Taking the Business Cycle's Pulse to Some Latin American Economies: Is There a Rhythmical Beat?

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Abstract. The paper deals with the macroeconomic behavior of Argentina, Bolivia, Brazil, Chile, Paraguay and Uruguay during the last twenty-five years. Its aim is twofold. First, to determine whether their economic fluctuations followed a similar pattern according to their duration, intensity and timing. Second, to evaluate the demand and supply disturbances. The arrhythmical beat among these economies in the past reveals that there is little point in trying to align macroeconomic policies with the absence of economic argument for a monetary union.

Key words: Business fluctuations demand and supply shocks, policy harmonization, monetary union.

JEL codes: E32, F02, F42

I. Introduction

The process of creating a European Union has triggered a substantial amount of research, both theoretical and empirical, to better understand the preconditions of this development for Europe. Some of these studies have adopted the idea that the existence of similar business fluctuations is the necessary condition for the harmonization of economic policies and institutions (Christodoulakis *et. al.*, 1995; Fiorito and Kollintzas, 1994). In fact, the synchronism in the cycles facilitates common policies among countries involved in an integration process. In this case, where coincidences exist, policies to cope with the cycle can be effectively designed

since the phases are going to be similar across countries. In spite of the fact that this is of extraordinary relevance for the region, there is not any study about Latin American economies by which one could determine the existence of such a uniform behavior.

There is an enormous literature trying to document some evidence about cyclical fluctuations after Kydland and Prescott's (1990) reports of the U.S. business cycle facts. This reactivation (with a different methodology) of the research agenda of Burns and Mitchell in the 40s at the NBER generated worldwide country-specific works with the same structure as that of Kydland and Prescott's. Although there are some studies about individual economies, Latin American countries were left aside from this line of research mainly for lack of stability and lack of data (Fullerton and Araki, 1996; Mena, 1995).[1] Notwithstanding one should recognized the existence of other studies, their authors are interested in using some "econometric pyrotechnics" rather than in determining the existence of a "rhythmical beat" among the economies.[2] In other words, because of the problems mentioned above, and a lack of emphasis in the comparison of business cycle facts among countries, Latin America is still behind in its evaluation of the preconditions of the integration process.

A related literature investigates the extent to which the countries appear to be symmetric or asymmetric with respect to the nature of shocks underlying their economies. The argument is that if the shocks that are impinging upon a particular economy and the rest of the countries do so different (asymmetrically), then the monetary and fiscal policies cannot be carried out efficiently. The curiosity in such behavior arises because the integration process tends to its *momentum* when a monetary union takes place. If this is the case, in response to country-specific shocks the governments will no longer have the option of adopting a monetary policy which differs from that of the union as a whole, and the weight attached to these arguments depends on the incidence of the shocks.

There are some studies for Europe that focus on these "shocking aspects of monetary unification" (Bayoumi and Eichengreen, 1992b). Although the monetary union is at all times a political decision (Eichengreen, 1993), these studies want to show the existence of an economic argument that supports the currency area. About this argument, the starting point of the literature is the work of Mundell (1961). In his framework, the incidence of disturbances across regions is a critical determinant of the design of a currency area, and countries would find it optimal whenever the nominal exchange rate is not necessary to adjust the real one at every time that these economies face asymmetric shocks. Again, and not surprisingly, Latin American countries were ignored. In fact, while the empirical studies have

[1] For a recent study about Chile see Belaisch and Soto (1998).
[2] The study of Carrera *et al.* (1999) seems to be aligned with those interested in the use of different econometric methodologies.

developed greatly for the case of the European Union, only marginal attention has been given to the case of MERCOSUR (Southern Common Market) has only received marginal attention (Martirena-Mantel, 1997).

The paragraphs above constitute merely an outline to intuitively discover the goals of this paper. About its first aim, the reader could infer the implicit interest to find the degree of homogeneity of Latin American economies, and hence the feasibility of policy harmonization. The countries to be examined are those related with the integration phenomenon that in the Southern Cone is named MERCOSUR (Argentina, Brazil, Paraguay and Uruguay). Currently, MERCOSUR has further extended its scope by entering free trade agreements with Bolivia and Chile, and that is why these two additional countries have joined to the study. The period selected for the analysis is the last quarter of the century (1970-1997), and the characterization of the GDP fluctuations in the past will be use only to predict the likely outcome of the integration process.

The second aim is related with the mechanisms underlying the business fluctuations with special reference to the size and correlation of shocks. While this featuring helps to describe the economies, it also helps to discover whether the economic argument for an optimum currency area exists.

With both aims, the remainder of the paper is organized as follows. Section two is devoted to some generalities about cyclical fluctuations and shocks; together with the methodologies employed to remove the trend from the data and to discover the shocks. Section three presents the results. The concluding comments are in Section four.

II. Fluctuations and Shocks

1. Fluctuations

Although the characterization of GDP fluctuations is an interesting and motivating feature, their discovery is not less attractive. In fact, cyclical fluctuations are not such is trend is not properly defined. For this reason, the first step is to separate the fluctuations from the GDP growth trend, something that is a common practice in macroeconomics.

The usual exercise for this purpose is to consider that the economic aggregates wave around a long run uniform trend line (Burns and Mitchell, 1946). This point of view is supported by the hypothesis that the growth rate of real variables is explained by exogenous factors such as population or technological changes. The notion that the secular component does not

fluctuate much over short periods of time, but it does slowly and smoothly with respect to the cyclical component has led to the practice of "detrending" the series using time as an explanatory variable.

However, the evidence has suggested that the secular movement change over time, and most of the theory has rejected the hypothesis that these rates of growth are constant. Therefore, it is assumed the transitory changes modify the rate. Once this assumption is accepted, the economic literature admits the existence of a stochastic trend as a variable in modeling macroeconomic fluctuations (Beveridge and Nelson, 1981; Nelson and Plosser, 1982).

These last theories arise mainly after the re-definition of the cycle made by Lucas (1977) who thinks that business fluctuations are deviations of aggregate output from trend (without an explicit explanation of what trend to use).[3] His incomplete definition gives the chance to use the trend considered more appropriate for the economies under analysis.

Lucas' point of view of the cycle is in clear contrast with that of Mitchell's. In fact, while Mitchell represents business cycles as sequences of expansions and contractions, particularly emphasizing turning points, Lucas does not think in terms of sequences of the cycles as inevitable waves of economic activity, and he does not consider necessary to distinguish the different phases of the cycle either. While it is true that with Lucas the detailed description about the phases is also abandoned, it is also true that with him the interest for the cycles is recovered.

The studies of business cycle flourished from the 1920s through 1940s; but in the 1950s and 1960s, with the development of the structural system of equations approach that Koopmans advocated, business cycles ceased to be an active area of economic research. Now, once again, the study of business cycles, in the form of recurrent fluctuations, is alive, and instrumental in bringing cycles back into the mainstream of economic research is the important paper of Lucas (1977) (see Kydland and Prescott (1990) for a quick reference).

In short, what matters here, is that if the rate of technological change were constant, then the natural logarithm of real GDP would be a linear function of time. Since the rate of technological changes varies (both over time and across countries), detrending using a linear function of time could be inappropriate. Formally, the key question is to perceive which is the trend of GDP series, and for this one can distinguish two kinds of process.[4]

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[3] His definition was completed by Kydland and Prescott (1990) who provided an explicit procedure for calculating the time series trend that successfully mimics the smooth curves most business cycle researchers would draw through the plots of the data.

[4] In other words, it is necessary to discompose the GDP series into a stationary (trend) and stationary (cyclical) components, because certain characterizations of the data are valid only if the series are stationary.

The first one is the process through which the series could be modeled by a deterministic trend plus a stochastic process with zero mean. This is known as a "trend stationary" process.

This first procedure is associated with the traditional point of view of business cycle through the equation $y_t = a + bt + e_t$ in which y_t is formed by a stationary fluctuation (e_t) around the time trend ($a + bt$). Since y_t is not stationary due to the presence of t, stationarity is easily achieved by removing the trend, that is, using time as an explanatory variable. In this context a stationary fluctuation appears after the trend is removed.

The second process is related to one in which the first (or higher) difference of the series is a stationarity and an invertible autoregressive moving average (ARMA) process.

This procedure appears when the series is $y_t = a + y_{t-1} + e_t$, *id est*, the series could be modeled using its past values, a drift (a) and a stationary disturbance (e_t). This is known as a random procedure with a drift, and the first difference of the series ($y_t - y_{t-1}$) is a stationary process ($a + e_t$). The fact that stationarity is achieved through differencing justifies labeling it as a "difference stationary". This model represents the unit root hypothesis.

The test of unit root is useful to distinguish which of the two process best explain the non-stationarity behavior of the series, contributing to answer if the non-stationarity arises from a deterministic or a stochastic trend. From the macroeconomic point of view, it suggests whether a shock influence in the growth of the economy in a transitory way or in a permanent one. Although the Augmented-Dickey Fuller test is a formal one to identify if the variable should be considered in levels or in differences (each unit root needs a difference for an ARMA model to fit the data), sometimes it tends to overdifference the series (Enders, 1995; p. 251). For this reason, Box and Jenkings methodology is preferred here.

The first step in this methodology is to choose d, the number of times the series should be differenced to make it "approximately" stationary.[5] A plot of the series over time gives a clue as to the nature of the series. If the series appears to grow exponentially, one should take the logarithm and then plot it against the time. If a linear trend is apparent, difference the series (or its logarithm) once and plot the differenced series. If this also exhibits a trend, a second differencing might be required.[6] A second way to identify whether differencing is required is to calculate the Autocorrelation Function (ACF) and plot the correlogram. If this plot declines slowly, then differencing is suggested. Next plot the correlogram of the first difference. If this plot also declines slowly, a second difference is indicated.

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[5] Analysis of time series is not a perfect science. Something may force the researchers to terminate their analysis even if there is still fairly regular residual element.

[6] Economic time series rarely require differencing more than twice (Ramanathan, 1992; p. 497).

With a visual examination of the Autocorrelation and the Partial Autocorrelation Functions (PACF) one can perceive the order of the moving average and the autoregresive processes (see Ramanathan (1992) and Larrain (1981) for further details).[7] The parameter estimates are something intricate. Since there are programs that not only compute ACF and PACF, but also do the estimation, it is not necessary to give further contents. When the procedure is finished the residuals are white noise, or "approximately" white noise.

2. Shocks

A richer description could be made distinguishing fluctuations as consequences of different shocks. This analysis is useful since it gives the chance to better characterize the economies. By the way, the analysis is also related to the possibility of an optimum currency area as stated in Section one. The renewal interest for this concept is the result of the dynamism of the integration phenomena (with special reference to Europe), together with monetary integration as an element of such phenomena.

Although it should be recognized that the political impulse and the economic relations have improved during the last years, a monetary union in MERCOSUR is not in a short distance. In fact, a common currency means an extraordinary sacrifice of monetary autonomy which turns to be useful against some specific shocks, and governments will not be able to use a different monetary policy from the one that should be use in a union as a whole giving up the chance to modify nominal prices. Since monetary policy is useful for adjustments, some problems may arise, and the relevance of these problems depends on the incidence of the shocks.

The cost and benefits of a monetary union were estimated in most of the cases on the symmetry or asymmetry of shocks.[8] Bayoumi and Eichengreen (1992b) concluded in their study between Germany and other European countries that the European Union is divided in a core and a periphery. In the core the shocks are highly correlated, but this does not happen in the periphery.[9] Besides, the size of the shocks is similar among the core countries, but it is not alike in the rest of Europe. Bayoumi and Einchegreen compare their results with those of a consolidated monetary union as represented by the United States, stating that the correlation in eight

[7] Also Nelson (1973) and Vandaele (1983) could be helpful in understanding the processes.
[8] For a fresh list of the costs and benefits of a monetary union see Fondo Monetario Internacional (1997), p. 14-16.
[9] Although the authors correctly use the term "periphery", it sounds pejoratively. Hereinafter, this expression will mean, strictly, the area beyond the limits of some common characteristics without a pejorative connotation.

regions of the United States is similar of that of the central region of Europe, but is higher than the one of the periphery.

The shocks are going to be obtained using the procedure described by Blanchard and Quah (1989). The purpose of these authors was to reconsider the decomposition of GDP made by Beveridge and Nelson (1981) in its permanent and transitory components. It is with this aim that they developed a model in which supply and demand shocks may influence in the GDP: the demand shocks having a transitory effect on output, the supply shocks a permanent one on it.

Consider a system in which the true model can be represented by an infinite moving average representation of a vector of variables X_t and an equal number of shocks E_t:

$$X_t = A_0 E_t + A_1 E_{t-1} + A_2 E_{t-2} + A_3 E_{t-3} + \ldots \qquad (3.1)$$

where the matrixes A_i represent the impulse responses functions of the shocks to the element of X. Specifically, let X_t be made up of changes in output and in the monetary aggregate:

$$\begin{bmatrix} \Delta y_t \\ \Delta(m - p)_t \end{bmatrix} = \sum_{i=0}^{\infty} L^i \begin{bmatrix} a_{11i} a_{12i} \\ a_{21i} a_{22i} \end{bmatrix} \begin{bmatrix} \varepsilon_{dt} \\ \varepsilon_{st} \end{bmatrix} \qquad (3.2)$$

where y_t is the logarithm of output, m is the logarithm of the monetary aggregate, p is the logarithm of the price level, L is the lag operator, a_{11i} is the a_{11} element in A_i, and ε_{dt} and ε_{st} are, respectively, the demand and supply shocks.

As stated before, supply shocks have permanent effects on the level of output while demand ones have only temporary effects. Since output is written in a difference form, this implies that the cumulative effects of demand shocks on the change in output must be zero. This implies the restriction:

$$\sum_{i=0}^{\infty} a_{11i} = 0 \qquad (3.3)$$

The model defined by equations (3.2) and (3.3) can be estimated using a vector autoregression. Each element of X_t can be regressed on lagged values of all elements of X. Using B to represent these estimated coefficients, the equation becomes:

$$X_t = B_1 X_{t-1} + B_2 X_{t-2} + \ldots + B_n X_{t-n} + e_t$$
$$X_t = (I - B(L))^{-1} e_t$$
$$X_t = (I + B(L) + B(L)^2 + \ldots) e_t \qquad (3.4)$$
$$X_t = e_t + D_1 e_{t-1} + D_2 e_{t-2} + D_3 e_{t-3} + \ldots$$

where e_t represents the residuals from the equation in the vector autoregression. In this case, e_t is comprised of the residuals of a regression of lagged values of y_t and m-p on current values of each in turn; these residuals are labeled e_{yt} and e_{pt}.

To convert equation (3.4) into the model defined by equation (3.2), the residuals from the VAR must be transformed into demand and supply shocks. Writing $e_t = C\varepsilon_t$, it is clear that in the two by two case considered four restrictions are required to define the four elements of the matrix C.[10] Two of these restrictions are simple normalization, which define the variance of the shocks. A third restriction arises from the fact that demand and supply shocks are orthogonal. The final restriction that allows C to be uniquely defined is that monetary shocks have only temporary effects.[11] In terms of VAR this implies:

$$\sum_{i=0}^{\infty} \begin{bmatrix} d_{11i} d_{12i} \\ d_{21i} d_{22i} \end{bmatrix} \begin{bmatrix} c_{11} c_{12} \\ c_{21} c_{22} \end{bmatrix} = \begin{bmatrix} 0 & . \\ . & . \end{bmatrix}$$

In summary, the disturbances are in general not directly observable, but these can be inferred from the joint behavior of two series. This joint behavior is characterized by a vector autoregresion, and the underlying shocks are identified by imposing some restrictions, one of which is the long-run neutrality of nominal shocks.

III. Results

[10] In applied work the nature of the identified shocks has differed. Some studies identify only one generic shock to aggregate demand (e.g. Blanchard and Quah, 1989), whereas others identify multiple shocks to aggregate demand (e.g. Shapiro and Watson, 1988; Galí, 1992). Likewise, some of these studies identify only a single supply shock (e.g. Blanchard and Quah, 1989; Galí, 1992), whereas others identify several supply shocks (e.g. Shapiro and Watson, 1988; Fackler and McMillin, 1998). However, one should be cautious in identifying shocks. King *et al*. (1991), for example, identify three shocks one of which is a real interest shock, but it is not clear how to classify this shock because it could be interpreted either as an aggregate demand or supply shock, or as a mixture of the two. In summary, the shocks are identified by imposing a number of restrictions, and in spite of the fact that in applied work the nature of the identified shocks has differed, they could be labeled either as demand or supply ones.

[11] This restriction excludes the possibility that aggregate demand shocks permanently affect the level of output. The assumption allows the data to choose a description closer to the keynesian view in which fluctuations are predominantly transitory, or to fit a description closer to the real business cycle view in which they are largely the result of permanent shocks.

The data to obtain the cyclical fluctuations are from *Anuarios Estadísticos de America Latina y El Caribe* for they provide consistent information for the period 1970-1997. The information was computed in constant prices. Although this procedure is no difficult to follow, it may show some distortions in very long periods of time as a consequence of changes in the statistical procedures.

It is difficult to obtain overlapping time series of national accounts under different base periods in Latin American countries. It is typical that, once the base period is changed, the old time series (based on the previous base period) are discontinued and the new time series are not extended backward for a significant number of years (Mena, 1995).[12] This makes unclear if the observed differences in the output growth rate across base periods effectively reflects changes in the structure of the economy (input-output matrix) or merely shows the peculiarities of statistical procedures. Anyway, this "second best methodology" related with the simple "chain" of the series is adopted.[13]

As to money, the construction of the series of the relevant monetary aggregate generated an additional problem since Argentina, Bolivia and Brazil were vary unstable economies and had changed their monetary units several times.[14] To overcome the difficulties that may arise from this situation, it was necessary to consult the International Financial Statistics provided by the International Monetary Fund. The series constructed were checked with the information provided by *Estudios Económicos de América Latina*. These early-based *Estudios* bring a short description of the performance of the economies that helps to find inconsistencies with the data and to avoid the introduction of distortion in the series.

The general procedure was to use the last volume of *Anuarios Estadísticos de América Latina*, and then to construct the series from the present to the past. It is done in this way because on the assumption that the last data was properly elaborated. The same procedure was employed for the monetary aggregate series.

1. GDP Fluctuations and their Characteristics

The adoption of a deterministic trend implies that the growth rate of the GDP was a constant one. Table 1 summarizes the results for the period

[12] Argentina, Chile and Uruguay are the only Latin American countries that do not present these difficulties in obtaining such national account statistics (Mena, 1995; p. 89).

[13] Macroeconometric testing in Latin American countries requires a country-specific detailed knowledge of the economic policy evolution throughout the period investigated. Such information needs to be incorporated into both the specification and estimation procedures. These "pressing restrictions" suggest the adoption of a second best methodology.

[14] This is due to the episodes of hyperinflation.

1970-1997 under this assumption. The growth rate for the economies were different among the countries selected. It was necessary to include a dummy variable for the eighties, which turned to be relevant for the cases of Argentina, Bolivia, Chile and Uruguay. The growth rate of Paraguay was 5.1% while the one of Brazil was 3.8%. The growth rate for the rest of the countries (dummy included) was 4.9% for Chile, 2.9% for Bolivia, 2.4% for Uruguay, and 2.2% for Argentina.

Table 1
GDP Growth Rate for Selected Latin American Countries

Countries	Growth Rate[(a);(b)]		r^2
	(without a Dummy)	(with a Dummy)	
Argentina	1.3 (7.84)		0.71
		2.2 (8.30)	0.82
Bolivia	1.7 (8.05)		0.72
		2.9 (9.36)	0.85
Brazil	3.8 (12.47)		0.86
		4.2 (6.95)	0.57
Chile	3.7 (12.36)		0.85
		4.9 (5.27)	0.89
Paraguay	5.1 (19.05)		0.93
		5.1 (9.56)	0.93
Uruguay	1.4 (6.85)		0.65
		2.4 (6.99)	0.76

Note: (a) In %; (b) t-statistic in parenthesis.

Despite the satisfactory results obtained, the procedure could be useful only for some economies since it is probably not true that all of them followed a constant growth rate.

The autocorrelation and partial autocorrelation functions suggested that the series of GDP be differenced in the cases of Brazil, Chile and Paraguay. The correlograms insinuated the use of a first autorregressive process for all the economies.[15] The residuals are shown in Graph 1 (see Appendix), and they are approximately white noise. The Graph also presents the residuals from a deterministic trend.

[15] This is probably due to the use of annual data.

The coincidences in expansions and recessions have been checked with the description of the economies provided by *Estudios Económicos de América Latina*, and a high number of coincidences have been found. Although there is no way to do this procedure directly due to methodological matters (related to fluctuations along a trend line or to the previous year), one could construct a table in which expansions and contractions are listed and then compare them with those given by *Estudios*.[16]

The reader should notice that the cyclical fluctuations are not purged from economic policy effects. In fact, one should consider that economic policies were partially effective (otherwise one must have nothing but a line). It seems nearly impossible to isolate the effects, and that is why they are contained in the fluctuations.

Once the fluctuations are obtained, the next step is to characterize them. Christodolulakis *et al*. (1995) suggest their duration, intensity and persistence as the most relevant characteristics; while their simultaneity and temporal correlation are also useful to perceive the join behavior of the countries.[17]

a. Duration, volatility and persistence

Table 2 presents the duration (in years) of the cyclical fluctuations given the alternatives selected. Argentina and Paraguay have shorter expansions; while Bolivia, Uruguay and Chile have longer ones. Brazil is somewhere in between. In the cases of contractions, they are similar in all the cases with the exception of Brazil.

[16] A similar practice is employed in Arnaudo and Jacobo (1998).
[17] See Arnaudo and Jacobo (1997).

Table 2
Characteristics of GDP Fluctuations

Type	Country					
	Argentina	Bolivia	Brazil	Chile	Paraguay	Uruguay
Duration[(a)]						
Expansions	2.6	6.2	4.0	4.7	2.3	5.0
Contracions	1.6	2.0	3.3	2,0	2.2	2.3
Volatility[(b)]						
D	5.3	6.2	9.4	9.5	10.3	7.2
S	4.8	2.6	6.2	6.2	3.8	8.1
Persistence[(c)]						
D (t-1)	0.46					0.29
S (t-1)		-0.10	0.01	0.02	0.36	
D (t-2)	0.10					-0.12
S (t-2)		0.05	0.45	0.05	-0.07	

Notes: (a) in years; (b) following a deterministic (D) or a stochastic (S) trend; (c) autocorrelation coefficient.

Since the estimated residuals show a great variability, it is useful to evaluate their volatility. The volatility of the fluctuations is measured through the standard deviation of the cyclical component. Table 2 shows that volatility is small for the cases of Bolivia, Brazil, Chile and Paraguay when a stochastic trend is selected; while there is no significant differences in the cases of Argentina and Uruguay. This situation seems to confirm the trend selected for the economies.[18]

The persistence is measured through the autocorrelation coefficient. The results indicate that the persistence in the economies is not relevant, although one should recognize some persistence in the cases of Argentina, Paraguay and Uruguay.

b. Simultaneity

The analysis of expansions and contractions showed a number of coincidences that should be recorded. The question is, in this case, which is the expected number of coincidences. If the fluctuations were happening simultaneously, the number of years should be equal to that of the years analyzed, whereas if the fluctuations were in opposite directions, the number should be zero; thus, it is reasonable to think that half the number of periods corresponds to a random situation.

[18] It is judicious to remember that the time series trend should mimic the smooth curves most cycle researchers would draw trough the plots of the data.

Table 3
Simultaneity of Cyclical Fluctuations

Countries	Argentina	Bolivia	Brazil	Chile	Paraguay	Uruguay
Argentina	.	65	71	65	54	67
Bolivia		.	58	69	65	73
Brazil			.	50	71	65
Chile				.	58	65
Paraguay					.	62
Uruguay						.

Note: Number of coincidences over the number of years analyzed (in %).

Since due to statistical procedures it was necessary to sacrifice one year in some cases, the number of periods in which the economies experimented coincidences was related to the years analyzed, and then the number was expressed in percent. This method does not invalidate what is stated above. In fact, a number near 50% suggests a random case.

Table 3 gives some information about simultaneity in these geographically linked countries. The coincidences are high for between Argentina and Brazil (71%). Something similar is observed between Brazil and Paraguay (71%), and between Uruguay and Bolivia (73%). Chile and Bolivia also have an interesting number of coincidences (69%), and the same occurs in the cases of Chile and Uruguay (65%).

In summary, the countries do not have a very different behavior and demonstrate a high number of coincidences in their expansions and recessions; with the exception of Chile and Brazil (where the coincidences seem not to occur).

c. Temporal correlation

Up to now the analysis focuses only on the number of years during which conditions were similar, disregarding the relative size of such fluctuations. This difficulty could be overcome by looking at the temporal correlation of economic fluctuations. The data included in Table 4 give the temporal characteristics of the fluctuations in each country, as well as their correlation with other economies. These figures, in general, confirm the basic measure mentioned before. Although one should recognize the existence of some correlation among the economies, its value is small.

The cyclical fluctuations of Brazil are simultaneously correlated with the fluctuations of the rest of the countries. In fact, the relationship is a positive one with Argentina (0.28), Bolivia (0.25), Paraguay (0.53) and Uruguay (0.21); while the correlation with Chile is negative (-0.20).

Paraguay's cyclical fluctuations are positively related to those of Argentina (0.21), Bolivia (0.49), and Chile (0.30). The business fluctuations of Uruguay are negative correlated with those of Chile (-0.20).

It is also possible to observe what happens when a current fluctuation in one country is compared with the fluctuation in the rest of the countries lagged one period. Although the selected indicator (cross-correlation) gives the chance to see if the fluctuation of one country leads the other country's cycle, the lack of significance of the indicator is an excuse for not giving conclusions in that sense.

While all the economies were contemporaneously correlated with the fluctuation of Brazil, there is no business fluctuation correlated with Brazil's lagged one. This means that even if the economies are influenced by the situation of this country they can recover themselves after a period (a year in this case). Nevertheless, some economies save information about their own experience (Argentina, Paraguay and Uruguay).

Just for explanatory purposes, one could assert that there are some economies in the region that due to the size of their GDP could seldom be affected by the rest. In fact, while Argentina, Brazil or Chile could influence each other, rarely could the situation of Bolivia, Paraguay or Uruguay influence on them.

The cyclical fluctuations of Bolivia seem to be correlated with those of Chile lagged one period (0.32), and with those of Brazil lagged two years (0.21). In the case of Paraguay, its fluctuations are related to the expansions and recessions of Argentina lagged one period (0.23), and to those of Brazil (0.22) and Chile (-0.37) lagged two years. Uruguay's cyclical fluctuations are related to those of Argentina lagged one year (-0.24), and to the ones of Chile lagged two (0.39).

Argentina's business fluctuations are weakly correlated with those of Brazil lagged two periods (0.25), which means that Brazil's influence on that country probably occurred two periods after. There is no other significant correlation among what could be called the "big economies".

Bolivia's fluctuations are influenced by Paraguay's lagged ones (0.23), while the opposite is not true. Uruguay's cyclical fluctuations are correlated with those of Paraguay' lagged one period (-0.24).

Table 4

Temporal Correlations of Cyclical Fluctuations

Countries		Argentina				Bolivia				Brazil				Chile				Paraguay				Uruguay			
	Lags	0	-1	-2	-3	0	-1	-2	-3	0	-1	-2	-3	0	-1	-2	-3	0	-1	-2	-3	0	-1	-2	-3
Argentina	0	1.00	0.46	0.08	-0.15	-0.02	-0.23	-0.02	0.08	0.28	0.01	0.25	-0.02	-0.13	-0.28	-0.31	0.13	0.21	-0.29	-0.23	-0.01	0.08	0.23	0.17	0.00
	-1		1.00	0.46	0.07	0.12	-0.03	-0.24	-0.03	0.14	0.32	0.01	0.25	0.09	-0.14	-0.30	-0.31	0.23	0.24	-0.3	-0.23	-0.24	0.07	0.22	0.15
	-2			1.00	0.49	-0.04	0.10	-0.03	-0.24	0.19	0.17	0.35	0.01	-0.01	0.09	-0.14	-0.32	-0.05	0.25	0.23	-0.3	-0.25	-0.25	0.06	0.21
	-3				1.00	-0.3	-0.09	0.10	-0.06	0.11	0.23	0.13	0.32	-0.01	-0.04	0.04	-0.15	-0.02	0.04	0.26	0.27	-0.21	-0.29	-0.29	0.00
Bolivia	0					1.00	-0.15	0.03	0.34	0.25	0.13	0.21	-0.03	0.02	0.32	-0.44	0.05	0.49	0.23	0.02	-0.23	0.05	-0.06	0.34	-0.02
	-1						1.00	-0.11	0.04	0.34	0.23	0.10	0.17	-0.01	0.02	0.31	-0.44	0.14	0.5	0.23	0.02	0.00	0.05	-0.06	0.33
	-2							1.00	-0.1	-0.12	0.34	0.25	0.13	0.02	0.00	0.02	0.31	0.04	0.15	0.5	0.23	-0.01	0.00	0.05	0.06
	-3								1.00	0.22	-0.12	0.25	0.24	-0.04	0.04	0.02	0.02	0.17	0.06	0.14	0.51	0.02	-0.02	0.00	0.03
Brazil	0									1.00	-0.17	0.43	-0.16	-0.20	0.07	-0.16	-0.23	0.53	0.12	0.09	-0.13	0.21	0.11	0.12	0.21
	-1										1.00	-0.07	0.52	0.03	-0.20	0.07	-0.16	0.00	0.53	0.12	0.09	0.02	0.21	0.11	0.12
	-2											1.00	0.01	-0.39	0.07	-0.20	0.07	0.22	0.01	0.53	0.12	0.10	0.03	0.21	0.11
	-3												1.00	-0.02	-0.33	0.03	-0.20	0.16	0.22	0.00	0.54	-0.23	0.10	0.02	0.2
Chile	0													1.00	0.00	-0.02	0.09	0.30	0.35	-0.28	-0.09	-0.29	-0.08	-0.54	-0.28
	-1														1.00	0.03	-0.05	0.09	0.32	0.35	-0.28	0.10	-0.30	-0.08	-0.56
	-2															1.00	0.01	-0.36	0.12	0.32	0.36	0.39	0.08	-0.31	-0.11
	-3																1.00	-0.13	-0.37	0.12	0.32	0.31	0.40	0.08	-0.32
Paraguay	0																	1.00	0.23	-0.13	-0.12	-0.06	-0.03	-0.15	-0.11
	-1																		1.00	0.25	-0.14	-0.24	-0.04	-0.02	-0.12
	-2																			1.00	0.25	0.02	-0.25	-0.05	-0.03
	-3																				1.00	0.15	0.03	-0.25	-0.04
Uruguay	0																					1.00	0.36	-0.04	-0.31
	-1																						1.00	0.37	-0.10
	-2																							1.00	0.36
	-3																								1.00

2. Monetary Shocks

The VAR was estimated using the Akaike Information Criteria prioritizing the utilization of correlograms for the residuals since they avoid the employment of an unnecessary number of lags. While in most of the cases the estimation and simulation results (by way of "illustration") show the impulse response functions and forecast error variance, they are not going to be exhibited here.[19] The shocks are shown in Graph 2 (see Appendix). In this case, the characteristics of the shocks are concentrated in their correlation and size.

a. Correlation

Table 5 presents the correlation for demand shocks. Argentina and Uruguay are weakly correlated (0.42), and something similar occurs with Argentina and Brazil (0.22). If now Brazil is the reference, its demand disturbances are weakly correlated with those of Bolivia and Paraguay (-0.36 and -0.43 respectively).[20]

Table 5
Correlations of Demand Shocks

Countries	Argentina	Bolivia	Brazil	Chile	Paraguay	Uruguay
Argentina	1.00	-0.28	0.22	0.08	0.01	0.42
Bolivia		1.00	-0.36	0.01	0.11	-0.04
Brazil			1.00	-0.02	-0.43	-0.10
Chile				1.00	0.23	-0.27
Paraguay					1.00	-0.14
Uruguay						1.00

[19] The impulse response functions and forecast error variance are usually computed from vector autoregressive models in order to investigate the interrelationship within the system. However, the authors usually provide no measures of estimation uncertainty. In contrast to common practice in econometric works where t-ratios or standard errors are usually reported, measures for estimation uncertainty are often not supplied. One reason for this "silence" on the estimation precision may be the fact that the relevant asymptotic distributions are not sufficiently easily accessible to applied researcher.

[20] The description only includes the most relevant correlations. In doing so, it considers Argentina and Brazil as reference due to their GDP size.

For the supply disturbances, the figures in Table 6 show that the weak correlation observed in demand shocks between Argentina, Brazil and Uruguay is lost. Nevertheless, it is possible to find a weak one between Argentina and Paraguay (0.22), Brazil and Bolivia (0.21) and Brazil and Paraguay (0.49).

The immediate conclusion is that while Argentina, Brazil and Uruguay have their demand disturbances correlated (although this correlation is a weak one), the supply shocks show a different situation, and make Brazil look close to Paraguay and Bolivia.

Table 6
Correlations of Supply Shocks

Countries	Argentina	Bolivia	Brazil	Chile	Paraguay	Uruguay
Argentina	1.00	-0.16	0.06	-0.31	0.22	0.03
Bolivia		1.00	0.21	0.30	0.31	-0.05
Brazil			1.00	-0.42	0.49	0.15
Chile				1.00	-0.05	-0.59
Paraguay					1.00	-0.08
Uruguay						1.00

b. Size

The methodology employed makes it possible to observe the size of demand and supply shocks. The wider the supply shocks, the bigger the usefulness of monetary policy. In other words, there will be extraordinary difficulties to fix the exchange rates if supply shocks do not have the same size in all the economies.

Table 7
Standard Deviation of Shocks

Country	Demand Schock	Supply Shock
Argentina	1.872	0.057
Bolivia	2.561	0.024
Brazil	3.172	0.063
Chile	0.774	0.050
Paraguay	0.118	0.037
Uruguay	0.146	0.069

Note: The variables are measured in logarithms, so that 0.057 is 5.7%

In the case of demand disturbances, their interpretation is rather different. In fact, Bayoumi and Einchengreen (1992b) suggest that the different size of the demand disturbances through the different regions of the United States are such due to the higher specialization of each region. In other words, if the region is diversified in its production the demand shocks should be small. But in the cases of the economies under analysis, the size of monetary shocks seems to be more related with stabilization's plans. Since these plans were exchange rate based ones, the size of demand disturbances tends to confirm the importance of exchange rates as a mechanism of adjustment.

The size of demand and supply shocks was computed using the estimated residual correlation matrix from the VAR, but not using the variance covariance one. In fact, the normal procedure implies an identity variance covariance matrix due to the assumption of variance equal to unity and orthogonality of the shocks. The transformation suggested only changes the scale factor.[21]

Table 8 shows the standard deviation of the shocks. The standard deviation of Argentina's supply disturbance is 0.055 (5.7%). The size of the supply shocks in Brazil is 0.063 (6.3%), and in Uruguay 0.069 (6.9%). In the case of demand shocks, those of Argentina, Brazil and Bolivia were the biggest ones.

In summary, supply and demand shocks are different among the economies. Besides, they seem to be bigger than those of European countries. In fact, while in the European core countries (Germany, France, Belgium, and Denmark) the size of supply shocks is between 1-2%, this is not the case here.[22] Moreover, the size of the supply shocks is bigger than those of the European periphery (United Kingdom, Italy, Spain, Portugal and Greece) where the size is between 2-4%. The demand disturbances are also different suggesting that monetary policy should be different.

[21] See the modification of the VAR decomposition discussed in footnote 10 of Bayoumi and Eichengreen (1992a;p. 6).

[22] Notice that some methodological differences may exists. For further details about Europe and the United States, see Bayoumi and Einchengreen (1992b).

IV. Concluding comments

An interesting exercise was to assume that the group of countries under analysis did not have a strong economic linkage. This was, of course, the period previous to the integration, and it could be identified as "the initial situation", opposite to the time when the integration process was taking place. This kind of partition may be applied to the countries now joining MERCOSUR where the *Tratado de Asunción* (1991) should be taken as the boundary between the two periods, marking the performance of the economy in the past and its likely behavior in the future. However, the results of the integration took time to emerge, and their first evidence may have occurred in the middle 1990s. Therefore, it seems more appropriate to take this latter time as a dividing point, and thus, the usefulness of considering the analysis up to 1997.

To determine the feasibility of policy harmonization before the countries had started the integration process (that is what was called the initial situation), the analysis focused on the behavior of the economies which is well summarized in the GDP fluctuations.

The macroeconomic fluctuations of Argentina, Bolivia, Brazil, Chile, Paraguay and Uruguay were variable and not time uniform during the last quarter of the century. As a consequence, the possibility of homogeneous policies in the future is difficult to predict.

Although there is a high discretion in separating the fluctuations from the GDP growth trend, the growth rate of these economies was different. The duration of expansions and recessions were variable, and the persistence was small.

While the simultaneity of expansions and recessions showed a great number of coincidences, with the exception of Brazil and Chile, the size of their association is small. Nevertheless, Brazil is positively correlated with all the economies (with the exception of that of Chile). Paraguay is also positively correlated with all. Argentina is not correlated with Bolivia, nor is it with Chile. When lagged fluctuations are analyzed, there is no relation with Brazil's past ones.

As a result, the arrhythmical beating among these countries reveals that in the future policy harmonization will not be easy. Similar policies could work in expansions and contractions, but their strength should be different: very high in one country, very small in the other. This is probably why the alignment of economic policies up to the moment is mainly due to the abandonment of inflationary finance.

When analyzing the underlying mechanism to the cyclical fluctuations, Argentina, Brazil and Uruguay have their demand disturbances (weakly) correlated, while the supply ones make Brazil closer to Paraguay and Bolivia. The supply disturbances of Chile are also weak, but negatively correlated with those of Argentina and Brazil.

In spite of the fact that there are three countries (Argentina, Brazil and Uruguay) that have their supply disturbances similar in size, these shocks are not correlated. Only the supply disturbances that show some correlation are those of Bolivia and Paraguay, but the size of these shocks is different.

For the demand disturbances, Argentina, Brazil and Uruguay have correlated ones, but their size is not equal. This simply means that their monetary policy is distant.

A well understood rule is that if the shocks are different the institutional agreement and the policies that may be accorded tend to exacerbate fluctuations since the governments should relinquish their tools for stabilizing their economies. Following this rule, the shocks underlying these economies were different. As a consequence, there is no economic reason for a monetary union. Nevertheless, and just to finish the paper with a small degree of optimism, one could inquiry oneself as Wyplosz (1997) did: Would the United States have passed the currency test area a century ago? And had it failed, all things considered, was a mistake for the country to adopt a single currency?

References

Agénor, Pierre-Richard, C. John McDermott and Eswar Prasad (1998). "Macroeconomic Fluctutations in Developing Countries. Some Stylized Facts", EDI *Working Papers*.

Arnaudo, Aldo A. and Alejandro D. Jacobo (1998). "Policy Harmonization in MERCOSUR", *Economia Aplicada*, **2** (4): 757-766.

Arnaudo, Aldo A. and Alejandro D. Jacobo (1997). "Macroeconomic Homogeneity within MERCOSUR: An Overview", *Estudios Económicos*, **12** (1): 37-51.

Bayoumi, Tamim and Barry Eichengreen (1992a). "Is There a Conflict Between EC Enlargement and European Monetary Unification?, NBER Working Paper Series, *Working Paper* Nro. 3950.

Bayoumi, Tamim and Barry Eichengreen (1992b). "Shocking Aspects of European Monetary Unification", NBER Working Paper Series, *Working Paper* Nro. 3949.

Belaisch, Agnès and Claudio Soto (1998). "Empirical Regularities of the Chilean Business Cycle", *Banco Central de Chile*, draft.

Beveridge, S. and Charles Nelson (1981). "A New Approach to Descomposition of Economics Time Series into Permanent and Transitory Components with Particular Attention to Measurement of the 'Business Cycle'", *Journal of Monetary Economics*, **7** (2): 151-174.

Blanchard, Oliver J.and Danny Quah (1989). "The Dynamic Effects of Aggregate Demand and Supply Disturbances", *American Economic Review*, **79** (4): 655-673.

Burns, Arthur F. and Wesley C. Mitchell (1946). Measuring Business Cycles, National Bureau of Economic Research.

Carrera, Jorge, Mariano Féliz and Demián Panigo (1999). "Una medición de los canales de transmisión de las fluctuaciones económicas. El caso de Argentina y los Estados Unidos", 34 Annual Meeting, Asociación Argentina de Economía Política, draft.

Christodoulakis, Nicos, Sophia P. Dimelis and Tryphon Kollintzas (1995). "Comparisons of Business Cycles in the EC: Idiosyncrasies and Regularities", *Economica*, **62** (245): 1-27.

Eichengreen, Barry (1993). "European Monetary Unification", *Journal of Economic Literature*, **31** (3): 1321-1357.

Enders, Walter (1995). Applied Econometric Times Series, John Wiley & Sons Inc., New York.

Fackler, James S. and W. Douglas McMillin (1998). "Historical Descomposition of Aggregate Demand and Supply Shocks in a Small Macro Model", *Southern Economic Journal*, **64**(3): 648-664.

Fiorito, Riccardo and Tryphon Kollintzas (1994). "Stylized Facts of Business Cycles in the G7 from a Real Business Cycle Perspective", *European Economic Review*, 38 (2): 235-269.

Fondo Monetario Internacional (1997). "Zonas monetarias óptimas: un desafío de políticas", *Boletín*, **26** (1): 14-16.

Funke, Michael (1997b). "The Nature of Shocks in Europe and in Germany", *Economica*, **64** (255): 461-469

Galí, Jordi (1992). "How Well Does the IS-LM Model Fit Postwar U.S. Data?", *Quarterly Journal of Economics*, **107** (2): 709-738.

International Monetary Fund. *International Financial Statistics*, various issues.

King, Robert G., Charles I. Plosser, James S. Stock and Mark Watson (1991). "Stochastic Trends and Economic Fluctuations", *American Economic Review*, **81** (4): 819-840.

Kydland, Finn E. and Edward C. Prescott (1990). "Business Cycles: Real Facts and Monetary Myth", Federal Bank of Minneapolis *Quarterly Review*, Spring.

Larrain, Felipe (1981). "El uso de las series de tiempo con fines predictivos", *Trabajo Docente Nro. 33*, Instituto de Economía, Pontificia Universidad Católica de Chile.

Lucas, R. (Jr.) (1977). "Understanding Business Cycles", en K. Brunner y A. Meltzer (Ed.), Stabilization of Domestic and International Economy, Carnegie-Rochester Conferences Series on Public Policy, Vol. 5, North-Holland.

Martirena-Mantel, Ana M. (1997). "Reflexiones sobre Uniones Monetarias: pensando el MERCOSUR desde el Caso Europeo", Academia Nacional de Ciencias Económicas.

Mena, Hugo (1995). "Pushing the Sisyphean Boulder? Macroeconometric Testing in Latin American Countries", *Review of Income and Wealth*, **10** (1): 81-99.

Mundell, Robert (1961). "A Theory of Optimum Currency Areas", *American Economic Review*, **51** (4): 657-665.

Naciones Unidas- Comisión Económica para América Latina y El Caribe. *Anuario Estadístico de América Latina y El Caribe*, various issues.

Naciones Unidas- Comisión Económica para América Latina y El Caribe. *Estudio Económico de América Latina*, various issues.

Nelson, Charles and Charles Plosser (1982). "Trends and Random Walks in Macroeconomic Time Series", *Journal of Monetary Economics*, **10** (2): 139-162.

Nelson Charles (1973). Applied Times Series Analysis for Managerial Forecasting, Holden- Day Inc.

Ramanathan, Ramu (1992). Introductory Econometric with Applications, Harcourt Brace Jovanovich Inc.

Shapiro, Matthew D. and Mark W. Watson (1988). "Sources of Business Cycle Fluctuations", NBER *Macroeconomic Annual*: 112-148.

Sterne, Gabriel and Tamim Bayoumi (1995). "Temporary Cycles or Volatile Trends? Economic Fluctuations in 21 OECD Economies", *The Manchester School*, 63 (1): 23-51.

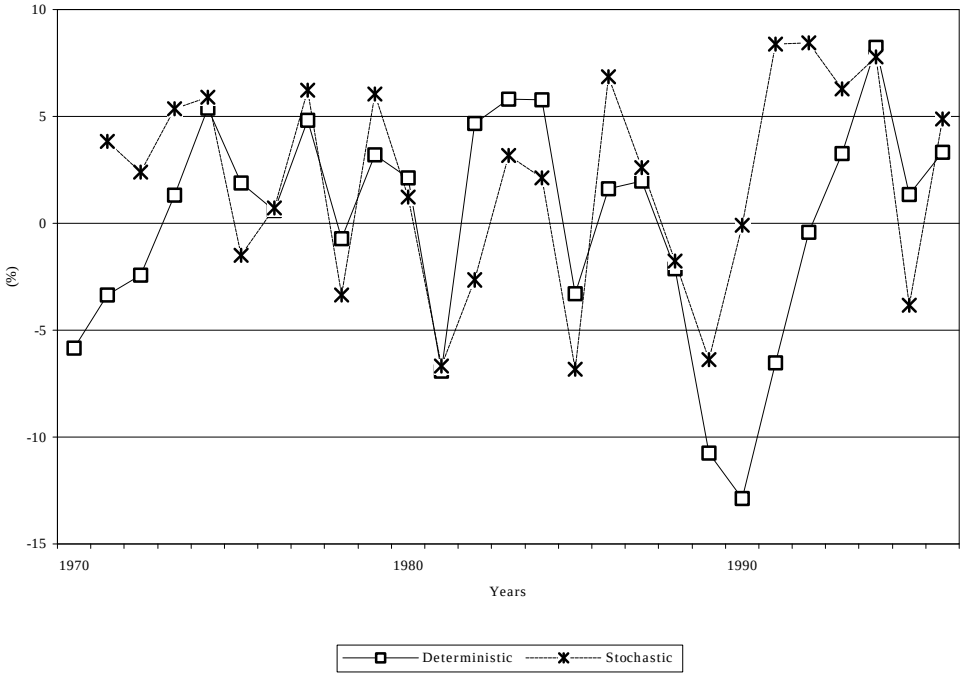
van Els, Peter J. (1995). "Real Business Cycle Models and Money: A Survey of Theories and Stilized Facts", *Welwirtschaflitches Archiv*, 131 (2): 234-264.

Vandaele, Walter (1983). Applied Times and Box-Jenkins Models, Academic Press, New York.

Wyplosz, Charles (1997). "EMU: Why and How it Might Happen", *Journal of Economic Perspectives*, **11** (4): 3-22.

Appendix 1
Graph 1

GDP Fluctuations
(Argentina)



GDP Fluctuations
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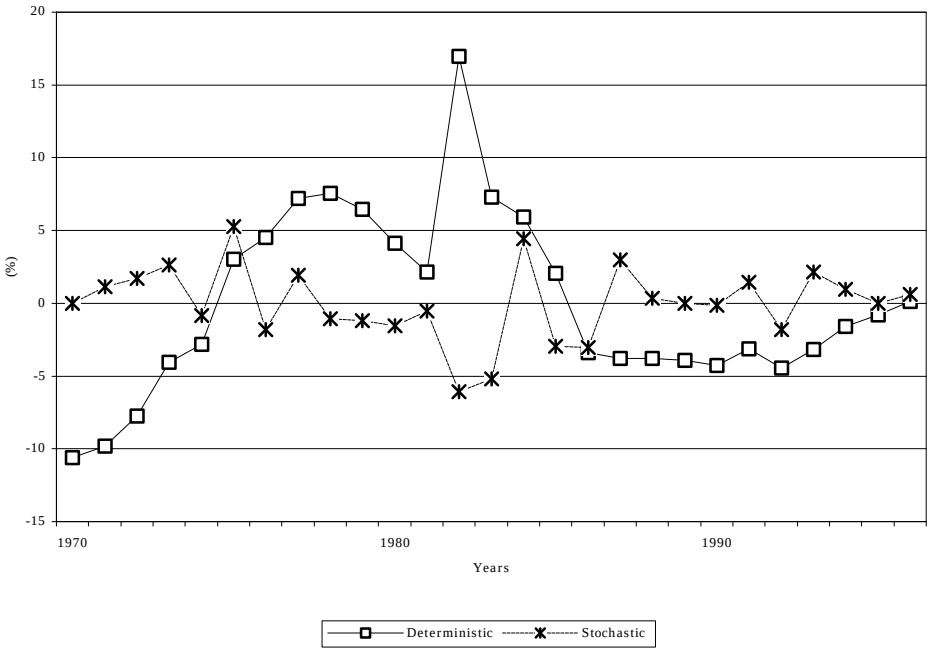

GDP Fluctuations
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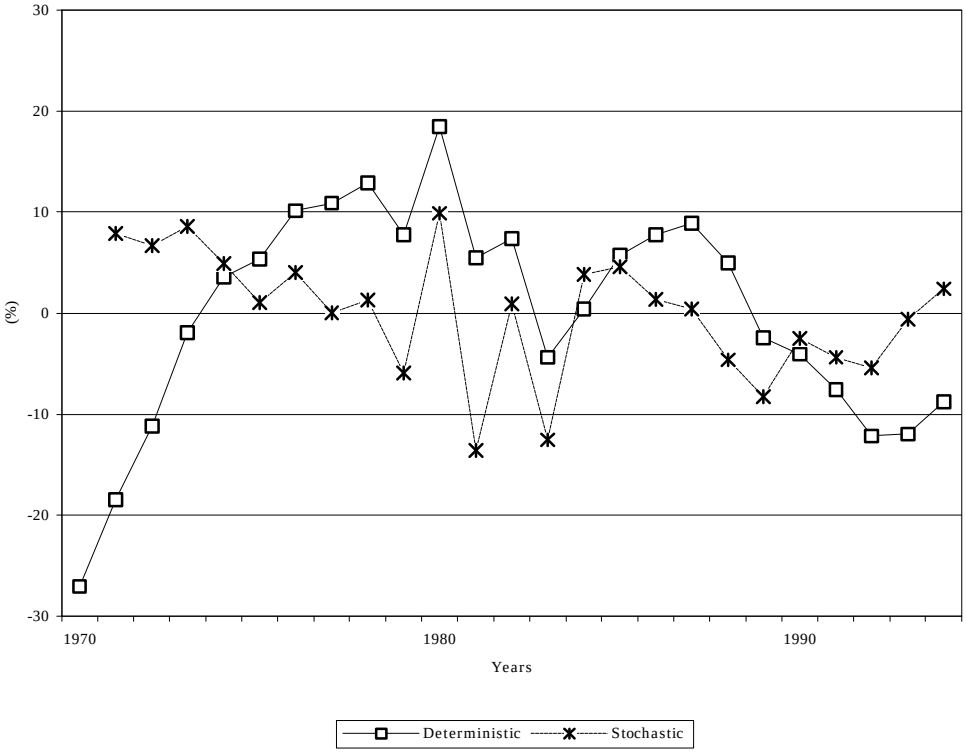

GDP Fluctuations
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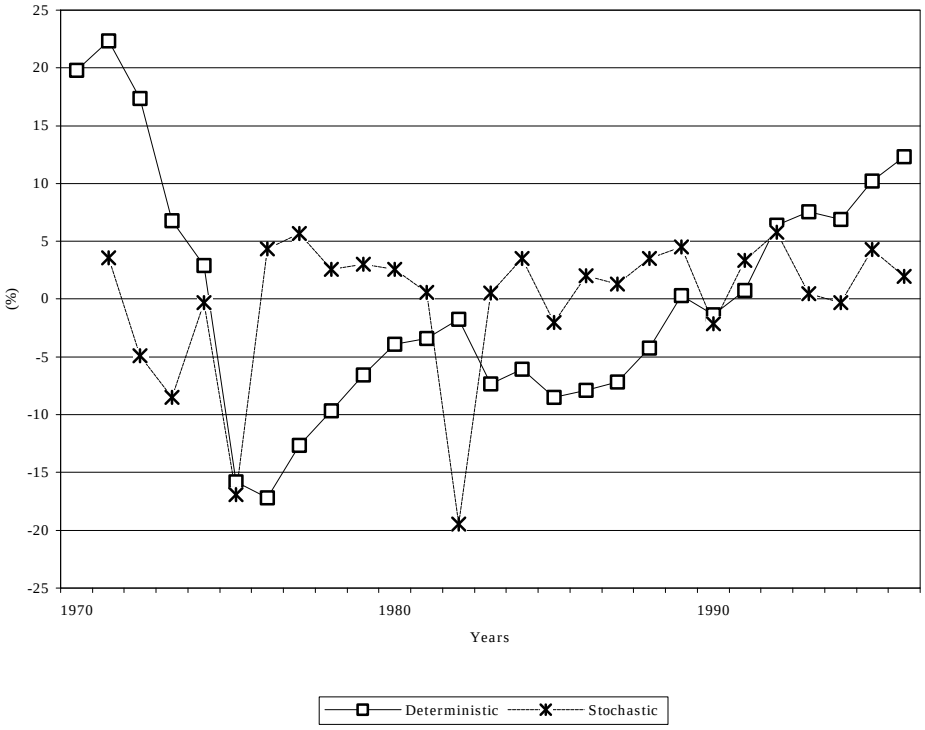

GDP Fluctuations
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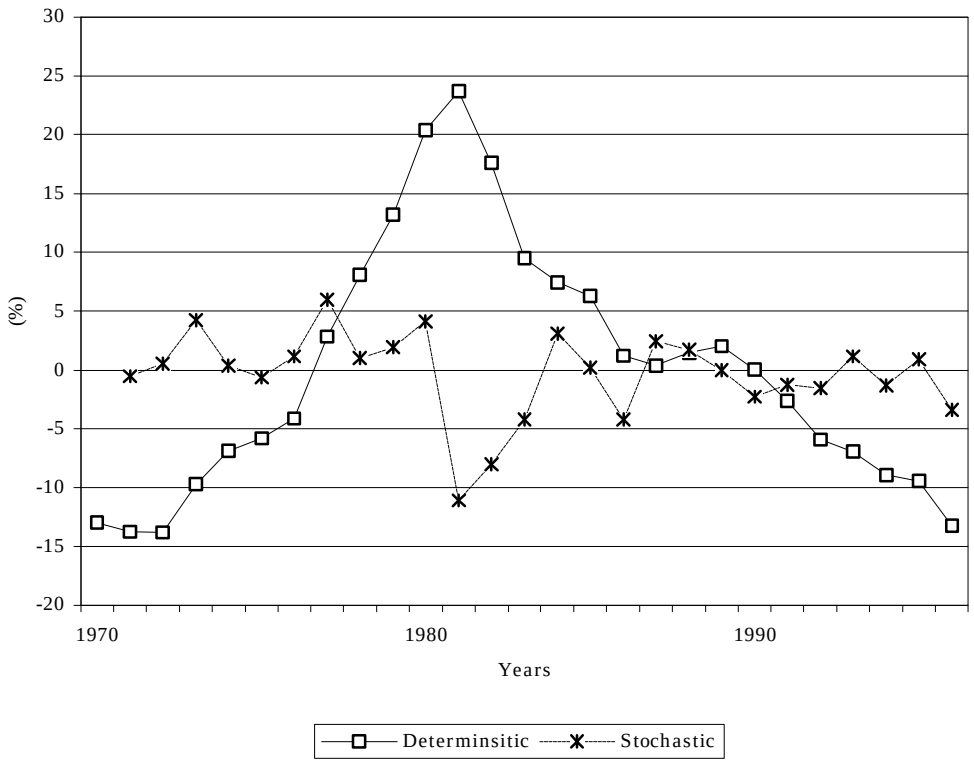

GDP Fluctuations
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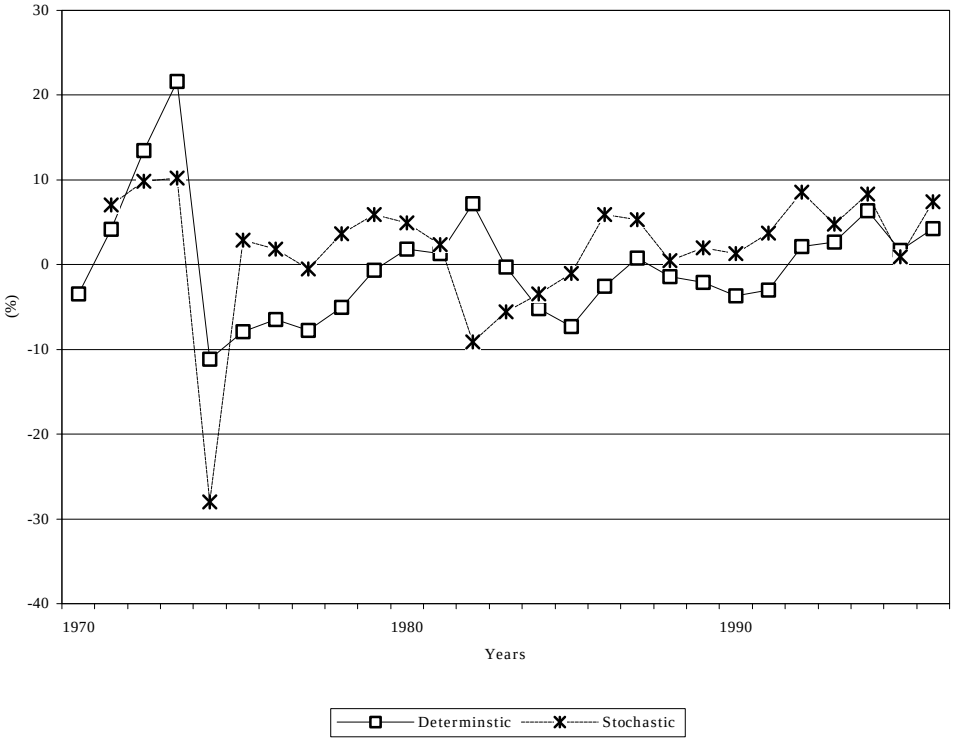
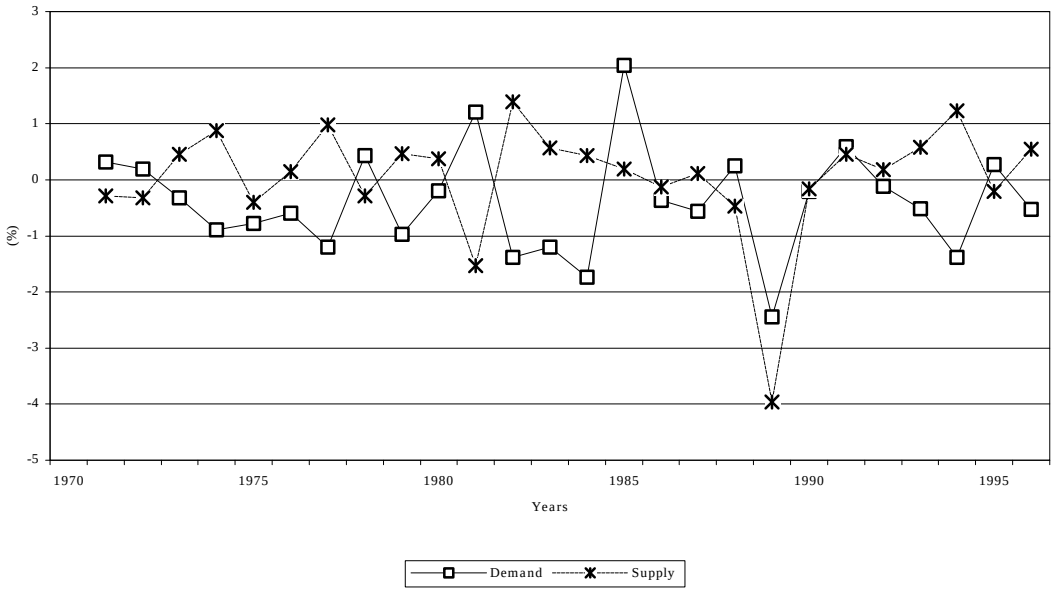
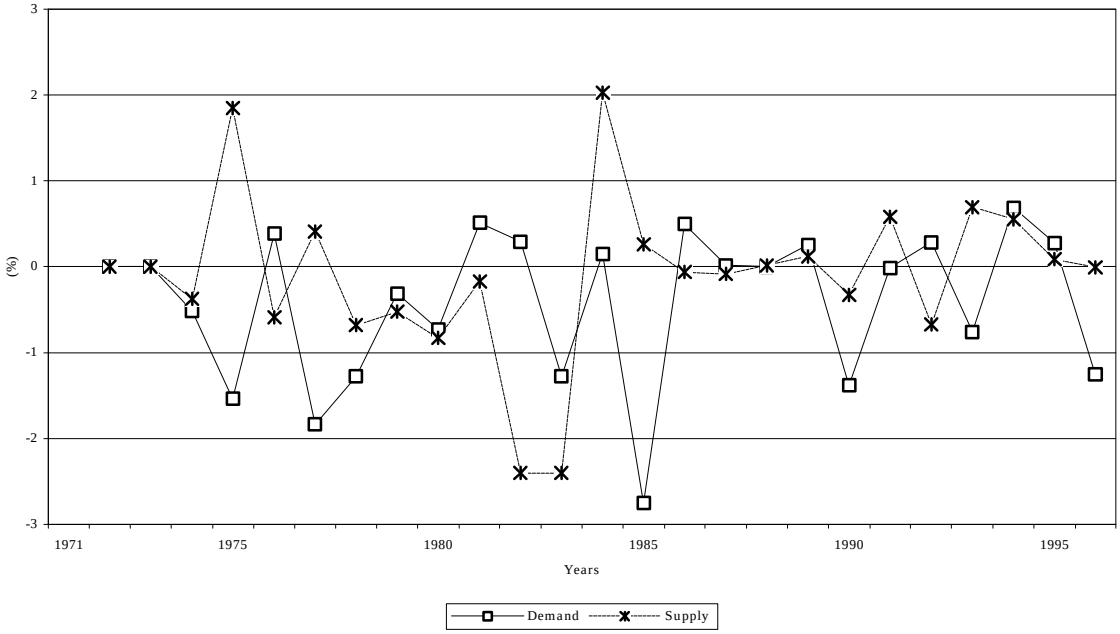


Appendix
Graph 2

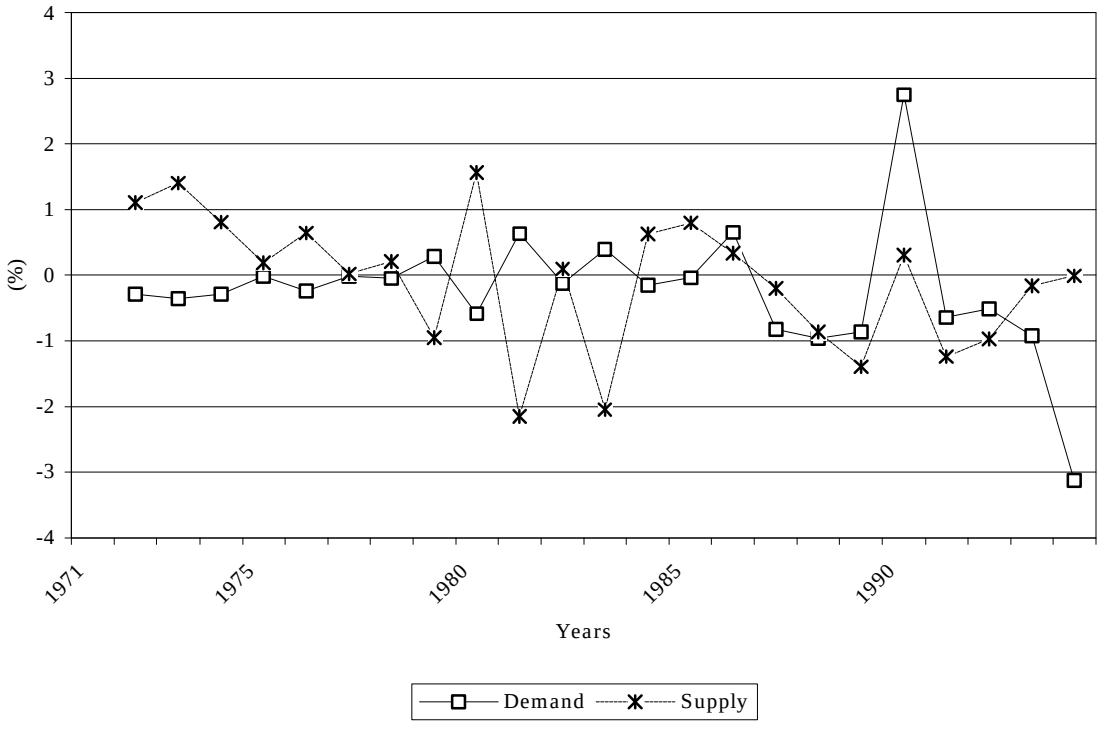
Demand and Supply Shocks
(Argentina)



Demand and Supply Shocks
(Bolivia)



Demand and Supply Shocks
(Brazil)



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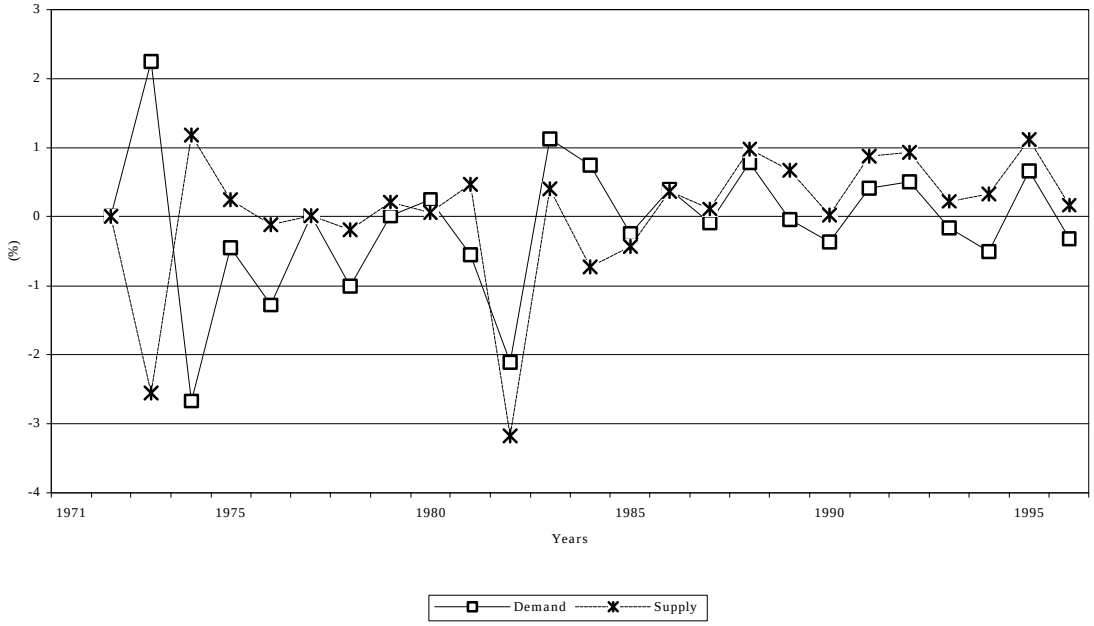
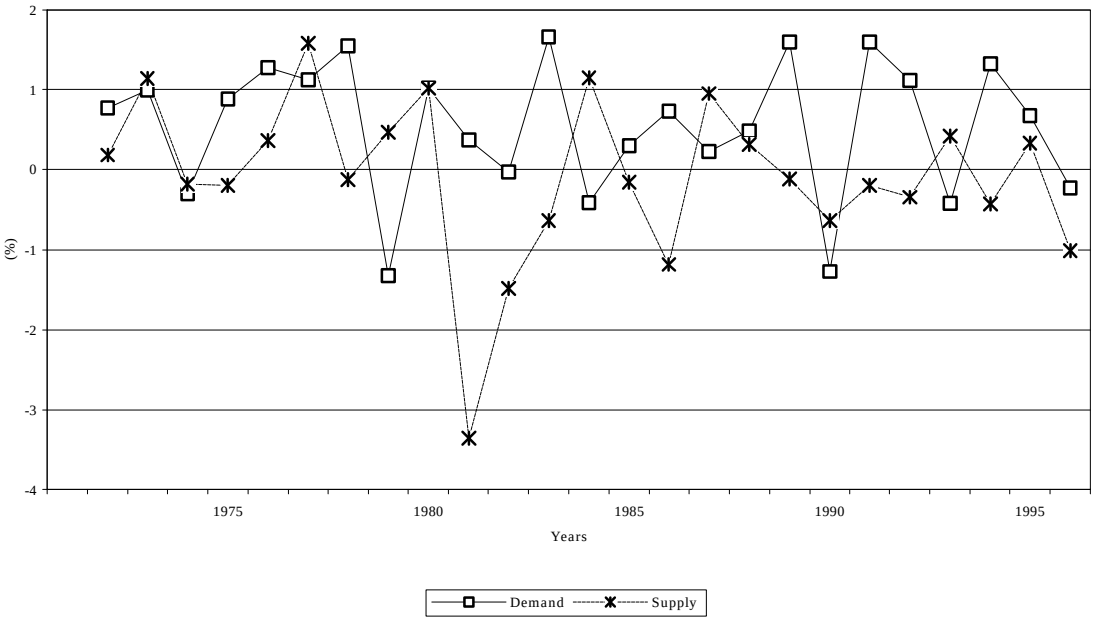


Demand and Supply Shocks
(Paraguay)



Demand and Supply Shocks
(Uruguay)