of A_IPI:								
Period	WOP	US_IPI	US_R	A_IPI	A_PPI	A_R	A_M2	A_ER
1	3.763652	0.022910	4.205578	92.00786	0.000000	0.000000	0.000000	0.000000
2	5.554897	0.015342	2.876422	62.46640	5.865399	7.223865	15.98096	0.016714
3	5.516798	0.121131	3.449917	60.36241	5.874455	6.919005	17.73552	0.020771
4	5.552182	0.238287	3.627779	59.33562	5.796679	6.893949	18.49051	0.064991
8	5.518746	1.809263	4.122169	57.54720	5.805062	6.704235	18.42540	0.067919
12	5.450238	3.749775	4.254476	56.21216	5.676814	6.548620	18.03888	0.069038
16	5.396472	4.845095	4.284757	55.46592	5.601937	6.464237	17.87080	0.070788

Variance decomposition of A_PPI:								
Period	WOP	US_IPI	US_R	A_IPI	A_PPI	A_R	A_M2	A_ER
1	15.33336	0.708019	0.318774	0.000406	83.63944	0.000000	0.000000	0.000000
2	4.935638	2.165250	0.882880	0.192146	77.59767	0.672719	1.462201	12.09150
3	9.990234	1.864568	1.612145	0.386670	63.90967	3.592567	6.885186	11.75896
4	11.47963	4.428771	1.531248	0.741161	58.75427	3.564135	9.053674	10.44712
8	10.70969	9.281155	1.474719	0.798919	55.16284	3.306528	9.534252	9.731888
12	10.56974	10.28864	1.496685	0.790763	54.39880	3.269404	9.585223	9.600734
16	10.52615	10.61083	1.506556	0.787601	54.16175	3.257146	9.589769	9.560196

Variance decomposition of A_R:								
Period	WOP	US_IPI	US_R	A_IPI	A_PPI	A_R	A_M2	A_ER
1	6.009516	0.089900	14.92659	2.266136	16.88096	59.82690	0.000000	0.000000
2	3.845705	1.781500	9.466145	1.476737	37.39329	38.07112	3.019730	4.945771
3	4.370098	2.662544	8.103218	1.436003	34.45647	34.26888	8.281322	6.421468
4	5.019000	4.675698	7.368192	1.743679	31.90748	31.78210	11.60032	5.903529
8	4.873454	6.805627	7.058761	1.979452	30.67691	29.80135	13.26582	5.538627
12	4.879087	6.819323	7.087785	1.997073	30.61823	29.73761	13.33411	5.526780
16	4.878098	6.912970	7.096314	1.996207	30.57965	29.69914	13.31793	5.519691

Variance decomposition of A_M2:								
Period	WOP	US_IPI	US_R	A_IPI	A_PPI	A_R	A_M2	A_ER
1	1.007475	2.326443	2.457062	0.866016	11.64951	9.667745	72.02575	0.000000
2	2.670277	2.452353	3.147996	3.139987	9.974393	7.957276	69.59718	1.060542
3	2.428355	2.227064	3.081941	3.752023	9.318943	8.322913	69.58280	1.285965
4	2.323869	2.132974	3.284424	4.148117	9.862104	8.116609	68.90267	1.229228

8	2.562213	3.408950	3.954902	4.306790	9.936087	7.797902	66.85194	1.181221
12	2.565636	5.482629	4.123663	4.212258	9.693432	7.598405	65.17025	1.153730
16	2.548969	6.708688	4.163365	4.149113	9.546992	7.485791	64.25793	1.139152

Variance decomposition of A_ER:								
Period	WOP	US_IPI	US_R	A_IPI	A_PPI	A_R	A_M2	A_ER
1	3.136809	3.607593	0.833326	0.005294	68.65896	0.005040	0.363799	23.38918
2	14.38427	2.803045	0.925904	0.367028	55.91000	4.507546	4.562126	16.54008
3	13.27796	4.526414	1.003163	0.581251	56.01463	4.218201	4.412937	15.96544
4	13.78940	4.716806	1.073178	0.573945	55.35410	4.296269	4.368721	15.82759
8	13.95833	4.727060	1.083520	0.577745	55.23754	4.284660	4.362236	15.76891
12	13.95359	4.768359	1.091198	0.578096	55.20648	4.282198	4.360183	15.75990
16	13.94875	4.800465	1.093773	0.577918	55.18473	4.280561	4.360054	15.75375

A.3.2. Brazil

Variance decomposition of B_IPI:								
Period	WOP	US_IPI	US_R	B_IPI	B_PPI	B_R	B_M2	B_ER
1	5.466197	4.723471	7.147304	82.66303	0.000000	0.000000	0.000000	0.000000
2	9.546873	4.605419	6.684467	77.19194	0.083710	0.065183	1.534582	0.287828
3	9.506756	4.509395	6.595288	76.30939	0.879516	0.296698	1.588258	0.314698
4	9.475566	4.503319	6.587295	76.05661	1.062832	0.346455	1.589626	0.378297
8	9.523259	4.601220	6.692321	75.71937	1.078862	0.385605	1.601933	0.397429
12	9.425302	4.933341	6.757360	74.90071	1.112151	0.675672	1.709730	0.485732
16	9.309708	5.145637	6.749711	74.05770	1.161052	1.130952	1.870571	0.574672

Variance decomposition of B_PPI:								
Period	WOP	US_IPI	US_R	B_IPI	B_PPI	B_R	B_M2	B_ER
1	3.636068	0.033197	0.191564	14.88792	81.25125	0.000000	0.000000	0.000000
2	1.836185	0.434500	0.346501	8.899886	74.17907	4.432703	0.000125	9.871029
3	1.776747	1.710860	0.363398	7.758128	70.47734	6.063936	1.632182	10.21741
4	2.350212	2.273033	0.385259	7.612866	67.80253	7.482184	2.370816	9.723095
8	3.585077	2.937933	1.299527	7.581789	64.15041	8.523439	2.633149	9.288670
12	3.514478	5.678050	2.343629	7.407094	59.26592	9.476000	3.145876	9.168953
16	3.192917	7.391542	2.778134	7.435437	54.08961	11.91279	4.171748	9.027819

Variance decomposition of B_R:								
Period	WOP	US_IPI	US_R	B_IPI	B_PPI	B_R	B_M2	B_ER
1	0.494327	0.047197	2.335269	11.29210	38.81776	47.01334	0.000000	0.000000
2	1.251293	0.514391	2.916948	8.281342	35.80124	43.50934	7.392426	0.333016

3	1.997194	1.117670	2.754367	7.696670	32.71246	44.09799	9.288880	0.334775
4	2.552981	1.386610	2.564871	7.649358	30.67137	44.47598	10.16078	0.538041
8	3.530253	1.477429	2.471630	7.669364	28.56820	44.84659	10.68602	0.750520
12	3.690927	2.473801	2.842816	7.566941	27.94706	44.04887	10.54851	0.881073
16	3.548842	3.532257	3.087117	7.551422	26.97772	43.50172	10.62975	1.171171

Variance decomposition of B_M2:								
Period	WOP	US_IPI	US_R	B_IPI	B_PPI	B_R	B_M2	B_ER
1	3.043986	1.691426	0.058942	9.666008	45.06444	13.49413	26.98107	0.000000
2	2.699535	2.730625	0.099477	8.666797	48.85944	11.21481	22.50233	3.226980
3	2.567351	3.947496	0.092225	8.447074	48.40855	11.94661	21.15870	3.432005
4	2.751187	4.484246	0.118438	8.403688	47.31516	12.61617	20.97908	3.332020
8	3.473925	4.759115	0.635957	8.404523	45.64089	13.29950	20.48964	3.296450
12	3.479011	6.331031	1.323997	8.247128	43.65859	13.53861	19.92077	3.500863
16	3.270273	7.459752	1.693210	8.207452	41.24523	14.82717	19.53315	3.763769

Variance decomposition of B_ER:								
Period	WOP	US_IPI	US_R	B_IPI	B_PPI	B_R	B_M2	B_ER
1	2.340308	0.197605	0.000774	5.150536	23.17447	6.847276	2.102308	60.18672
2	1.975868	1.473256	0.016778	8.042244	27.17983	6.858723	3.576871	50.87643
3	1.890503	1.514568	0.075785	7.555662	29.19473	6.647986	3.430441	49.69033
4	1.915869	1.496430	0.077723	7.506280	29.36789	6.669237	3.520375	49.44620
8	2.091180	1.647640	0.234967	7.461303	29.19991	6.685635	3.542893	49.13647
12	2.076076	2.093994	0.402767	7.443688	28.83456	6.960383	3.650195	48.53834
16	2.049014	2.384021	0.486531	7.451041	28.47841	7.412245	3.813751	47.92499

A.3.3 Uruguay

Variance decomposition of U_IPI:								
Period	WOP	US_IPI	US_R	U_IPI	U_PPI	U_R	U_M2	U_ER
1	0.324544	4.178657	1.131742	94.36506	0.000000	0.000000	0.000000	0.000000
2	0.395337	4.231890	1.552191	85.52875	3.340129	0.003264	2.291797	2.656640
3	0.392668	4.221588	2.370322	83.47108	3.675583	0.124793	2.865205	2.878761
4	0.429223	4.407274	2.388397	83.21871	3.662922	0.135840	2.875204	2.882428
8	0.436008	5.124344	2.686739	82.23894	3.652750	0.156354	2.851047	2.853817
12	0.434052	5.535849	2.804888	81.74302	3.642711	0.162195	2.836930	2.840354
16	0.433010	5.711111	2.850874	81.53722	3.637315	0.164802	2.830969	2.834701

Variance decomposition of U_PPI:								
Period	WOP	US_IPI	US_R	U_IPI	U_PPI	U_R	U_M2	U_ER
1	0.973501	2.476455	0.012964	0.564886	95.97219	0.000000	0.000000	0.000000
2	1.113939	3.236243	0.339338	0.988322	90.96560	0.594259	0.065827	2.696477
3	1.013674	5.460685	0.341341	1.116973	87.31261	1.987269	0.078471	2.688980
4	1.037086	7.678841	0.353923	1.098279	84.41019	2.707848	0.074828	2.639000
8	1.223373	11.65244	0.516392	1.199090	79.58489	3.261021	0.071263	2.491523
12	1.236584	12.47603	0.610800	1.220787	78.64352	3.277863	0.072035	2.462374
16	1.234889	12.67662	0.649141	1.223847	78.41081	3.276125	0.072650	2.455919

Variance decomposition of U_R:								
Period	WOP	US_IPI	US_R	U_IPI	U_PPI	U_R	U_M2	U_ER
1	1.065680	7.346287	1.393505	0.672532	44.65494	44.86705	0.000000	0.000000
2	0.612598	13.24507	0.781596	0.595779	49.21094	31.96556	0.039597	3.548860
3	0.641946	19.30050	1.061680	0.767444	44.68882	30.18419	0.032711	3.322715
4	0.770800	24.53563	1.474841	0.762694	40.84711	28.56069	0.041936	3.006295
8	0.946566	33.34530	2.580023	0.977870	34.52117	25.05735	0.052781	2.518938
12	0.932701	35.38822	3.064134	1.028088	33.01444	24.08995	0.062636	2.419837
16	0.921664	35.97586	3.254997	1.037261	32.56536	23.78531	0.067000	2.392553

Variance decomposition of U_M2:								
Period	WOP	US_IPI	US_R	U_IPI	U_PPI	U_R	U_M2	U_ER
1	2.679765	5.573089	9.628792	0.004157	15.35849	3.423424	63.33228	0.000000
2	2.287820	5.505612	8.012389	2.222041	27.79488	2.678660	50.64254	0.856060
3	2.165220	7.834070	7.734754	2.126731	28.10881	3.358750	47.79625	0.875412
4	2.091367	9.978026	7.652497	2.089492	27.66074	3.667399	45.97951	0.880974
8	2.007042	14.80091	7.814100	2.068256	25.86588	3.904170	42.71656	0.823075

12	1.972803	16.18907	7.963004	2.065244	25.31256	3.878151	41.80750	0.811659
16	1.959353	16.62586	8.031027	2.061965	25.13590	3.863373	41.51336	0.809162

Variance decomposition of U_ER:								
Period	WOP	US_IPI	US_R	U_IPI	U_PPI	U_R	U_M2	U_ER
1	9.379882	0.002651	17.11941	8.049184	5.094891	0.272064	11.88215	48.19977
2	7.261007	0.189239	15.78597	6.626321	20.53733	2.039484	9.780016	37.78064
3	7.025384	0.760631	15.33122	7.216480	21.80876	1.963731	9.409137	36.48466
4	6.992753	0.852965	15.32610	7.209052	21.96055	1.976918	9.372830	36.30883
8	6.944672	1.125039	15.44981	7.144479	22.03689	1.974686	9.303142	36.02128
12	6.928539	1.298457	15.48421	7.125275	21.99336	1.969555	9.278724	35.92189
16	6.919814	1.389111	15.49429	7.117061	21.96834	1.967986	9.267376	35.87602

Appendix 4 Unobservable Components Models Estimations

Foreign Variables Shocks: Impact on the three economies

A4.1. Oil Prices

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	0.819431	0.016923	48.42136	0.0000
C(2)	0.686534	0.019256	35.65248	0.0000
C(3)	0.823999	0.027538	29.92181	0.0000

A.4.2. US IPI

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	0.724298	0.032420	22.34090	0.0000
C(2)	0.623213	0.029792	20.91877	0.0000
C(3)	0.680470	0.030621	22.22210	0.0000

A.4.3. US Federal Fund Rates

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	0.713784	0.047974	14.87868	0.0000
C(2)	0.515605	0.016995	30.33916	0.0000
C(3)	0.621358	0.031831	19.52076	0.0000

Domestic Variables Shocks:

In all our results, C(1), C(2), and C(3) point out the weight of common component in the structural shocks for Argentina, Brazil, and Urugay respectively. The reference country is defined as the country whose the cycle has a dominant weight during the attribution of the values of initialization. When Argentina is present, it is chosen as country of reference to the cycle of which are compared the other cycles. Otherwise, the reference country is Brazil. This choice is arbitrary, but it does not modify the results. In particular, it does not hide the presence of a common component when there is such component.

A.4.4. Domestic IPI

Three Countries

Sspace: CHOCS4

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	0.988419	0.075659	13.06418	0.0000
C(2)	0.062053	0.066537	0.932605	0.3510
C(3)	0.089826	0.052552	1.709269	0.0874

Argentina - Brazil

Sspace: CHOCS4_AB

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	0.996318	0.075475	13.20067	0.0000
C(2)	0.061896	0.066450	0.931472	0.3516

Argentina - Uruguay

Sspace: CHOCS4_AU

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	0.992016	0.072712	13.64311	0.0000
C(3)	0.089716	0.052350	1.713791	0.0866

Brazil - Uruguay

Sspace: CHOCS4_BU

	Coefficient	Std. Error	z-Statistic	Prob.
C(2)	0.999858	0.082655	12.09675	0.0000
C(3)	-0.011601	0.066542	-0.174339	0.8616

A.4.5. Domestic PPI

Three Countries

Sspace: CHOCS5

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	0.986720	0.038162	25.85603	0.0000
C(2)	0.060653	0.056806	1.067715	0.2856
C(3)	0.099918	0.039829	2.508659	0.0121

Argentina - Brazil

Sspace: CHOCS5_AB

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	0.996488	0.039015	25.54144	0.0000
C(2)	0.060459	0.056643	1.067373	0.2858

Argentina - Uruguay

Sspace: CHOCS5_AU

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	0.990184	0.035279	28.06742	0.0000
C(3)	0.099788	0.039647	2.516874	0.0118

Brazil - Uruguay

Sspace: CHOCS5_BU

	Coefficient	Std. Error	z-Statistic	Prob.
C(2)	0.998744	0.087787	11.37696	0.0000
C(3)	-0.034753	0.049299	-0.704946	0.4808

A.4.6. Domestic Interest Rates

Three Countries

Sspace: CHOCS6

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	0.998135	0.058554	17.04639	0.0000
C(2)	0.031792	0.070349	0.451915	0.6513
C(3)	0.029897	0.061313	0.487616	0.6258

Argentina – Brazil

Sspace: CHOCS6_AB

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	0.999029	0.057348	17.42039	0.0000
C(2)	0.031783	0.069328	0.458445	0.6466

Argentina-Uruguay

Sspace: CHOCS6_AU

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	0.999101	0.057251	17.45115	0.0000
C(3)	0.029889	0.060465	0.494313	0.6211

Brazil - Uruguay

Sspace: CHOCS6_BU

	Coefficient	Std. Error	z-Statistic	Prob.
C(2)	0.995383	0.060596	16.42666	0.0000
C(3)	0.067176	0.048546	1.383755	0.1664

A.4.7. Domestic Monetary Aggregates

Three Countries

Sspace: CHOCS7

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	0.996839	0.081676	12.20484	0.0000
C(2)	0.013360	0.112377	0.118888	0.9054
C(3)	0.054749	0.090159	0.607243	0.5437

Argentina - Brazil

Sspace: CHOCS7_AB

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	0.999819	0.082357	12.14010	0.0000
C(2)	0.013348	0.112580	0.118566	0.9056

Argentina - Uruguay

Sspace: CHOCS7_AU

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	0.997006	0.048762	20.44652	0.0000
C(3)	0.054746	0.090161	0.607206	0.5437

Brazil - Uruguay

Sspace: CHOCS7_BU

	Coefficient	Std. Error	z-Statistic	Prob.
C(2)	0.998854	0.112688	8.863914	0.0000
C(3)	-0.033048	0.076812	-0.430248	0.6670

A.4.8. Real Exchange Rates

Three Countries

Sspace: CHOCS8

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	0.998111	0.098674	10.11523	0.0000
C(2)	0.018343	0.057335	0.319934	0.7490
C(3)	0.039594	0.070296	0.563239	0.5733

Argentina - Brazil

Sspace: CHOCS8_AB

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	0.999676	0.098761	10.12216	0.0000
C(2)	0.018334	0.057094	0.321123	0.7481

Argentina - Uruguay

Sspace: CHOCS8_AU

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	0.998435	0.097671	10.22239	0.0000
C(3)	0.039590	0.069968	0.565824	0.5715

Brazil - Uruguay

Sspace: CHOCS8_BU

	Coefficient	Std. Error	z-Statistic	Prob.
C(2)	0.997283	0.063833	15.62330	0.0000
C(3)	0.052956	0.055387	0.956107	0.3390