

# Business Cycles and Macroeconomic Policy Coordination in Mercosur

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**Abstract:** The paper analyzes cyclical comovements in the Mercosur area differentiating idiosyncratic from common shocks. In the Mercosur (or any region for that matter) shocks can be country-specific, affecting only one country or a specific set of countries (for example, a weather-related shock, a domestic policy shock); or they can be common to the entire region (for example, a change in the conditions in international capital markets or a world recession). Propagation mechanisms, in turn, are important because a shock that was initially country-specific, originating in one country, might eventually spillover to others. We build on the unobserved component approach to decompose the Mercosur countries' real GDP (seasonally adjusted) fluctuations into these three components and compare them with previous results. The main findings in the paper are: first, common factors originating in impulses stemming from changes in investor's sentiment are relevant to explaining regional output comovements and the spillover effects between neighbors are significant. Second, volatility matters, and matters especially in the case of recent regional agreements. Supply shocks in Mercosur countries tend to be larger than in the US and European countries. Third, finance matters for both volatility and output/price dynamics. Accelerator effects may be important in explaining some features of the output/price dynamics that the standard models based on vector autoregression techniques are unable to account for.

**Key-Words:** Business cycle, Comovement, Mercosur, OCA, Policy coordination, Unobserved components, VAR, Volatility.

**JEL Classification:** C32, E32, F02.

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# 1 Introduction

The main purpose of this paper is to analyze aggregate fluctuations and cyclical comovements in the Mercosur area, as well as to draw conclusions on macroeconomic policy coordination.<sup>1</sup> Our primary concern will be to characterize the fluctuations in GDP. We basically follow the literature on optimum currency areas (OCA) and exchange-rate-regime choice. Therefore, the issues that we discuss here are to a great extent those treated in that literature: the degree of symmetry of the business cycles, the identification of the sources of shocks, volatility, and the interactions between the cyclical movements of output and prices.<sup>2</sup>

Our treatment of cyclical fluctuations, nonetheless, departs from the literature insofar as the emphasis we give to certain factors. This is basically due to the fact that the Mercosur presents a series of particularities that must be incorporated into the analysis. The most relevant are: first, that the Mercosur is a relatively recent regional integration agreement in which the degree of economic and trade integration is still low; second, its members are instability-prone medium-income countries and some are highly dollarized; and third, the countries have been hit by sizable shocks in the last five years and this has been detrimental to the integration process.

In our view, the particularities of the Mercosur macroeconomic setting indicate that focusing exclusively on the problem of the symmetry of business cycles may not be the best research strategy. In the OCA-inspired studies on the cycle, the identification of common shocks and of the degree of harmony in the adjustment process play prominent roles because of their primary interest on the cost-and-benefit analysis of renouncing the independence of monetary policy. In the case of Mercosur, the problem of relinquishing monetary policy in favor of a common one with the members of an eventual monetary union is not the most pressing issue of the day. The key macroeconomic policy question poses whether regional actions can be taken to reduce the volatility of some variables—the real bilateral exchange rate in the first place— thereby facilitating the process of integration. A closely related question considers what institutional framework at the regional level and what domestic policy regimes can best support the coordi-

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<sup>1</sup>The findings on the cycle that we will present are the result of an ongoing research project on macroeconomic policy coordination undertaken by the Mercosur Research Network. At a previous stage of the project we analyzed the constraints from the structure of intraregional trade in the region, the behavior of prices, and some of the institutional issues involved. See Fanelli, González-Rozada, and Keifman (2001).

<sup>2</sup>In Fanelli (2001) we discussed the relationship between this literature and our research project.

nation efforts. More specifically, among the most urgent problems at present are: what kinds of rules/practices should be set to reduce volatility in the short-run and coordinate a process of long-run convergence in the dynamic path of fundamental macroeconomic variables? Given the existing differences in the macroeconomic situation and policy stance in the four countries, what combination of exchange rate regimes in each country would best facilitate the convergence process? Are there “cheap” policy initiatives that can be implemented regionally? That is, are there “x-inefficiencies” in the conduct of macroeconomic policies that can be eliminated through coordinated regional initiatives?

These policy questions raise two points that merit particular attention on the business cycle research agenda. The first is volatility. It is a well-documented fact that stochastic processes characterizing key macroeconomic variables tend to be more unstable in developing countries. In particular, the size and variance of shocks are large and the parameters of the stochastic processes frequently show unexpected changes (“structural breaks”). Many authors observed that certain features of the economic structure may be the source of excessive volatility. In his work on the US regional cycle, Kouparitsas (2002) found that, in those US regions that devote a disproportionate share of their industrial activity to the production of commodities, region-specific cycles are dominated by fluctuations in commodity prices that are largely exogenous to the region; region-specific shocks explain almost thirty percent of the business cycle variation. In those states in which industrial composition is virtually identical to that of the aggregate US economy, on the other hand, region-specific shocks account for an insignificant share of the business cycle variation in income. According to Kenen (1969), if countries specialize in distinct goods, they will be affected very differently by a given disturbance. Elaborating on this idea, Eichengreen and Taylor (2003) show that real exchange rate variability is associated with trade dissimilarity between partners. In the case of Mercosur, Fanelli and Heymann (2002) highlight the role of financial fragility and dollarization. But there is also evidence that causality runs both ways: high volatility leaves traces in the economic structure as well. In our previous work on the exchange rate (Fanelli, González-Rozada, and Keifman, 2001), we observed that higher volatility is associated with more rapid adjustment toward equilibrium, which may have to do with shorter contracts when the context is volatile. Likewise, there is evidence that excessive macroeconomic volatility erodes the financial structure resulting in weak financial deepening. Missing markets for financial contracts of larger duration and, especially, for spreading risk, are

a canonical feature of the region. This suggests that financial aspects should play a significant role in the analysis of shocks and propagation mechanisms.

The second point that deserves attention on the research agenda is the relationship between idiosyncratic and common (regional) cycles. When the degree of integration is low and the market structure has significant missing markets, one would expect—*ceteris paribus*—a low correlation of business cycles. However, a low correlation of cyclical movements does not mean that there are no coordination opportunities to exploit. The countries could still reduce macroeconomic volatility by implementing mechanisms to exchange idiosyncratic risks. The implementation of these mechanisms should improve both macroeconomic stability and welfare because it would expand trading opportunities and permit exchanging risks that could not otherwise be exchanged insofar as the international markets for transacting those risks are clearly missing. For these mechanisms to be designed and implemented, it is critical to fully comprehend the relationship between common and idiosyncratic cycles and to identify regional propagation mechanisms within a unified methodological framework

The issues that we study in this paper are closely related with these two points. The rest of the paper is organized as follows. The second section presents the stylized facts of output fluctuations in Mercosur. The purpose is twofold: to present empirical evidence and to motivate the analysis. The third reviews and discusses the approaches used in previous studies on cyclical comovement in Mercosur and proposes some innovations for addressing the issues raised in the introduction and in the section dealing with stylized facts. The fourth section presents the estimates of a VAR model for identifying supply and demand shocks based on the Blanchard and Quah (1989) methodology (BQ hereafter) and examines the weaknesses of this approach to account for price/output dynamics in Mercosur. The fifth section presents estimates of the common and idiosyncratic cycles in Mercosur. We apply the unobserved component methodology developed by Watson (1986) and Kouparitsas (2002) to identify the common (regional) and idiosyncratic (national) components of cyclical fluctuations in the region. We also investigate the relationship between the estimated common cycle and changes in financial conditions. The sixth section concludes the paper.

## 2 Cyclical Comovements in Mercosur: the Stylized Facts

Identifying the shocks that affect a specific economic area—a country, the sub-region of a country, or an aggregate of countries in a regional agreement—and characterizing the propagation mechanisms that operate are two key purposes of business cycle studies. As was mentioned above, our analysis will focus on the regional dimension of business cycles rather than the national level. Our primary concern is to characterize fluctuations and comovements in the GDP.<sup>3</sup> We will measure the size of shocks affecting the product, its volatility, and the speed of adjustment toward equilibrium after a disturbance has occurred. On these bases we will assess the degree of business cycle comovement across Mercosur countries, which implies identifying common sources of disturbances, country-specific shocks, and cross-country spillover effects.

The study of these factors is very demanding on both analytical and empirical grounds. The full specification of the structural model calls for a knowledge of the economic, policy, and institutional factors that often go well beyond the state of the art in developing-country macroeconomics. However, even if we were able to specify correctly the stochastic structural model at the analytical level, the identification of its parameters usually calls for a knowledge of the data generating process that is inconsistent with the quantity and quality of the data available in the countries under study. Given these constraints, we will adopt a heterodox strategy and will approach the problem from different perspectives. We will first characterize the most important stylized facts and, then, try different approaches to model shocks, comovements, and propagation mechanisms. By using different models and procedures we hope to highlight different factors that we regrettably cannot show within a unified framework.

The first row of Table 1, Panel A, reports the average quarterly growth rates of the three countries under analysis from 1980 to the present. It is clear that the rate of growth of Mercosur countries has been very low in the last two decades. Although Brazil exhibits the highest growth rate, its case is the most striking because Brazil was considered a “miracle” of high growth in the post-war period. It is easy to anticipate, then, that the popularity of Mercosur and the political will to deepen integration will be strongly influenced by the ability of the agreement to contribute to restoring and sustaining growth. Panel B of Table 1 indicates that no substantial differences exist between the pre- and post-Mercosur periods.<sup>4</sup> Only Argentina shows a higher

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<sup>3</sup>Owing to data availability, we do not include Paraguay in the analysis.

<sup>4</sup>To be sure, we are describing the data and do not intend to imply any causal relationship between regional

growth rate, but its recovery in the nineties proved to be unsustainable.

A second apparent feature is the high volatility the three countries have experienced, although it is much more marked in Argentina and Uruguay. The three countries exhibit a fall in the standard deviation of GDP growth rate in the period that follows the establishment of the agreement, but the differences between the two periods are far from striking. The wide gap that still exists between the observed maximum and minimum values of the growth rate reveals that the degree of instability is still too high. We must take into account, nonetheless, that the most important achievement regarding volatility in the nineties does not appear in the table: the generalized reduction in the mean and standard deviation of the inflation rate in the four countries (See Fanelli, González-Rozada, and Keifman, 2001). This represents an important asset regarding the necessary conditions for macroeconomic policy coordination.

TABLE 1 about here

A natural first step to assess the degree of comovement of business cycles at the regional level is to calculate the correlation between domestic business cycles, where “business cycle” is defined as the residual left once the Hodrick-Prescott (H-P) trend has been removed.<sup>5</sup> In this context, a high correlation suggests the existence of common sources of and similar responses to shocks. If the correlation is low, however, it may be due either to differing perturbations and/or different responses to shocks. Table 2 shows that contemporaneous correlations between Argentina and Brazil are low, while Uruguay experiences a larger degree of comovement with the other members. The value of the coefficients indicates that the strongest comovement occurs between Argentina and Uruguay. If we consider that the US is a well-developed monetary union, we can use the value of the correlation coefficients between US regions as a standard for comparison. According to the evidence in Kouparitsas (2002) the minimum value of the correlation coefficient is 0.51 and the mean is 0.78. It is apparent that the degree of comovement in Mercosur is much weaker. This suggests that common sources of disturbances are weak and/or that the responses to common shocks are dissimilar. Regarding the latter, we should consider that—with the possible exception of the third quarter 94/fourth quarter 98 period

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integration and growth; to do so we would have to control for other factors, such as external financial shocks and domestic structural reforms.

<sup>5</sup>We have also used the Baxter-King filter to extract the trend (Baxter and King, 1995) but the results do not differ significantly. Hence, we have not reported them here.

where Argentina and Brasil both had fixed exchange rates—the exchange rate regimes and, hence, policy responses presented substantial differences in the period under analysis.

TABLE 2 about here

A contemporaneous correlation, however, does not permit the evaluation of persistence and lead relationships. We can obtain a better knowledge of regional dynamics by computing lead coefficients between these variables, that is, the correlation between output residuals<sup>6</sup> at time  $t$  and at time  $t + k$ , where  $k$  is a positive integer. Table 3 shows the value of the coefficients for  $k = 1$  and  $k = 4$ . Coefficients close to one indicate highly persistent cyclical fluctuations while coefficients close to zero indicate very little persistence. Own-lead correlation coefficients reveal a moderate degree of persistence with Brazil showing the lowest value. This suggests that there is less inertia in the adjustment process, which is consistent with the findings on real exchange rate in our previous work: the length of the periods of departure from trend after the occurrence of a shock is shorter in these economies (Fanelli, González-Rozada, and Keifman, 2001). In the case of US regions, for example, there are no own-lead coefficients below 0.9.

TABLE 3 about here

The effects of disturbances may be transmitted across countries via trade, productive, and financial channels. If lead correlations are high relative to contemporaneous correlations, this is an indication that there may be relevant propagation mechanisms at work. The linkages of Uruguay with the other two partners are the most striking in this regard. The correlation between Argentine output residual at time  $t$  and Uruguayan output residual at  $t + 1$  is higher than the contemporaneous correlation between these two variables and the coefficient corresponding to Argentina at time  $t$  and Uruguay at time  $t + 4$  is only slightly lower. Something similar occurs with the relationship between Uruguay and Brazil. The Brazilian( $t$ ) vs. Uruguayan( $t + 1$ ) and the Brazilian( $t$ ) vs. Uruguayan( $t + 4$ ) correlation coefficients are 0.37 and 0.40, respectively. Both are higher than the contemporaneous correlations (see Table 2). This means that both the Argentine and the Brazilian cycle leads the Uruguayan cycle and that the value of the lead coefficient does not decay very much over time (indeed, it increases in the case of Brazil). It is

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<sup>6</sup>We use the term “output residuals” to indicate the deviations of output from its H-P trend.

interesting that the value of the four-lead correlation coefficients linking Uruguay with Brazil and Argentina are higher than the Uruguayan own-lead correlation coefficient.

The correlations between Brazil and Argentina do not reveal strong lead relations but note that the value of the coefficient of  $\text{Brazil}(t)$  vs.  $\text{Brazil}(t + 4)$  is similar to the coefficient of  $\text{Argentina}(t)$  vs.  $\text{Brazil}(t + 4)$ . The value of the latter is identical to the value of the one lead coefficient between output residuals of Argentina and Brazil. It seems, on the other hand, that neither Brazil nor Uruguay leads Argentina.

We can obtain a broader and synthetic view of the dynamic relationships between these variables by plotting the cross-correlations. Figure 1 shows business cycle correlations between one country output residual at time  $t = 0$  and output residual at time  $t = k$  in the others, for various  $k > 0$ . Two features stand out. First, Argentina and Brazil tend to lead Uruguay. The correlation corresponding to different leads is positive and does not decay quickly. Second, the values of the correlation coefficients linking different leads of Argentina's output residuals with an impulse originating in Brazil at time  $t = 0$  are low and decay quickly (Panel B), and a similar pattern of behavior is observed between Argentina at  $t = 0$  and Brazil at  $t = k > 0$  (Panel A).

FIGURE 1 about here

A drawback of assessing comovement on the basis of cross-correlations is that it only allows for a rudimentary identification of the sources of shocks. To improve identification we will have to apply more complex methods and make more audacious assumptions, which entails making hypotheses about the interactions between shocks to output and prices. It may be useful, then, to take a preliminary look at the dynamic linkages between prices and quantities.

Price residuals are measured as the deviation of the natural logarithm of a price index from its H-P trend. Figure 2 displays the cross-correlation corresponding to price-output residuals. We use two price indices, the "combined" index and the wholesale or producer index. The combined index blends consumer and producer prices with equal weights and it is intended to be a proxy for the implicit deflator of GDP. Panel A in Figure 2 displays the business cycle correlations between combined prices at  $t = 0$  and output at  $t = k$  for different values of  $k$ . The shape of the curve indicates that there is an inverse relationship in the short run in the three countries under analysis. Whenever there is a movement above trend in prices, there is a



movement below trend in output. The correlation turns positive, nonetheless, as time elapses. Brazil shows the most rapid reversion in the sign of the correlation coefficient. This seems to be counterintuitive. According to the literature, this relationship should be positive in the short run and negative in the long run as demand impulses are stronger than supply forces in the short run, with the sign of the correlation reversed as time elapses because of the dominance of supply effects in the long run.

FIGURE 2 about here

In the Mercosur context, however, this fact is not as striking as it may seem at first glance. In the region, prices tend to be above their trend under two basic circumstances. First, a demand shock (because of monetary or fiscal impulses) creates extra inflationary pressures and output expansion. As a consequence, when the impulse originates in a demand shock, we would expect the response to take the form of a positive correlation between output and price residuals. Second, upward deviations in prices also occur when the domestic currency depreciates, usually to compensate for an external shock. The upward pressure on prices originates in the fact that pass-through coefficients tend to be high in the region. But unlike the case of demand shocks, real depreciation usually has contractionary effects on output; this is a well-documented fact in the region, particularly in the case of Uruguay and Argentina. Hence, when an external shock occurs (a “supply” shock) one would expect a negative correlation between prices and output residuals. Historically, the most frequent external disturbances are supply shocks originating on the trade side (variations in the terms of trade, oil shocks, or changes in the parity between the main reserve currencies). In the last two decades, nonetheless, changes in financial conditions became a primary source of shocks, hand in hand with the increase in capital flows. Under these new circumstances, swings in market sentiment usually induce changes in the supply of external funds and the country risk premium. Since “sudden stops” (Calvo and Reinhardt, 1999) create recessionary forces and upward pressures on the real exchange rate, this kind of financial shock should also result in a negative correlation between output and price residuals. In sum, the plot in Panel A suggests that supply/financial shocks dominate demand shocks as a source of short-run disturbances. In the three countries, supply and financial impulses seem to drive price-output responses in the short run. When we examine longer time horizons, nonetheless, this counter-cyclical pattern weakens in the case of Brazil and persists in the case

of Argentina. This differential pattern may reflect the distinct responses to shocks that occur in different financial settings, as we will discuss below.

We also have data on the price-output comovement in the case of industry. Panel B displays output-price correlations using industrial production and producer prices to measure residuals. The graph confirms the impression that a negative correlation exists between cyclical movements of output and price residuals in the short run in the case of Argentina but disconfirms this impression for Brazil. The reversion in sign may correspond to tradable sectors that are more responsive to price signals than non-tradable sectors, which are more heavily represented in the GDP index. Panels C and D show the responses of prices to output impulses. The correlogram indicates that there is a consistent negative correlation between output residuals in  $t = 0$  and various leads of price residuals.

In the preceding paragraphs we advanced some conjectures about the behavior of the real exchange rate vis-à-vis output residuals. Let us examine the cross-correlation linking real exchange rate variations with output residuals (see Figure 3). The first panel in Figure 3 indicates that the contemporaneous correlation between the real exchange rate (measured in natural logarithm) and cyclical movements in output is negative. That is, whenever the real exchange rate increases (i.e. the country becomes more competitive), real output tends to fall below its trend in the ensuing periods. In the case of Uruguay and Argentina the correlation remains negative for several quarters after the change in the real exchange rate takes place. In the case of Brazil, to the contrary, the correlation coefficient soon becomes positive, indicating that real depreciation is less contractionary. This provides additional evidence in favor of the hypothesis that Brazilian producers respond more quickly to relative prices. It could also be the case that more Brazilian firms on the verge of international competitiveness become internationally competitive immediately following real depreciation. Another factor that may have a bearing on this adjustment dynamics is the lower degree of dollarization in the Brazilian financial system. Under imperfect financial markets, variations in the real exchange rate affect the financial position of firms and banks when currency mismatches exist (see Bebczuk, Fanelli, and Pradelli 2002 for the Argentinian case). It seems sensible to assume, then, that via financial accelerator effects, higher dollarization strengthens the negative effects of increases in the real exchange on output.

FIGURE 3 about here

To further investigate this latter hypothesis, Panel B displays the evolution of industrial output following an alteration in the real exchange rate. Many more firms are exposed to external competition in the industrial sector than in the economy as a whole. Consequently, one would expect the real depreciation to benefit industry not only because industrial firms produce tradables but because the incidence of the currency mismatch effect should be weaker in the case of these firms. In effect, tradable firms will see the value of both their assets and their dollarized liabilities moving in the same direction after depreciation, while non-tradable firms holding dollarized liabilities will experience a reduction in their net worth. Panel B in Figure 3 plots the correlations between the real exchange rate at  $t = 0$  and the leads of industrial output residuals. In the case of Brazil, which is the least dollarized economy, these correlations rapidly turn positive as  $t$  increases. In Argentina, to the contrary, it takes three quarters for output residuals to become positive after real depreciation occurs. Note, however, that the high degree of persistence shown by the negative comovement between GDP residuals and real depreciation that we found in Panel A has disappeared in Panel B. This is consistent with our hypotheses about the roles of dollarization and competitiveness.

### 3 Modeling cyclical comovements and shocks

The great majority of the studies analyzing aggregate fluctuations and the problem of monetary cooperation in Mercosur follows the OCA literature and concentrates on the analysis of the synchronicity of business cycles. The degree of sophistication of the studies varies greatly, depending on the methodology and the data utilized, but there are essentially two approaches. One is based on panel data techniques and the other on time series methods.

Eichengreen (1998) and Eichengreen and Taylor (2003) are important studies using cross country data and panel data techniques to address the question of whether Mercosur needs a single currency and, more generally, what the monetary consequences of a Free Trade Area of the Americas would be. To answer these questions they build on the theory of OCA (augmented to include a role for regionalism) and derive a model of the determinants of exchange rate outcomes. In their view, to assess the conditions for monetary cooperation it is necessary to investigate the determinants of bilateral exchange rate volatility. The approach is ambitious because they include all of the factors the OCA literature highlighted as relevant in the equation explaining

exchange rate volatility. The main conclusion on Mercosur is that no important economic impediments exist for monetary cooperation and that the lack of political will may be the most important obstacle: “The failure to engage in monetary cooperation in MERCOSUR is not obviously a function of economic variables. The countries do not have unusual size, trade, composition, or other economic characteristics that militate against monetary cooperation; in this respect they are reasonably similar to the EU. Rather, the sources of the cooperation deficit lie elsewhere” (Eichengreen and Taylor, 2003 p. 25). The authors provide evidence that higher synchronicity of the business cycle is associated with lower volatility of the bilateral rate. From the perspective of the stylized facts that we discussed above, Eichengreen and Taylor (2003) offer two valuable features. First, they show that more recent regional trade agreements tend to be more volatile. Second, they recognize that the OCA approach, which focuses on the current account, may have some limitations in the context of Latin America—and particularly in Mercosur—because the capital account matters in this region and finance may be more important than trade to explain exchange rate fluctuations. Consequently, they extend the framework to take into account the financial characteristics and external vulnerabilities of the regional members. These studies, nonetheless, have serious drawbacks in the treatment of cycles. Data availability and the need to ensure comparability across countries obliged the authors to use a rudimentary indicator of synchronicity. Their indicator of asymmetric disturbance is the increment of the natural logarithm of the ratio of the GDP of each country pair. Additionally, the treatment of nominal vs. real exchange rate volatility is ambiguous and the indicators used to introduce financial factors are somewhat rough. This point may be less important in other regions, but it is not the case in Mercosur. One further weakness is that these techniques are not suitable when analyzing propagation mechanisms even though they are performed in a multi-country framework. Owing to these limitations, we will not discuss this line of research any further and concentrate on time series methods.

Decomposing the fluctuations of economic time series into trend and cycle is usually the starting point for time series analyses. As we have seen in the previous section, based on this decomposition, it is possible to analyze output comovement by calculating the correlation between residuals corresponding to different countries. This method constitutes a very useful heuristic tool and helps characterize stylized facts. However, the method has an important weakness: it does not take into account the identification of the sources of disturbances or the

characteristics of the responses to disturbances across regions and, hence, does not make for a thorough analysis of propagation mechanisms.

Following the approach of Bayoumi and Eichengreen (1992) and many others (for example, Cheung, and Westerman, 2000) who used vector autoregressive (VAR) techniques to study business cycle symmetry in the European case, it is possible to achieve a better characterization of the sources of shocks and propagation mechanisms in Mercosur. The common procedure in these studies of the cycle is to render the series stationary by differentiation and then use VAR techniques to examine the cyclical residuals and to identify impulse response functions. To identify the sources of disturbances, the most frequently used procedure is the so-called BQ decomposition that helps identify supply and demand shocks. The shocks are identified based on the standard assumption that, in the long run, supply shocks can affect both output and prices, while demand shocks only affect prices. That is, supply shocks are assumed to be permanent and demand shocks temporary. Once these components have been identified, correlation analysis is applied to assess synchronicity.

This strategy is very useful in that it makes it possible to have a better approximation of the sources of shocks. However, in light of the stylized facts that we have analyzed in the previous section, this approach has three main drawbacks. First, it cannot distinguish between country-specific cyclical movements, common cycles, and propagation mechanisms within a unified framework. Second, financial factors—dollarization, missing markets, swings in market sentiment—play no role. Third, the analytical underpinnings may not fit the Mercosur case. The identification assumptions are based on a simple aggregate supply/demand closed-economy analysis that can be misleading in a context in which real depreciation has contractionary effects.

Another possibility to decompose cyclical comovements in a given region is to differentiate idiosyncratic from common shocks (Watson, 1986, Kouparitsas, 2002). In Mercosur (or any region for that matter) shocks can be country-specific, affecting only one country or a specific set of countries (for example, a weather-related shock or a domestic policy shock); or, they can be common to the entire region (for example, a change in the conditions in international capital markets or a world recession). Propagation mechanisms, in turn, are important because a shock that was initially country-specific, originating in one country, might eventually spillover to others. Following Watson and Kouparitsas, it is possible to identify common and idiosyncratic shocks and spillover effects within a unified framework.

In what follows, we will use all these techniques to discuss the questions raised and will try to introduce the role of swings in market sentiment into the analysis. We will also use the VAR approach for a more complete characterization of fluctuations in Mercosur. In order to circumvent the limitations of the BQ decomposition and assess the relevance of the identification problem, we have applied the alternative approach advanced by Den Haan (2000) and Den Haan and Summer (2001), which relies on the information provided by the correlation of the VAR forecast errors to identify the sign of the relationship between price and quantity residuals in the short and long run.

## 4 Supply and Demand Shocks and Prices

### 4.1 Identifying Supply and Demand Shocks

As mentioned in the previous section, the standard methodology to identify the sources of disturbances is to estimate a VAR model and then use the BQ identification procedure. Our first step in applying the BQ decomposition technique was to estimate a VAR for GDP and combined prices for the cases of Argentina, Brazil and Uruguay.<sup>7</sup> We transformed both variables taking natural logarithms and checked for non-stationarity using standard Dickey-Fuller tests. Both variables individually, in each country, have unit roots but, according to Johansen's cointegration test, each pair of variables are not cointegrated.<sup>8</sup> Therefore, we used the variables in first differences in the VAR specification. The number of lags in each VAR was selected using the Akaike information criterion and the individual  $t$ -statistics. For each country, we specified the following  $VAR(p)$  representation for the two variables,

$$\begin{bmatrix} \Delta \ln(gdp)_t \\ \Delta \ln(ip)_t \end{bmatrix} = \sum_{l=1}^p \begin{bmatrix} \Gamma_{11}(l) & \Gamma_{12}(l) \\ \Gamma_{21}(l) & \Gamma_{22}(l) \end{bmatrix} \begin{bmatrix} \Delta \ln(gdp)_{t-l} \\ \Delta \ln(ip)_{t-l} \end{bmatrix} + \begin{bmatrix} e_{1,t} \\ e_{2,t} \end{bmatrix}$$

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<sup>7</sup>We performed an additional exercise using industrial production and producer prices and obtained similar results. Therefore, we only show the results for the GDP. Industrial production results are available from the authors upon request.

<sup>8</sup>Results of the stochastic properties of the variables are not presented. They are available from the authors upon request.

$$X_t = \sum_{l=1}^p \Gamma(l) X_{t-l} + e_t, \quad (1)$$

where  $X_t = [\Delta \ln(gdp)_t \quad \Delta \ln(ip)_t]'$ ,  $\Gamma(\cdot)$  are the parameter matrices and  $e_t$  is the error vector. In the cases of Argentina, Brazil, and Uruguay, we selected  $p=2$ ;  $p=4$ , and  $p=3$ , respectively.<sup>9</sup>

Assuming that the errors of the reduced form VAR of equation (1) are related to structural supply and demand shocks, the BQ decomposition is used to identify these structural shocks. The usual identification restriction is that demand shocks have no long-run effects on GDP. That is, since the true structural model can be represented by an infinite moving average of the form,

$$\begin{bmatrix} \Delta \ln(gdp)_t \\ \Delta \ln(ip)_t \end{bmatrix} = \sum_{l=0}^{\infty} \begin{bmatrix} A_{11}(l) & A_{12}(l) \\ A_{21}(l) & A_{22}(l) \end{bmatrix} \begin{bmatrix} \epsilon_{d,t} \\ \epsilon_{s,t} \end{bmatrix} \quad (2)$$

where  $\epsilon_{d,t}$  and  $\epsilon_{s,t}$  are the independent demand and supply shocks, respectively. The BQ identification restriction is  $\sum_{l=0}^{\infty} A_{11}(l) = 0$ .

Table 4 shows the standard deviation of the demand and supply shocks for each country based on the structural factorization estimation.

TABLE 4 about here

The values in Table 4 indicate that the size of supply shocks is consistently larger than the size of demand shocks. The comparison with the results obtained by Bayoumi and Eichengreen (1992) for the case of Europe and the US reveals that supply shocks are much larger in Mercosur, while demand shocks are similar. In the US regions and “core” European countries, the size of shocks is consistently between 1% and 2%. “Peripheral”<sup>10</sup> European countries, however, are much more volatile. Their supply shocks are twice as large as the core countries, which is a level of volatility similar to the one that we have estimated for Brazil. This evidence, in sum, appears to confirm the impression that Mercosur countries experience higher volatility.

Based on these estimates of the supply and demand disturbances, we computed the correlation between the supply and demand shocks in the countries of the region (see Table 5). The

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<sup>9</sup>Appendix 1 display the complete estimation results of this section.

<sup>10</sup>Bayoumi and Eichengreen (1992) divide the EC and the US into a “core” of regions characterized by relatively symmetric behavior and a “periphery” whose disturbances are more loosely correlated.

highest degree of correlation is observed between the supply shocks of Argentina and Brazil (see Panel B) and the demand shocks affecting Argentina and Uruguay (see Panel A). In the comparison with the US and the EU we again find the same pattern: the value of the coefficient of correlation for both supply and demand shocks for Mercosur is much lower than the EU and US core regions and similar to the peripheral regions.

TABLE 5 about here

These estimation results, however, present some weaknesses, which raise doubts about the appropriateness of the BQ specification assumptions in the case of Mercosur. One relevant drawback is that our estimations do not meet the over-identification restrictions. According to Bayoumi and Eichengreen (1992), such restrictions imply that positive aggregate demand shocks should be associated with increases in prices while aggregate supply shocks should be associated with falls in prices. As can be seen in the Panels of Figure 4, which display the impulse response functions, these restrictions are basically not met by our estimations. It is very interesting to note, however, that in 3 out of 30 cases the estimates of Bayoumi and Eichengreen do not meet this restriction either and the cases correspond to peripheral countries. We could hypothesize, then, that there are some “unobserved” factors at work in more volatile economies that weaken the ability of the BQ decomposition to identify the shocks properly.

FIGURE 4 about here

## 4.2 Cyclical Comovement of Prices and Output

Given that the cyclical behavior of prices differs from what was expected, we use a different technique advanced in Den Haan (2000) and Den Haan and Summer (2001). This approach specifically aims to evaluate the comovement of prices and output avoiding the BQ identification restriction. The methodology is based on the utilization of the correlation of VAR forecast errors at different horizons to interpret and capture the dynamics between real output and prices.

Specifically, equation (1) can be written as a first order VAR model as follows,

$$Z_t = FZ_{t-1} + u_t \tag{3}$$

where  $Z_t = [X'_t \ X'_{t-1} \ \dots \ X'_{t-p+1}]'$ ,  $u_t = [e'_t \ 0 \ \dots \ 0]'$  and



$$F = \begin{bmatrix} \Gamma(1) & \Gamma(2) & \cdots & \Gamma(p) \\ I_2 & 0_2 & \cdots & 0_2 \\ \vdots & \vdots & \ddots & \vdots \\ 0_2 & 0_2 & \cdots & I_2 \end{bmatrix}$$

where  $I_2$  and  $0_2$  are  $2 \times 2$  identity and zero matrices, respectively. From (3) Den Haan and Summer show that the covariance between output and prices at the  $K$ -ahead period,  $Cov(K)$ , is given by

$$Cov(K) = \sum_{j=0}^{K-1} F^j \Omega F^{j'} \quad (4)$$

where  $F^0$  is the identity matrix and  $\Omega = E(u_t u_t')/T$ .

Using the variance-covariance matrix (4) we compute the correlation coefficient between output and prices for Argentina, Brazil and Uruguay. We found a negative correlation at all forecast points for Argentina and, except for the first lead, for all of the other forecast points for Brazil. In the case of Uruguay we found a negative correlation in the very short run and after five quarters the correlation becomes statistically nonsignificant (See Figure 5).

FIGURE 5 about here

Given the evidence at hand, we can conclude, that there is a negative correlation between output and prices. This result is in line with the long-run correlation found by Den Haan and Summer (2001) in the G7, but it does not coincide with the sign of the correlation estimated for the short run, which tends to be positive in the G7 countries. One important point is that these authors find that the seventies (and to a certain extent the early eighties) contribute significantly to the magnitude of several of the negative correlation coefficients that they estimated. Therefore, the inverse relationship between inflation and the activity level that was frequently observed in the period following the oil crisis influenced the results. This means that cost-push like impulses originating on the supply side may have an important bearing on our results. More specifically, the negative correlation between price and output disturbances displayed in Figure 5 could be caused by changes in the real exchange rate that, via financial accelerator and contractionary effects, induce a negative price-output correlation. To fully understand

these dynamics we have to take into account two important stylized facts: one, in a context of pervasive nominal price rigidities, the real and nominal exchange rates tend to move together and in the same direction (Rogoff, 1996); and two, the pass-through coefficient linking nominal depreciation and inflation is sizable in Mercosur countries. Hence, for example, if a negative external shock (i.e. a fall in the terms of trade, a shift in market sentiment) induce an increase in the real exchange rate via the nominal depreciation of the currency, this would generate an upward pressure on prices and would trigger contractionary effects via the financial accelerator and distributive effects. Under these circumstances, we would observe a negative correlation between output on the one hand and prices and the real exchange rate, on the other.

In order to investigate further the relevance of these hypotheses, we have estimated a VAR for GDP and the real exchange rate, measured in first differences of natural logarithm, in the three countries.<sup>11</sup> In the case of Argentina, we selected a VAR(2); for Brazil a VAR(5); and for Uruguay a VAR(4).

To compute the impulse response functions, we use the Cholesky factorization under the assumption that the shocks of GDP do not have an immediate effect on the real exchange rate, while the shocks corresponding to the real exchange rate equation can have an effect on the real output in the same period. The rationale for these assumptions is that it takes some time for the changes in the activity level to affect relative prices because of price rigidities, while the effects of changes in the real exchange rate tend to influence output more rapidly via distributive and financial accelerator effects (especially in more dollarized economies). The existence of a “fear of floating syndrome” (Calvo and Reinhart, 2002) is consistent with a rapid effect of real depreciation on financial fragility and output. The Panels in Figure 6 show the estimated impulse response functions. These results suggest the existence of a negative correlation between the real exchange rate residuals and output movements in the short run in Argentina and Brazil. But there is a tendency for the relationship to become non-significant over time. In Uruguay there is also a negative relationship but it appears that the impulse running from output to the real exchange rate is particularly strong.<sup>12</sup>

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<sup>11</sup>We checked for non-stationarity using standard Dickey-Fuller tests and find that both variables individually have unit roots. We checked and did not find cointegration using Johansen’s cointegration test. Therefore, in the VAR specification we use the variables in first differences. The number of lags in each VAR was selected using the Akaike information criterion and the individual  $t$ -statistics.

<sup>12</sup>In order to assess the importance of our identification procedure, which is based on the Cholesky decom-

FIGURE 6 about here

## 5 Common and Idiosyncratic Shocks and Financial Factors

We build on the unobserved component approach (Watson, 1986; Kouparitsas, 2002) to decompose the Mercosur countries' real GDP fluctuations<sup>13</sup> into idiosyncratic and common cycles. We based our estimation on the seasonally adjusted logarithm of GDP for Argentina (a), Brazil (b), and Uruguay (u). The sample used covers the period since the beginning of the integration process in Mercosur (1988 first quarter to 2003 first quarter). Since we measure real GDP in logarithm, we use an additive decomposition. The unobserved components methodology applied to our series results in the following equations,

$$\ln(gdp)_{j,t} = T_{j,t} + C_{j,t}, \quad j = a, b, u \quad (5)$$

where  $T_{j,t}$  is the trend component and  $C_{j,t}$  captures the short-run economic cycles. We model the trend component as a stochastic process. Specifically, we assume for  $T_{j,t}$  a unit root process with drift,

$$T_{j,t} = \delta_{j,t} + T_{j,t-1} + w_{j,t}, \quad j = a, b, u \quad (6)$$

In equation (6) the drift term  $\delta_{j,t}$  stands for the deterministic trend growth rate of real GDP in country  $j$  at time  $t$ . The error term  $w_{j,t}$  is assumed to be time independent with mean zero and variance covariance matrix  $\Sigma_w$ .

To model the short-run economic cycle, we follow Watson's approach by assuming that it is composed of two different parts: a common cycle across countries,  $CC_t$ , and country-specific position, we also used Den Haan and Summer methodology. The exercise confirms the results we have already discussed. Consequently, the results are not shown here.

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<sup>13</sup>The unobserved components approach is usually applied to decompose an observed time series into their seasonal, trend and irregular components. That is, if  $X_t$  is the variable of interest, applying the unobserved components methodology we obtain:  $X_t = S_t + T_t + I_t$ . Where  $S_t$  is the seasonal component capturing those cycles that repeat themselves each year,  $T_t$  is the component capturing the long-run trend and  $I_t$  is the irregular component capturing the short-run economic cycle.

cycles,  $RC_{j,t}$ . Therefore, the short-run cyclical component can be expressed as,

$$C_{j,t} = \gamma_j CC_t + RC_{j,t}, \quad j = a, b, u \quad (7)$$

where the parameter  $\gamma_j$  captures the sensitivity of the countries to the common cycle. To capture the dynamics of the common cycle we tried several autoregressive specifications and ended up with an  $AR(2)$  process,

$$CC_t = \alpha_1 CC_{t-1} + \alpha_2 CC_{t-2} + v_t, \quad (8)$$

where  $\alpha_1$  and  $\alpha_2$  are the autoregressive parameters and  $v_t$  is the disturbance term, assumed to be independent with zero mean and variance  $\sigma_v^2$ .

The country-specific dynamics, in turn, are assumed to be governed by a VAR process. We tried several specifications and preferred the following  $VAR(1)$  model,

$$\begin{bmatrix} RC_{a,t} \\ RC_{b,t} \\ RC_{u,t} \end{bmatrix} = \begin{bmatrix} \Gamma_{11} & \Gamma_{12} & \Gamma_{13} \\ \Gamma_{21} & \Gamma_{22} & \Gamma_{23} \\ \Gamma_{31} & \Gamma_{32} & \Gamma_{33} \end{bmatrix} \begin{bmatrix} RC_{a,t-1} \\ RC_{b,t-1} \\ RC_{u,t-1} \end{bmatrix} + \begin{bmatrix} e_{a,t} \\ e_{b,t} \\ e_{u,t} \end{bmatrix}, \quad (9)$$

where the disturbance vector is composed of innovations that are independently distributed with zero mean and variance-covariance matrix  $\Lambda$ .

## 5.1 Estimation Strategy

This model has the characteristic that observed variables are explained by unobserved parameters and variables. Therefore, the estimation has to be made using the maximum likelihood function evaluated by the Kalman filter. We follow Watson and Engle (1983) and estimate the model using the Estimation-Maximization (EM) algorithm.<sup>14</sup> To be able to apply this method-

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<sup>14</sup>The EM algorithm is a method for maximizing the likelihood function in the presence of missing observations. It has two steps. The first is the estimation step, consisting of applying the Kalman filter to obtain sufficient statistics of the problem conditional on the observed data. The second is the maximization step in which we compute the maximum likelihood estimates of the unknown parameters of the model conditional on a full data set. These two steps are iterated until convergence. In each step of the algorithm, the Kalman filter is used to construct the unobserved variables, through the smoothing algorithm, and then the unknown parameters of the model are estimated conditional on the constructed unobserved variables. For a description of the algorithm, see Dempster, Laird, and Rubin (1977).

ology, we need to ensure that the observed variables are stationary (in order to construct the likelihood function) and we have to express the model in state space form. Since the log of real GDP of Argentina, Brazil and Uruguay, individually, have a unit root, we specify the model in first differences of the observed variables.

The state space form consists of a measurement equation and a transition equation. They are, respectively, as follows,

$$\begin{bmatrix} \Delta \ln(gdp)_{a,t} \\ \Delta \ln(gdp)_{b,t} \\ \Delta \ln(gdp)_{u,t} \end{bmatrix} = \begin{bmatrix} \delta_a \\ \delta_b \\ \delta_u \end{bmatrix} + \begin{bmatrix} \gamma_a & 1 & 0 & 0 \\ \gamma_b & 0 & 1 & 0 \\ \gamma_u & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \Delta CC_t \\ \Delta RC_{a,t} \\ \Delta RC_{b,t} \\ \Delta RC_{u,t} \end{bmatrix} + \begin{bmatrix} w_{a,t} \\ w_{b,t} \\ w_{u,t} \end{bmatrix}, \quad (10)$$

$$\begin{bmatrix} \Delta CC_t \\ \Delta RC_{a,t} \\ \Delta RC_{b,t} \\ \Delta RC_{u,t} \end{bmatrix} = \begin{bmatrix} \alpha_1 & 0 & 0 & 0 \\ 0 & \Gamma_{11} & \Gamma_{12} & \Gamma_{13} \\ 0 & \Gamma_{21} & \Gamma_{22} & \Gamma_{23} \\ 0 & \Gamma_{31} & \Gamma_{32} & \Gamma_{33} \end{bmatrix} \begin{bmatrix} \Delta CC_{t-1} \\ \Delta RC_{a,t-1} \\ \Delta RC_{b,t-1} \\ \Delta RC_{u,t-1} \end{bmatrix} + \begin{bmatrix} \alpha_2 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} \Delta CC_{t-2} \\ \Delta RC_{a,t-2} \\ \Delta RC_{b,t-2} \\ \Delta RC_{u,t-2} \end{bmatrix} + \begin{bmatrix} v_t \\ e_{a,t} \\ e_{b,t} \\ e_{u,t} \end{bmatrix}, \quad (11)$$

## 5.2 Estimation Results

In order to identify all the parameters of the model, we use Argentina as a benchmark and normalize  $\gamma_a$  to be unity. We estimate the model and find that the trend growth rate of the real GDP of the three countries was the same. Therefore, in the results presented here we impose that restriction. Table 6 presents the values of the growth trend and the sensitivity parameters that appear in equations (6) and (7).

TABLE 6 about here

Since our estimate of the growth parameters indicates that the trend growth rate of the real GDP is the same in the three countries,  $\hat{\delta}$  stands for the common trend growth rate of real GDP in the three countries. As was expected, the estimation reveals that the growth trend is very low. The sensitivity coefficients associated with Brazil ( $\hat{\gamma}_b$ ) and Uruguay ( $\hat{\gamma}_u$ ) indicate that the sensitivity to the common cycle is high and significant, although this sensitivity is much higher

in the case of Uruguay. These parameter values are similar to the ones obtained by Kouparitsas (2002) in the case of the US regions.

Table 7 shows the estimated values of the autoregressive parameters of equation (8), which represent the dynamics of the common cycle as an  $AR(2)$  process. These parameters describe how the three countries respond to a common cyclical shock over time.

TABLE 7 about here

Table 8 presents the estimation results for the parameters of the VAR equation (9) representing the country-specific cycles. The estimated  $\Gamma_{i,j}$ 's coefficients show the spillover effects.

TABLE 8 about here

Many of the parameter estimates in the VAR are statistically significant, which means that shocks that originate in one country have an effect on the output of the other countries. In other words, spillover effects are statistically significant. This result contrasts with the findings of Kouparitsas for the US. He finds that shocks that originate in one region have a significantly positive effect on their own income, but not on the income of other regions. An interesting point is that shocks in “peripheral”, more commodity-dependent regions such as Rocky Mountains and Plains, show a lower degree of persistence. This is consistent with our findings on volatility in Mercosur, which suggests that deviations from trend tend to die out faster in these countries. On the bases of these estimated values, Figure 7 plots the common cyclical component of real GDP across the three countries (expressed as a percentage deviation from the common trend) and the Panels in Figure 8 show the country-specific cycles.

FIGURES 7 and 8 about here

In order to assess the importance of each of the cyclical components we compute the component total variability. For example, for Argentina, the total variability of the national component  $\sum_{t=1}^{61} (RC_{a,t} - \bar{RC}_a)^2$  is 0.3620 while the total variability of the common cycle component  $\sum_{t=1}^{61} (CC_t - \bar{CC})^2$  is 0.0512. This means that Argentina’s regional cycle explains 87.6% of the total cycle variability, while the common component represents 12.4% of that variability. Of course, we have to take into account the intrarregional effects on the national business cycle revealed by the VAR. For Brazil, these numbers are: the regional cycle variability explains 84.5%

of the total cycle variability and the common cycle variability explains 15.5%. In Uruguay 87% of the total cycle variability is explained by the variation in the regional cycle and 13% is explained by the variability of the common cycle.

In order to assess the influence of the external financial shocks and swings in market sentiment on the comovement of Mercosur economies, we run a regression with the common cycle that we have already identified as the dependent variable and a weighted average of the country risk premium as the independent variable. To control for endogeneity, we instrumented the country risk with its own lag. The results in Table 9 indicate that swings in financial market conditions that affect the region as a whole have a bearing on cyclical comovement; the risk premium variable is strongly significant. Figure 9 vividly illustrates this point. There is a clearly negative association between the common cycle and variations in the country risk premium.

TABLE 9 about here

FIGURE 9 about here

## 6 Final Remarks

Growth and stability are the two main standards against which the outcomes of Mercosur are being judged. The agreement is under strong political pressure because the four members have been dealing with sizable shocks in the last five years and the consequences were highly detrimental to the integration process. Under these circumstances, the most important challenge that the bloc is facing is the recovery of the dynamic that the integration process showed in the pre-shock period, before 1998. Macroeconomic instability has been and is still perceived by the authorities as one of the main—perhaps the main obstacle—to deepening the process of integration and a variety of proposals have addressed this problem. They go from soft macroeconomic coordination initiatives (i.e. periodic meetings of economic authorities) to appeals to advance firmly toward a monetary union. But, beyond the specifics of each proposal, we think that one important conclusion that follows from this paper is that the problems that policy makers must solve to harmonize the Mercosur's macroeconomies are different from those that, say, the European Union was facing when the architecture of the future monetary union was being designed and built. In this sense, we would like to highlight the following points that were raised in our work.

First, volatility matters, and matters especially in the case of recent regional agreements. We have seen that shocks (for example, supply shocks) in Mercosur countries tend to be larger and that departures from trends tend to die out more quickly. These characteristics appear to be shared with those countries that were peripheral when the European monetary union was being formed and with US regions specializing in the production of commodities. In this sense, the basic insight of the OCA approach that calls for establishing a strong analytical link between the characteristics of the economic and the trade structure on the one hand, and the macroeconomy on the other, seems to be particularly suitable for understanding the cycle in recent regional agreements.

Second, finance matters for both volatility and output/price dynamics. We have detected a relationship between the common regional cycle and changes in financial conditions—as represented by the country risk premium. We have also seen that accelerator effects may be important in explaining some features of the output/price dynamics that the standard models based on the Blanchard and Quah specification are unable to account for.

Third, the application of the Watson-Kouparitsas approach to decompose cyclical fluctuations into a common and an idiosyncratic component uncovered a rich set of interactions that lie behind series comovements. In particular, it seems that common factors originating in impulses stemming from changes in investor’s sentiment are relevant to explaining regional output comovements and that spillover effects between neighbors are significant. Likewise, we have detected that the country-specific cycle accounts for a large part of total output variance. These two points have important implications for macroeconomic policy coordination, which is largely unexplored. For example, while it seems sensible that the IMF helps these countries to manage the effects of common shocks that cannot be diversified away within the region, the members of the region could take some steps to diversify the idiosyncratic risks associated with the country-specific cycle. More simply, there could be a division of labor in risk management. The IMF would help countries to hedge “systematic” risk and the countries would develop an institutional framework to manage those risks that could be diversified away within the regional agreement, for example, via reserve funds or new fiscal instruments developed at the regional level.



**Table 1: Quarterly GDP Growth and Volatility (%)***Panel A. Period: 1980:1-2003:1*

	Argentina	Brazil	Uruguay
Mean	0.18	0.50	0.12
Maximum	5.18	8.71	6.21
Minimum	-8.43	-8.74	-12.10
Std. Dev.	2.81	2.40	2.99
Coef. Var.	15.9	4.8	25.0

*Panel B. Period: 1991:1-2003:1*

	Argentina	Brazil	Uruguay
Mean	0.44	0.58	0.13
Maximum	5.18	6.10	4.89
Minimum	-6.76	-5.44	-11.72
Std. Dev.	2.40	1.77	2.92
Coef. Var.	5.4	3.0	23.4

**Table 2: Business Cycle Comovement in Mercosur**

GDP at time $t$	GDP at time $t$		
	Argentina	Brazil	Uruguay
Argentina	1.00	0.13	0.43
Brazil	0.13	1.00	0.34
Uruguay	0.43	0.34	1.00

Source: Central Banks of Argentina Brazil and Uruguay.  
 Period of analysis: 1980:1-2003:1

**Table 3: Business Cycle Leads Correlations in Mercosur**

GDP at time $t$	Panel A. GDP at time $t + 1$			Panel B. GDP at time $t + 4$		
	Argentina	Brazil	Uruguay	Argentina	Brazil	Uruguay
Argentina	0.79	0.12	0.55	0.10	0.12	0.37
Brazil	0.08	0.68	0.37	-0.08	0.19	0.40
Uruguay	0.26	0.23	0.72	-0.15	0.05	0.18

Source: Central Banks of Argentina Brazil and Uruguay. Period of analysis: 1980:1-2003:1

**Table 4: Size of Shocks (%)**

	Demand Shock	Supply Shock
Argentina	0.7	7.3
Brazil	0.2	3.2
Uruguay	2.2	1.6

**Table 5: Correlations of Supply and Demand Shocks in Mercosur***Panel A. Correlations of Demand Shocks*

	Argentina	Brazil	Uruguay
Argentina	1.00	-0.06	0.23
Brazil	-0.06	1.00	0.10
Uruguay	0.23	0.10	1.00

*Panel B. Correlations of Supply Shocks*

	Argentina	Brazil	Uruguay
Argentina	1.00	0.13	-0.08
Brazil	0.13	1.00	-0.02
Uruguay	-0.08	-0.02	1.00

**Table 6: Estimation of Growth and Sensitivity Parameters**

	Coefficient	Std. Error	<i>t</i> -Statistic	Prob.
$\hat{\delta}$	0.003928	1.23E-10	31906579	0.0000
$\hat{\gamma}_b$	0.736893	9.86E-09	74748914	0.0000
$\hat{\gamma}_u$	0.923318	1.99E-08	46333581	0.0000

**Table 7: Estimation of Common Cycle Parameters**

	Coefficient	Std. Error	<i>t</i> -Statistic	Prob.
$\hat{\alpha}_1$	1.224803	0.124146	9.865859	0.0000
$\hat{\alpha}_2$	-0.404496	0.124706	-3.243591	0.0019

**Table 8: Estimation of Regional Cycle Parameters**

Dependent Variable	$RC_{a,t}$	$RC_{b,t}$	$RC_{u,t}$
$RC_{a,t-1}$	0.9233	0.0699	0.2055
<i>t</i> -Statistic	24.93	0.99	2.66
$RC_{b,t-1}$	-0.2450	0.8200	-0.1784
<i>t</i> -Statistic	-6.18	10.93	-2.16
$RC_{u,t-1}$	0.1483	0.0319	0.8248
<i>t</i> -Statistic	3.28	0.37	8.75
Adj. R-squared	0.9707	0.7497	0.8366
<i>F</i> -Statistic	977.6375	89.3480	152.0286
Prob.	0.0000	0.0000	0.0000

**Table 9: External Financial Shocks and Swings in Market Sentiment**

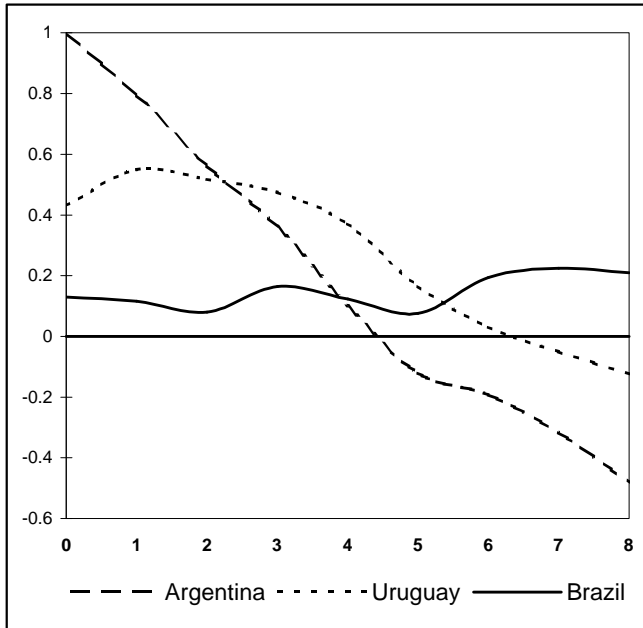
$$CC_t = \pi_0 + \pi_1 CRisk_{t-1} + \pi_2 r_{t-1} + h_t$$

	Coefficient	Std. Error	<i>t</i> -Statistic	Prob.
$\hat{\pi}_0$	0.038299	0.022048	1.737041	0.0882
$\hat{\pi}_1$	-0.001681	0.000676	-2.487761	0.0160
$\hat{\pi}_2$	-0.003485	0.003166	-1.100591	0.2760
Adj. R-squared		0.8123	S.E. of Reg.	0.0128
<i>F</i> -Statistic		62.6570	Prob.( <i>F</i> -Statistic)	0.0000

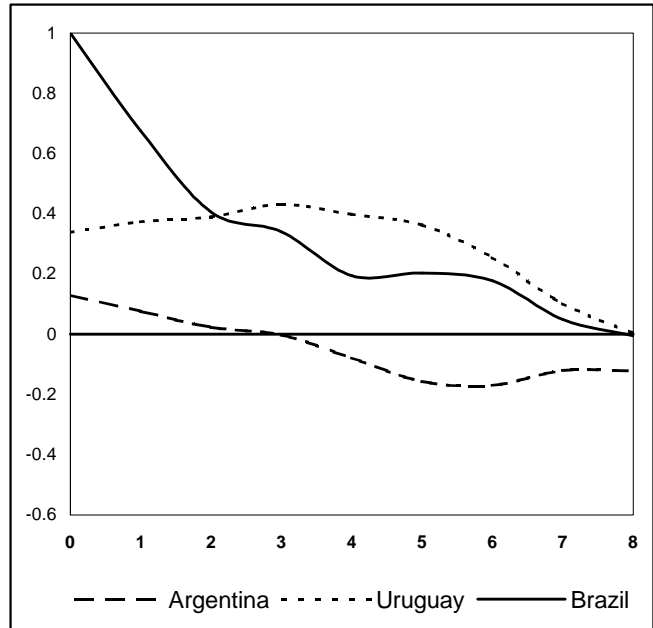
$CRisk_t$  was computed as a weighted average between Brazil's and Argentina's country risk. Weighted coefficients were 0.67 and 0.34, respectively.  $r_t$  is the three year US bond yield.  $CC_t$  is Mercosur common cycle. Standard errors are robust to the presence of serial correlation.

**Figure 1**  
**Business Cycle Correlations Using GDP Residuals.**

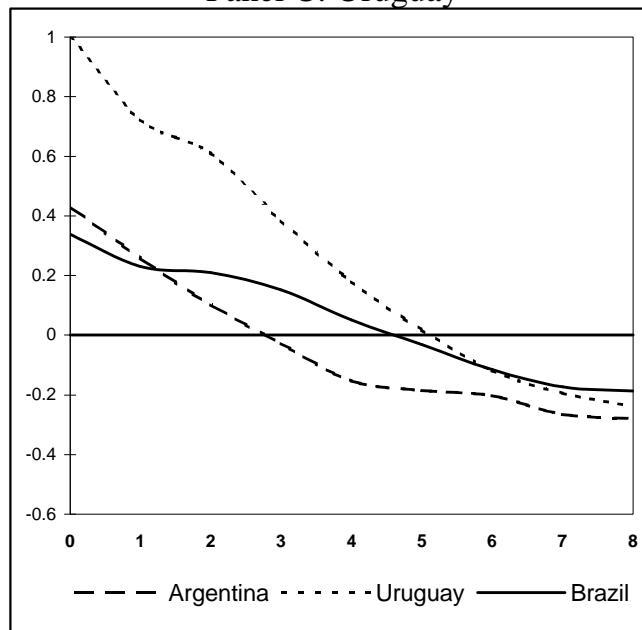
Panel A: Argentina



Panel B: Brazil

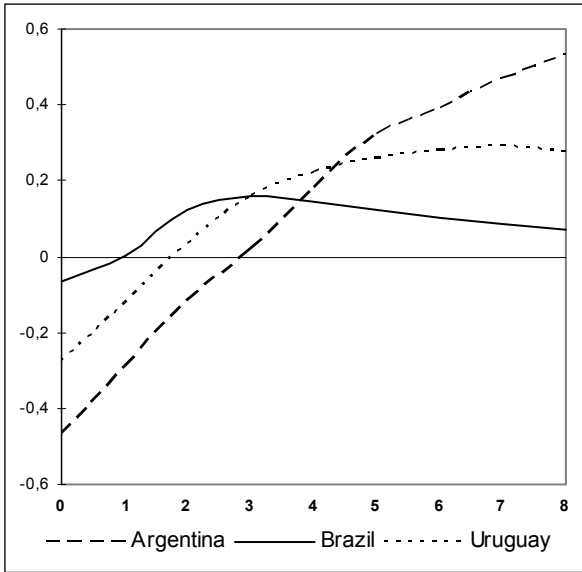


Panel C: Uruguay

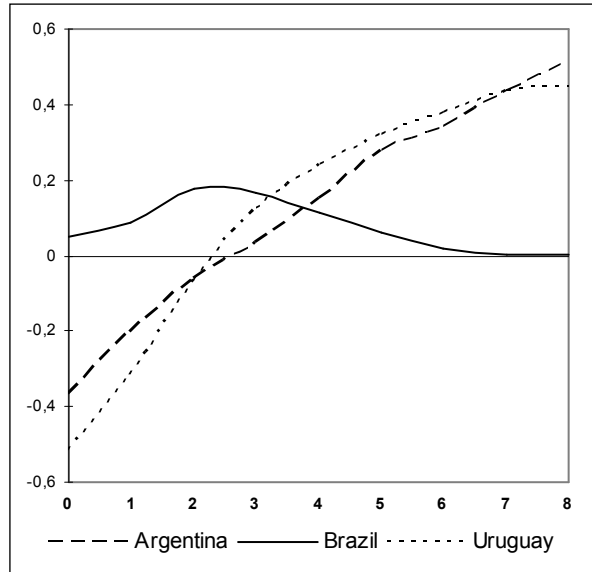


**Figure 2**  
**Correlation between Output and Price Residuals**

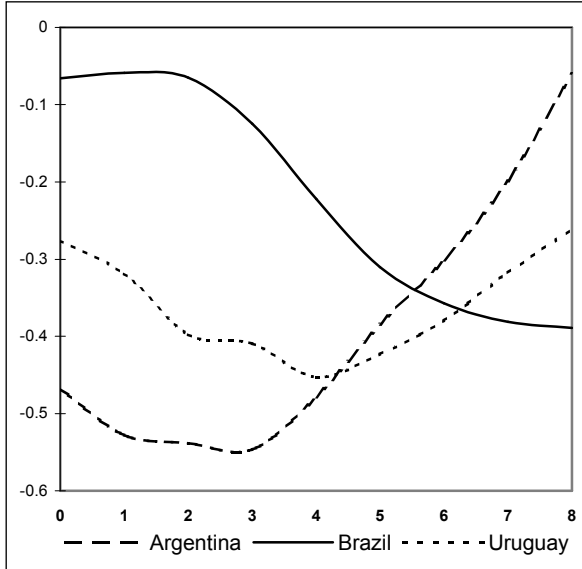
Panel A: Combined Prices and GDP leads



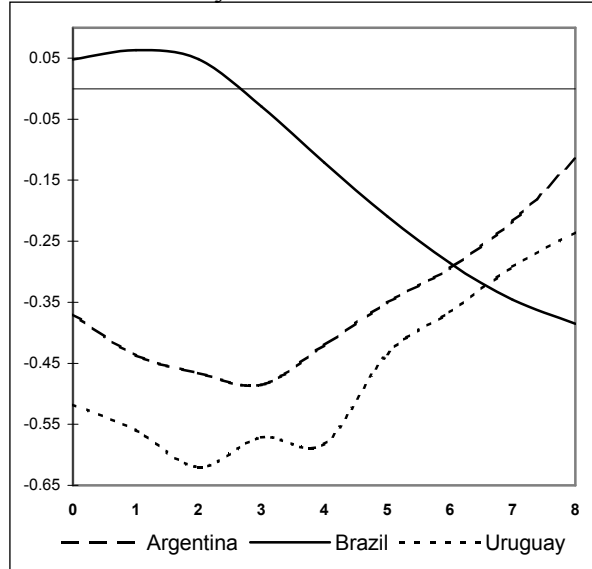
Panel B: Producer Prices and Industry leads



Panel C: GDP and Combined Prices leads

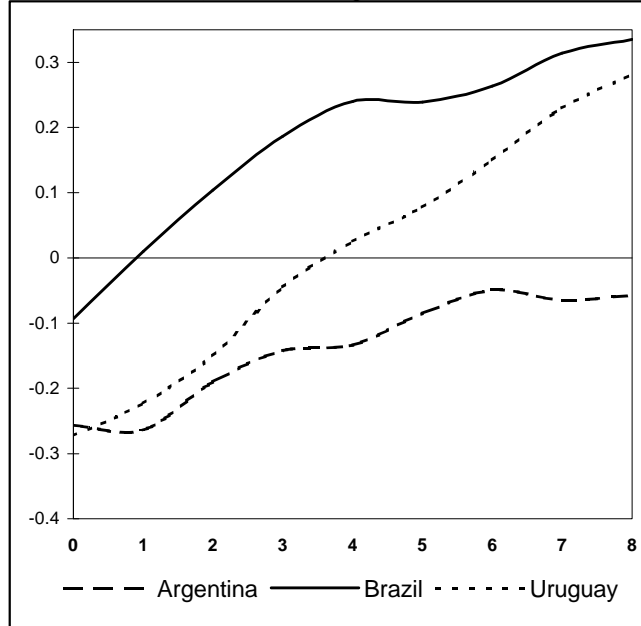


Panel D: Industry and Producer Prices leads

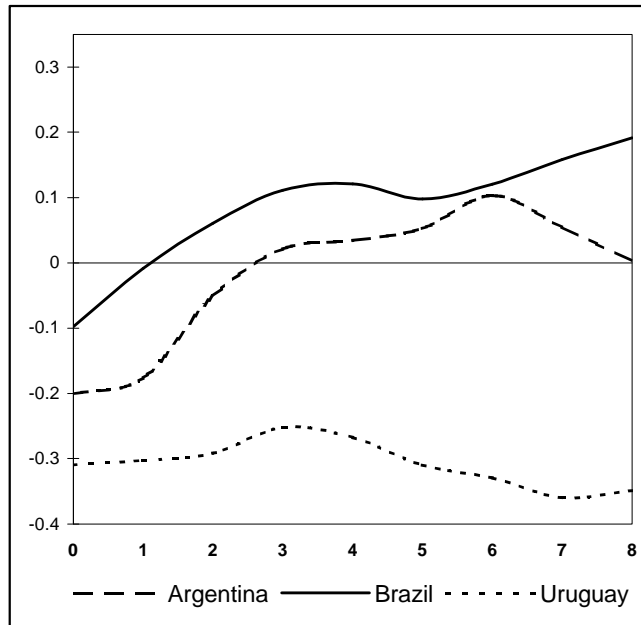


**Figure 3**  
**Correlations between Real Exchange Rate and Output Residual**

Panel A: RER(combined prices) and GDP leads

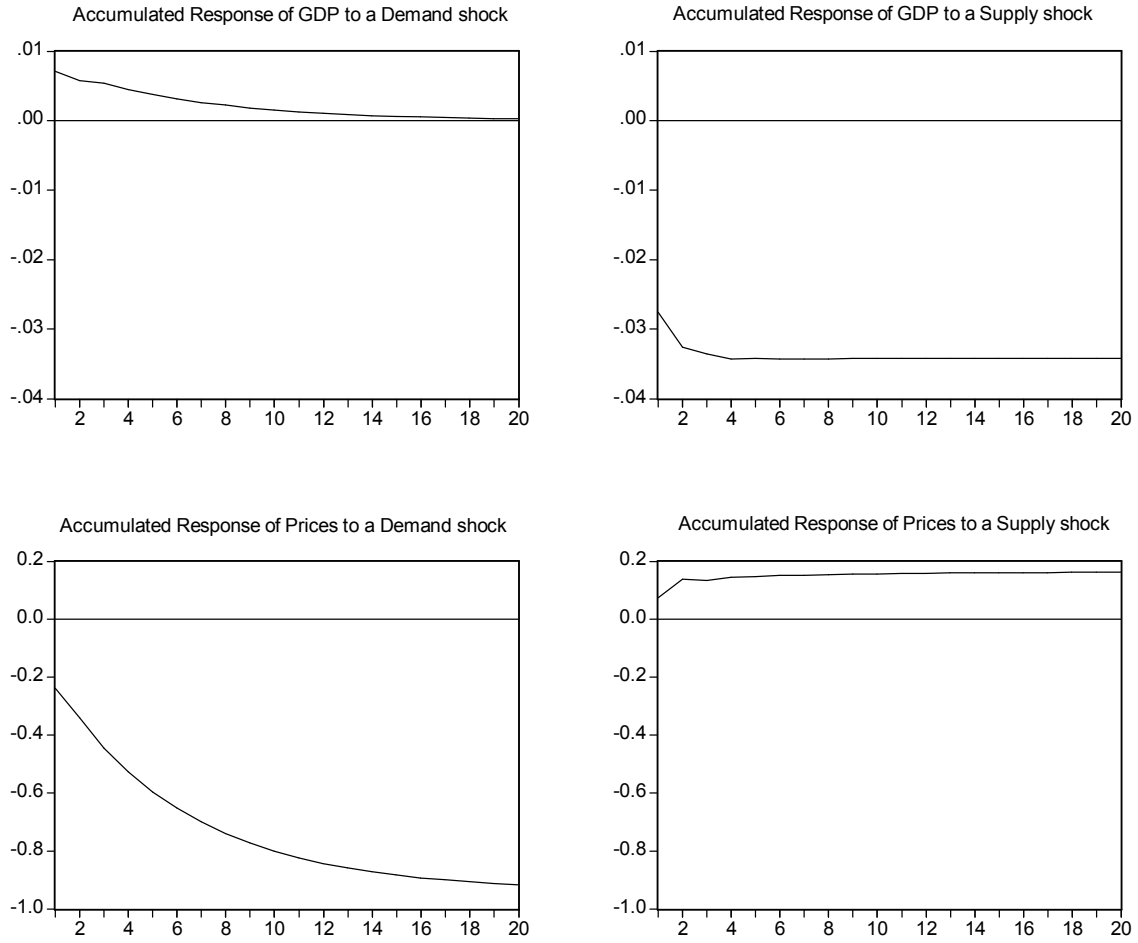


Panel B: RER(producer prices) and Industry leads



**Figure 4. Panel A. Argentina**

Accumulated Response to Structural One S.D. Innovations





**Figure 4. Panel B. Brazil**

Accumulated Response to Structural One S.D. Innovations

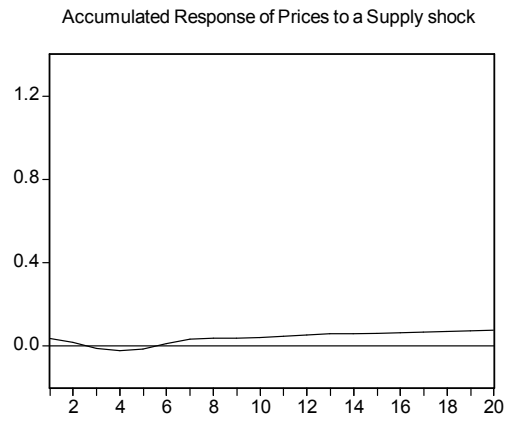
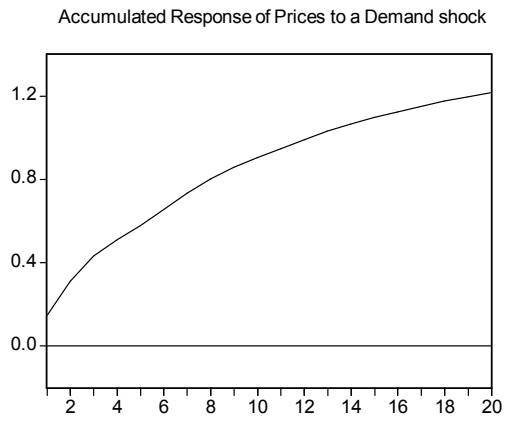
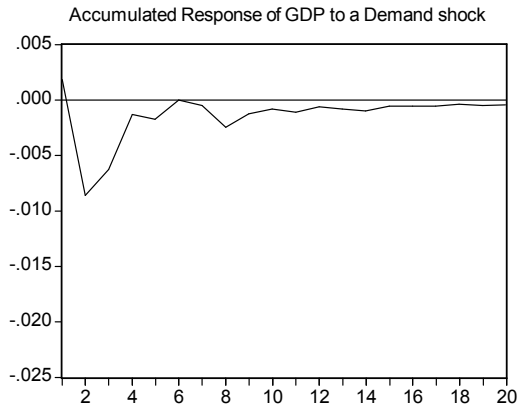


Figure 4. Panel C. Uruguay

Accumulated Response to Structural One S.D. Innovations

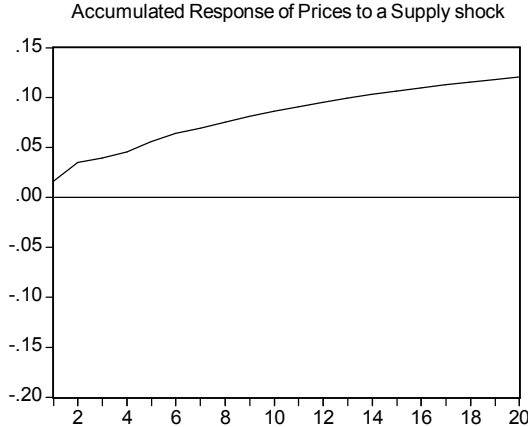
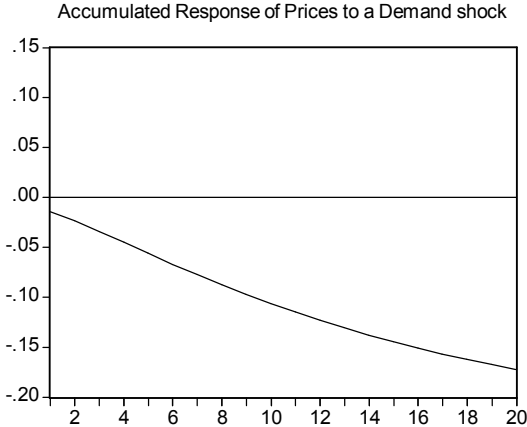
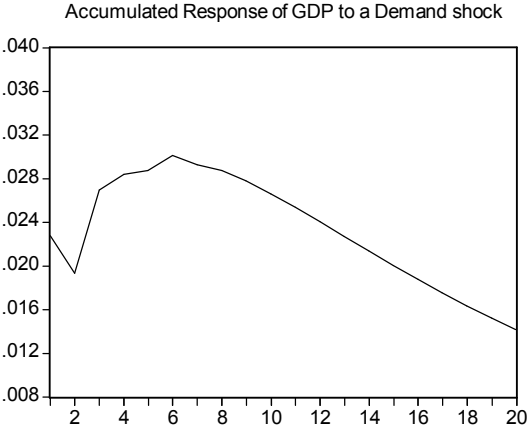
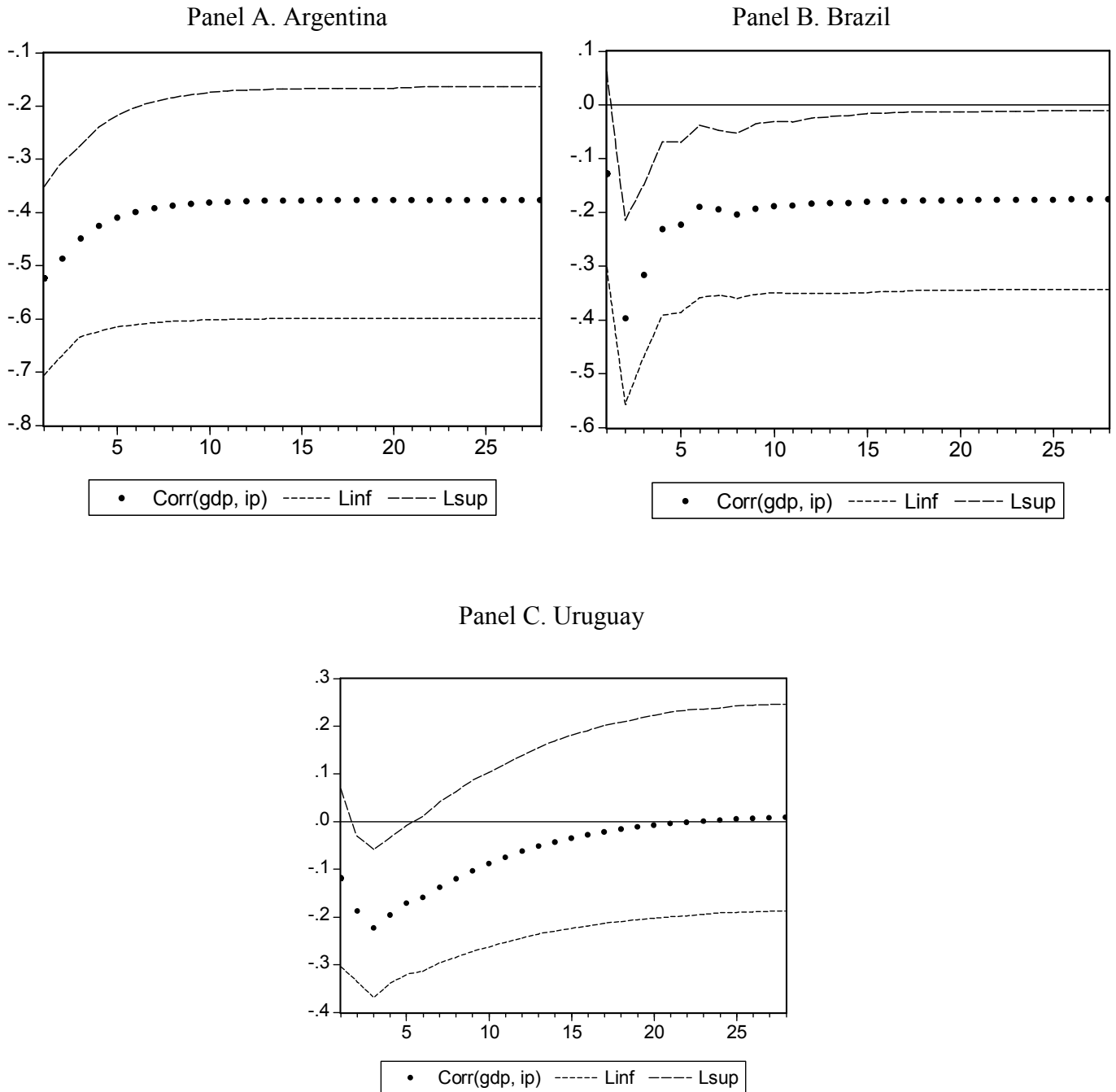


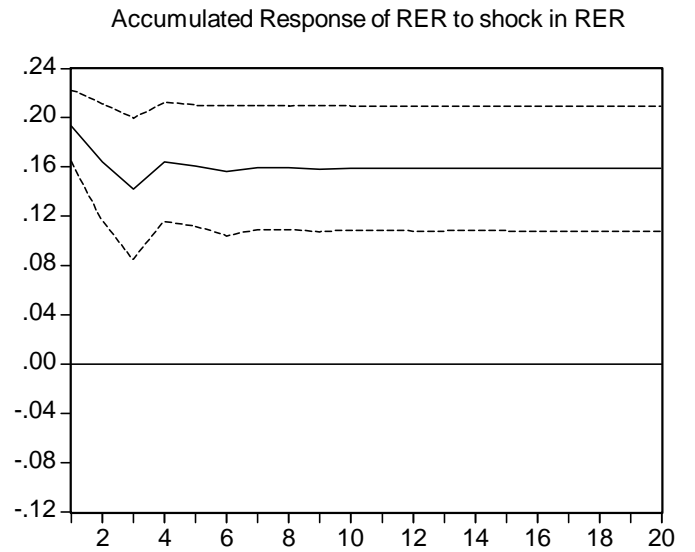
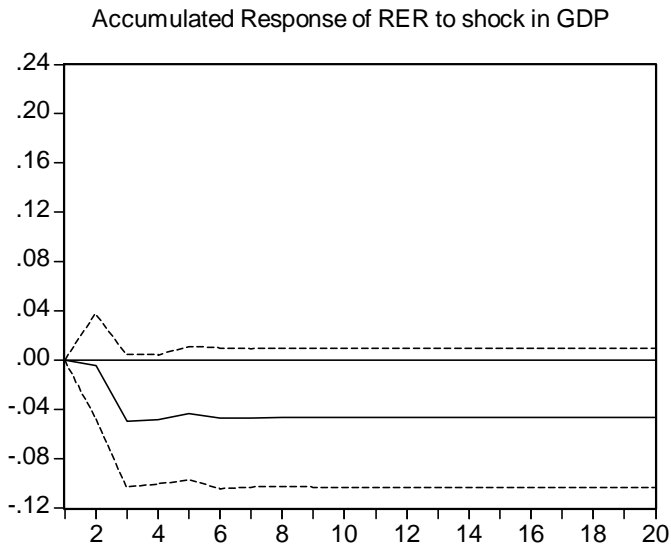
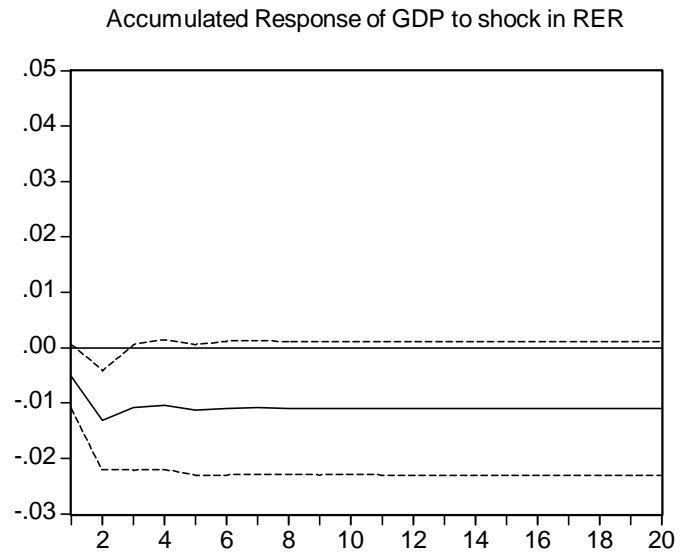
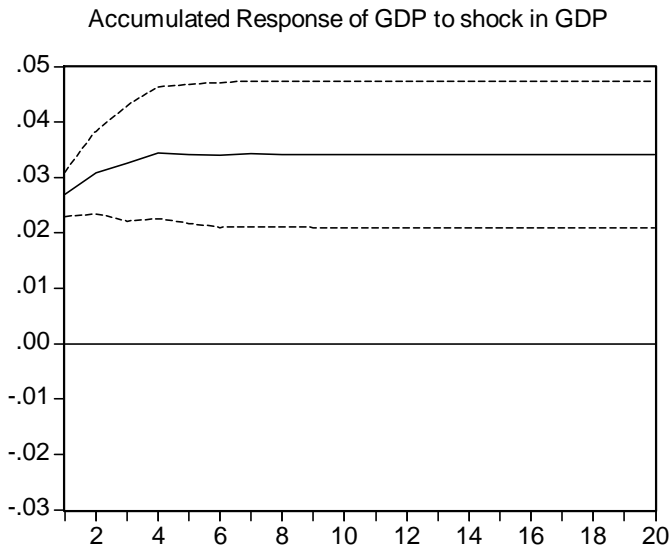
Figure 5



Note: the central dotted line in each graph represents the correlation between real gdp and prices at 28 quarters-ahead forecast points. Linf and Lsup are the limits of 95% Monte Carlo confidence intervals, computed using 1000 simulations.

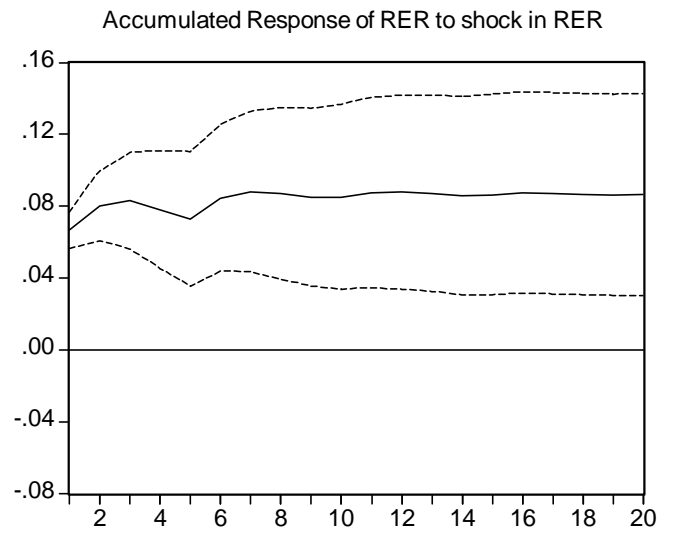
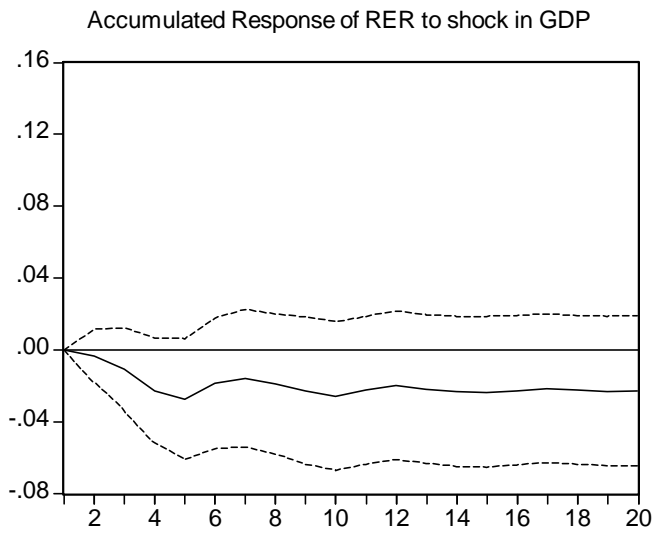
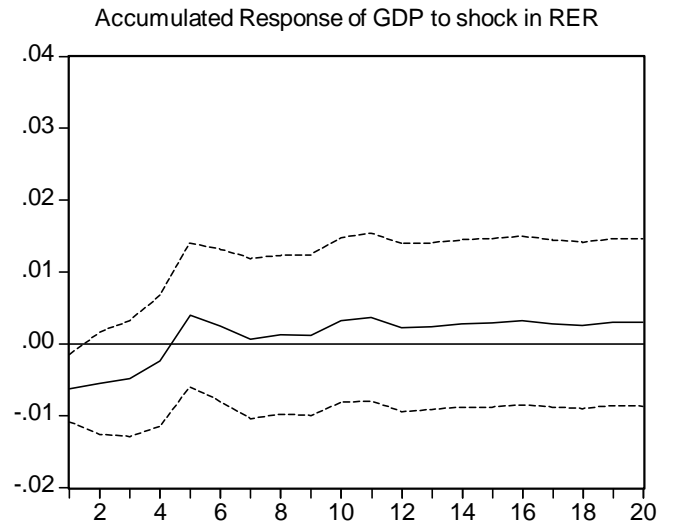
**Figure 6. Panel A. Argentina**

Accumulated Response to Cholesky One S.D. Innovations  $\pm 2$  S.E.



**Figure 6. Panel B. Brazil**

Accumulated Response to Cholesky One S.D. Innovations  $\pm 2$  S.E.



**Figure 6. Panel C. Uruguay**

Accumulated Response to Cholesky One S.D. Innovations  $\pm 2$  S.E.

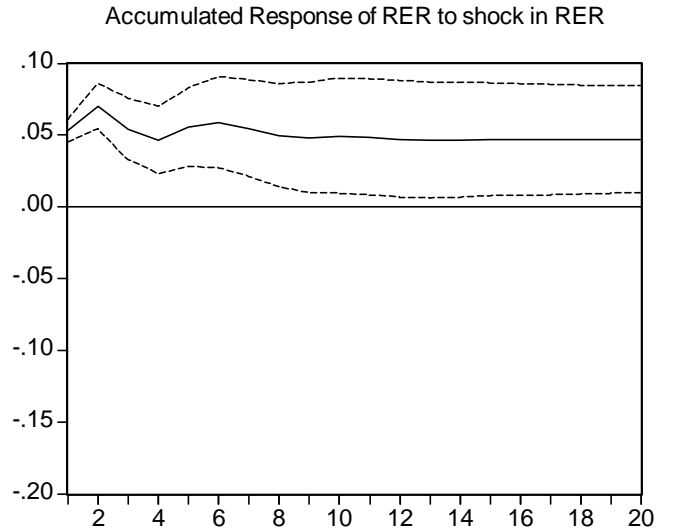
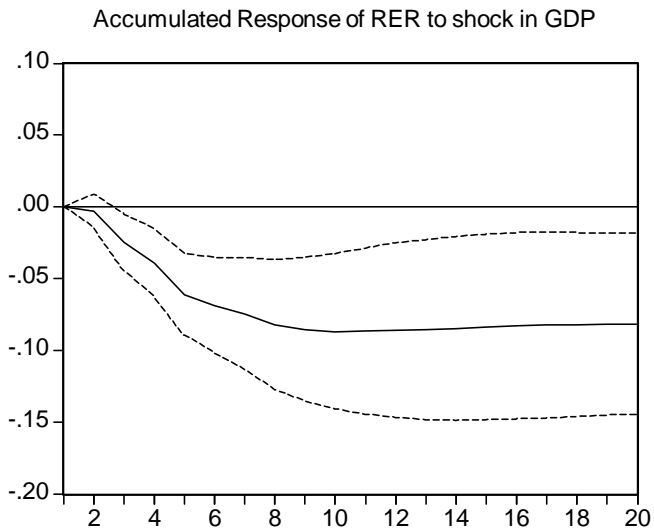
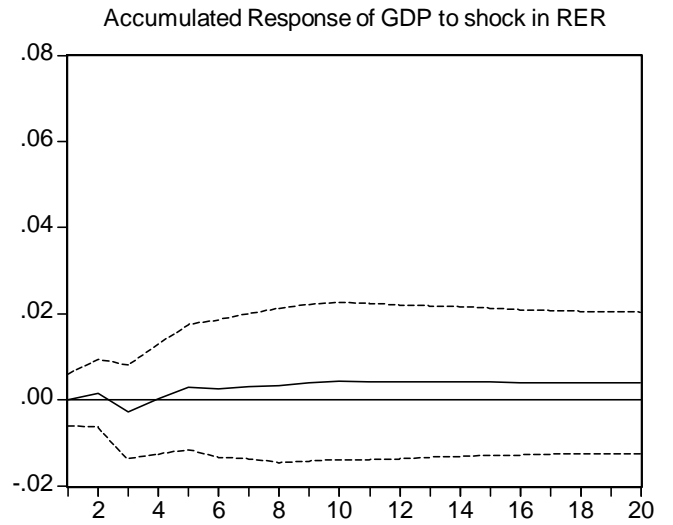
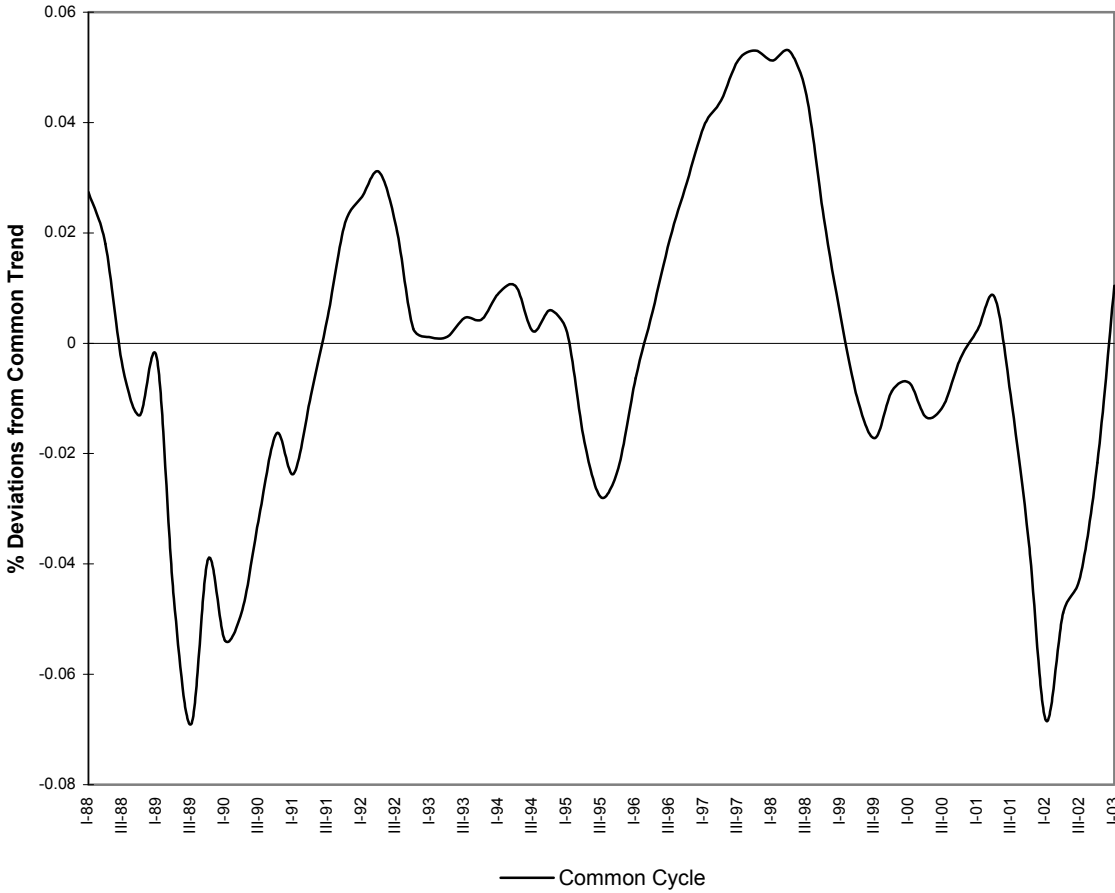
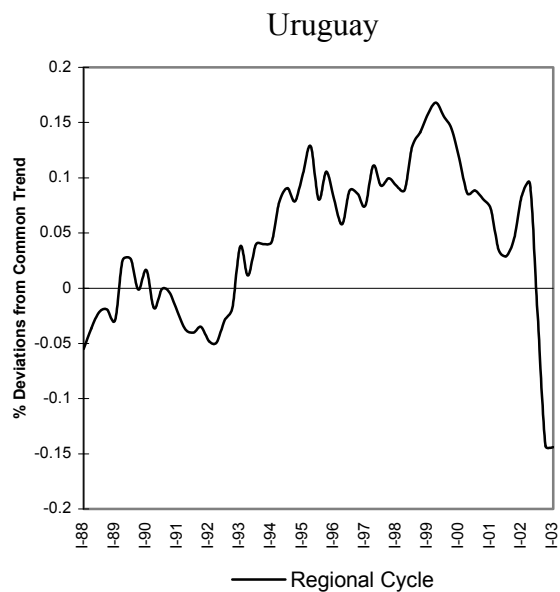
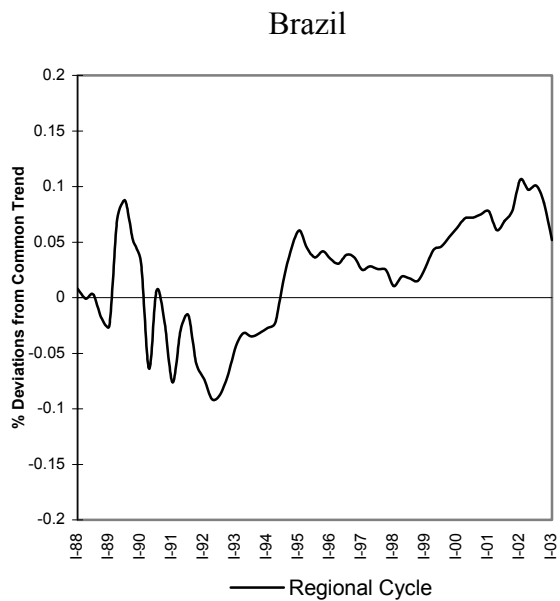
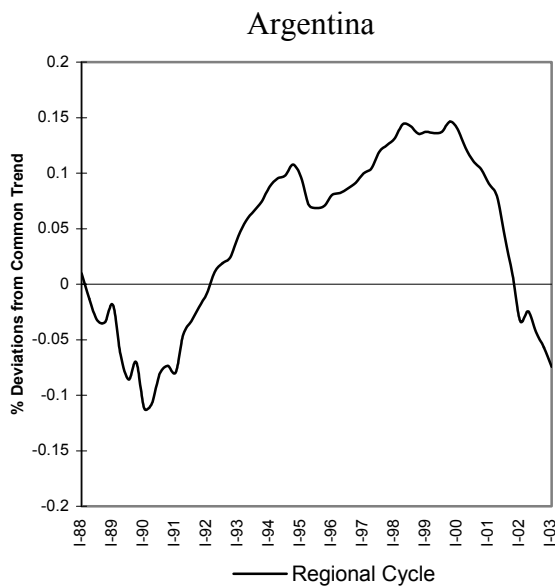


Figure 7

Mercosur Business Cycle

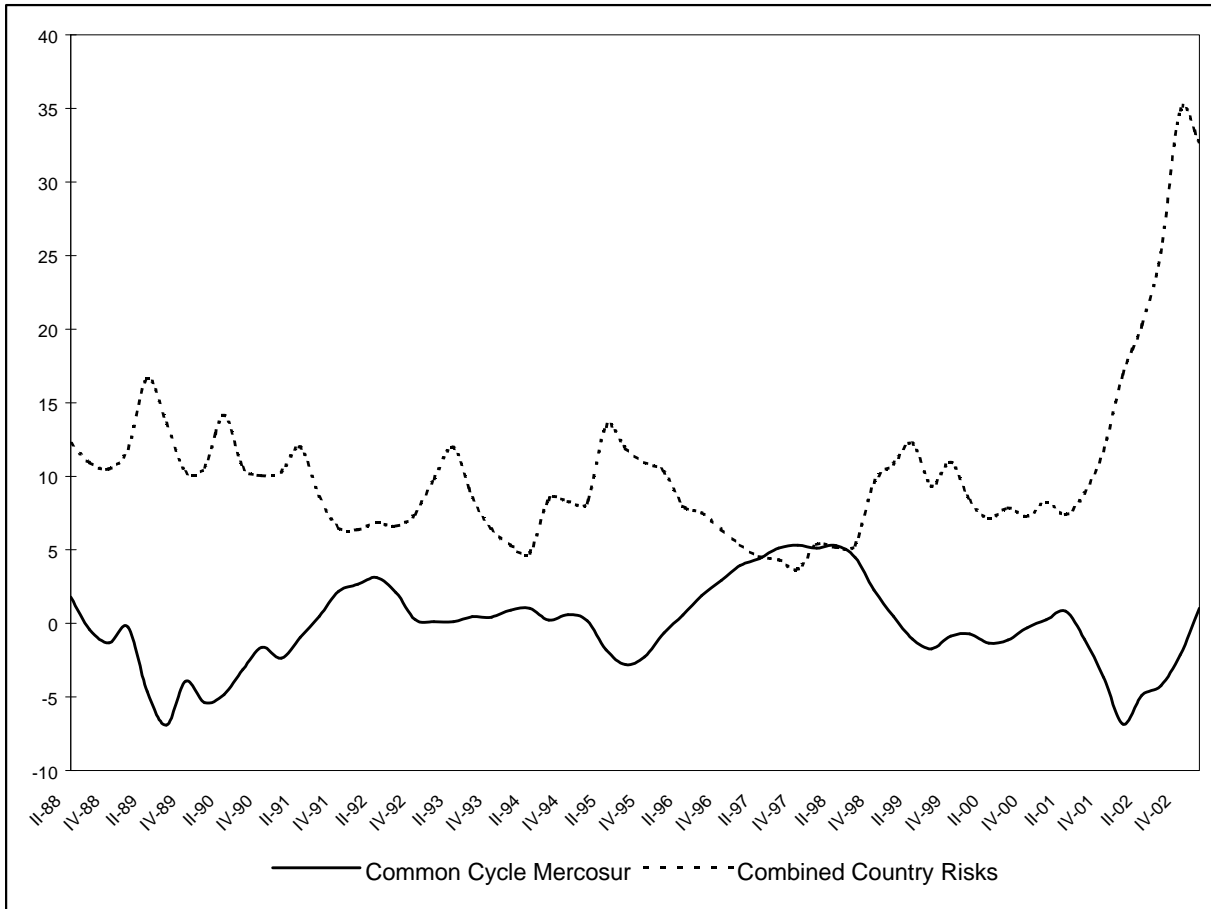


**Figure 8**





**Figure 9**  
**Mercosur Common Cycle and Lagged Combined Country Risk**



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# Appendix 1

**Table A.1: Estimation of Argentina's VAR(2) Model**

Vector Autoregression Estimates		
Sample: 1980:1 2003:1		
	Dependent Variables	
Independent Variables	$\Delta \ln (gdp)_t$	$\Delta \ln (ip)_t$
$\Delta \ln (gdp)_{t-1}$	0.2123	-1.3449
<i>t</i> -Statistic	1.70	-1.23
$\Delta \ln (gdp)_{t-2}$	0.0157	2.2920
<i>t</i> -Statistic	0.13	2.23
$\Delta \ln (ip)_{t-1}$	0.0120	0.3870
<i>t</i> -Statistic	0.89	3.28
$\Delta \ln (ip)_{t-2}$	-0.0044	0.3601
<i>t</i> -Statistic	-0.33	3.09
<i>C</i>	-0.0004	0.0495
<i>t</i> -Statistic	-0.10	1.47
R-squared	0.0367	0.4363
<i>F</i> -Statistic	0.8089	16.4442

**Table A.2: Blanchard-Quah Structural Factorization Estimation**

Model is:  $Ae_t = B\epsilon_t,$

Long run response pattern:

$$\begin{matrix} 0 & C(1) \\ C(2) & C(3) \end{matrix}$$

	Coefficient	Std. Error	<i>t</i> -Statistic	Prob.
<i>C</i> (1)	0.9396	0.0700	13.4164	0.0000
<i>C</i> (2)	0.0342	0.0025	13.4164	0.0000
<i>C</i> (3)	-0.1627	0.0998	-1.6302	0.1031
Log Likelihood	204.4705			
Estimated A matrix:				
	1.0000	0.0000		
	0.0000	1.0000		
Estimated B matrix:				
	0.0071	-0.0276		
	-0.2376	0.0735		

Note:  $e_t$  is the observed vector of residuals and  $\epsilon_t$  is the unobserved vector of structural supply and demand shocks (see equations (1) and (2)) .

**Table A.3: Estimation of Brazil's VAR(4) Model**

Vector Autoregression Estimates		
Sample: 1980:1 2003:1		
	Dependent Variables	
Independent Variables	$\Delta \ln (gdp)_t$	$\Delta \ln (ip)_t$
$\Delta \ln (gdp)_{t-1}$	0.0656	2.5297
<i>t</i> -Statistic	0.62	3.24
$\Delta \ln (gdp)_{t-2}$	-0.1269	-0.2426
<i>t</i> -Statistic	-1.18	-0.31
$\Delta \ln (gdp)_{t-3}$	0.1543	-0.1513
<i>t</i> -Statistic	1.58	-0.21
$\Delta \ln (gdp)_{t-4}$	-0.2778	-0.8160
<i>t</i> -Statistic	-2.84	-1.14
$\Delta \ln (ip)_{t-1}$	-0.0726	1.0932
<i>t</i> -Statistic	-4.89	10.02
$\Delta \ln (ip)_{t-2}$	0.1040	-0.2108
<i>t</i> -Statistic	4.51	-1.24
$\Delta \ln (ip)_{t-3}$	-0.0345	-0.2036
<i>t</i> -Statistic	-1.39	-1.12
$\Delta \ln (ip)_{t-4}$	0.0017	0.2174
<i>t</i> -Statistic	0.10	1.79
<i>C</i>	0.0066	0.0222
<i>t</i> -Statistic	1.95	0.90
R-squared	0.3696	0.7957
<i>F</i> -Statistic	5.7903	38.4626

**Table A.4: Blanchard-Quah Structural Factorization Estimation**

Model is:  $Ae_t = B\epsilon_t,$

Long run response pattern:

$$\begin{matrix} 0 & C(1) \\ C(2) & C(3) \end{matrix}$$

	Coefficient	Std. Error	<i>t</i> -Statistic	Prob.
<i>C</i> (1)	1.4024	0.1057	13.2665	0.0000
<i>C</i> (2)	0.0172	0.0013	13.2665	0.0000
<i>C</i> (3)	-0.0927	0.1496	-0.6195	0.5356
Log Likelihood	261.2297			
Estimated A matrix:				
	1.0000	0.0000		
	0.0000	1.0000		
Estimated B matrix:				
	0.0018	-0.0202		
	0.1457	0.0323		

Note:  $e_t$  is the observed vector of residuals and  $\epsilon_t$  is the unobserved vector of structural supply and demand shocks (see equations (1) and (2)) .



**Table A.5: Estimation of Uruguay's VAR(3) Model**

Vector Autoregression Estimates		
Sample: 1980:1 2003:1		
	Dependent Variables	
Independent Variables	$\Delta \ln (gdp)_t$	$\Delta \ln (ip)_t$
$\Delta \ln (gdp)_{t-1}$	-0.2493	0.2122
<i>t</i> -Statistic	-2.31	2.48
$\Delta \ln (gdp)_{t-2}$	0.3157	-0.3208
<i>t</i> -Statistic	2.93	-3.74
$\Delta \ln (gdp)_{t-3}$	0.2556	-0.0441
<i>t</i> -Statistic	2.07	-0.45
$\Delta \ln (ip)_{t-1}$	-0.1506	0.9185
<i>t</i> -Statistic	-1.11	8.49
$\Delta \ln (ip)_{t-2}$	0.1174	-0.3686
<i>t</i> -Statistic	0.65	-2.59
$\Delta \ln (ip)_{t-3}$	0.1312	0.3862
<i>t</i> -Statistic	0.94	3.46
<i>C</i>	-0.0086	0.0058
<i>t</i> -Statistic	-1.40	1.19
R-squared	0.2222	0.8285
<i>F</i> -Statistic	3.9047	66.0192

**Table A.6: Blanchard-Quah Structural Factorization Estimation**

Model is:  $Ae_t = B\epsilon_t,$

Long run response pattern:

$$\begin{matrix} 0 & C(1) \\ C(2) & C(3) \end{matrix}$$

	Coefficient	Std. Error	t-Statistic	Prob.
$C(1)$	0.2323	0.0174	13.3416	0.0000
$C(2)$	0.0453	0.0034	13.3416	0.0000
$C(3)$	0.1495	0.0271	5.5246	0.0000
Log Likelihood	405.8452			
Estimated A matrix:				
	1.0000	0.0000		
	0.0000	1.0000		
Estimated B matrix:				
	0.0227	0.0161		
	-0.0148	0.0165		

Note:  $e_t$  is the observed vector of residuals and  $\epsilon_t$  is the unobserved vector of structural supply and demand shocks (see equations (1) and (2)) .

**Table A.7: Estimation of Argentina's VAR(2) Model**

Vector Autoregression Estimates		
Sample: 1980:1 2003:1		
	Dependent Variables	
Independent Variables	$\Delta \ln(gdp)_t$	$\Delta \ln(rer)_t$
$\Delta \ln(gdp)_{t-1}$	0.1447	-0.1719
<i>t</i> -Statistic	1.31	-0.22
$\Delta \ln(gdp)_{t-2}$	0.0340	-1.6710
<i>t</i> -Statistic	0.33	-2.27
$\Delta \ln(rer)_{t-1}$	-0.0370	-0.1548
<i>t</i> -Statistic	-2.45	-1.45
$\Delta \ln(rer)_{t-2}$	0.0130	-0.1890
<i>t</i> -Statistic	0.83	-1.71
<i>C</i>	0.0016	0.0197
<i>t</i> -Statistic	0.54	0.96
R-squared	0.1069	0.0953
<i>F</i> -Statistic	2.5424	2.2372

**Table A.8: Estimation of Brazil's VAR(5) Model**

Vector Autoregression Estimates		
Sample: 1980:1 2003:1		
	Dependent Variables	
Independent Variables	$\Delta \ln(gdp)_t$	$\Delta \ln(rer)_t$
$\Delta \ln(gdp)_{t-1}$	0.0634	-0.1584
<i>t</i> -Statistic	0.55	-0.46
$\Delta \ln(gdp)_{t-2}$	-0.3751	-0.3094
<i>t</i> -Statistic	-3.46	-0.96
$\Delta \ln(gdp)_{t-3}$	0.2410	-0.5313
<i>t</i> -Statistic	2.11	-1.56
$\Delta \ln(gdp)_{t-4}$	-0.2169	-0.1954
<i>t</i> -Statistic	-1.99	-0.60
$\Delta \ln(gdp)_{t-5}$	0.2161	0.2567
<i>t</i> -Statistic	1.94	0.77
$\Delta \ln(rer)_{t-1}$	0.0163	0.1846
<i>t</i> -Statistic	0.41	1.56
$\Delta \ln(rer)_{t-2}$	-0.0289	-0.0195
<i>t</i> -Statistic	-0.72	-0.16
$\Delta \ln(rer)_{t-3}$	0.0677	-0.1246
<i>t</i> -Statistic	1.63	-1.01
$\Delta \ln(rer)_{t-4}$	0.0632	-0.0425
<i>t</i> -Statistic	1.52	-0.34
$\Delta \ln(rer)_{t-5}$	-0.0110	0.2638
<i>t</i> -Statistic	-0.26	2.10
<i>C</i>	0.0059	0.0081
<i>t</i> -Statistic	2.03	0.94
R-squared	0.2529	0.1282
<i>F</i> -Statistic	2.5729	1.1176

**Table A.3: Estimation of Uruguay's VAR(4) Model**

Vector Autoregression Estimates		
Sample: 1980:1 2003:1		
	Dependent Variables	
Independent Variables	$\Delta \ln(gdp)_t$	$\Delta \ln(rer)_t$
$\Delta \ln(gdp)_{t-1}$	-0.1850	-0.1118
<i>t</i> -Statistic	-1.64	-0.53
$\Delta \ln(gdp)_{t-2}$	0.3633	-0.7498
<i>t</i> -Statistic	3.30	-3.64
$\Delta \ln(gdp)_{t-3}$	0.3153	-0.3998
<i>t</i> -Statistic	2.32	-1.57
$\Delta \ln(gdp)_{t-4}$	-0.0850	-0.6684
<i>t</i> -Statistic	-0.63	-2.64
$\Delta \ln(rer)_{t-1}$	0.0282	0.3189
<i>t</i> -Statistic	-0.49	2.95
$\Delta \ln(rer)_{t-2}$	-0.0862	-0.4033
<i>t</i> -Statistic	-1.40	-3.49
$\Delta \ln(rer)_{t-3}$	0.0688	0.0910
<i>t</i> -Statistic	1.09	0.77
$\Delta \ln(rer)_{t-4}$	0.0391	0.0260
<i>t</i> -Statistic	0.68	0.24
<i>C</i>	-0.0003	0.0116
<i>t</i> -Statistic	-0.08	1.94
R-squared	0.2194	0.3999
<i>F</i> -Statistic	2.7765	6.5806