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Business Cycle Fluctuations in a Small Open Economy: The Case of Uruguay

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RESUMEN

En este trabajo se realiza una descripción del ciclo macroeconómico de la economía uruguaya entre 1975 y 1994. La metodología de estimación de los componentes cíclicos se basa en la aplicación del filtro de Hodrick-Prescott sobre los componentes de tendencia-ciclo estimados a partir de modelos univariantes de forma reducida. La metodología utilizada para estimar componentes cíclicos ofrece dos ventajas sobre los procedimientos generalmente encontrados en la literatura Primero, el componente cíclico es extraído de series temporales que han sido previamente ajustadas estacionalmente utilizando un método que explícitamente toma en cuenta las características específicas del proceso generador de datos. Segundo, dado que los componentes irregulares son excluídos de la estimación de los componentes cíclicos finales, las correlaciones consideradas en la caracterización del ciclo económico no están afectadas por oscilaciones no sistemáticas (ruido) en los datos. El patrón observado en los comovimientos cíclicos de los componentes de la oferta y demanda agregada y los niveles de variabilidad relativa de los mismos coinciden, en general, con lo observado a nivel internacional La procicliclidad y baja volatilidad del gasto público, el rezago cíclico de las fluctuaciones de los agregados monetarios y la contraciclicidad de las tasas de interés, aparecen como características específicas de la economía uruguaya. Las exportaciones, las tasas de interés reales *ex-ante* en moneda nacional y los PBI de Argentina y Brasil se comportan como indicadores adelantados del ciclo de referencia de la economía uruguaya.

ABSTRACT

This paper provides an empirical description of the business cycle regularities of the Uruguayan economy between 1975 and 1994. The method of estimation of the cyclical components is based on the application of the Hodrick-Prescott filter over the unobservable trend-cycle components estimated from reduced-form univariate models The method used to derive cyclical components offers two advantages over the procedures usually used in the literature. First, the cyclical component is extracted from time series that have been previously seasonally-adjusted using a method which explicitly takes into account the specific characteristics of the estimated data generating process. Second, given that irregular components are excluded from the estimation of the final cyclical components, correlations considered in the characterization of the business cycle are not affected by non-systematic oscillations (noise) in the series. The pattern observed in the cyclical comovements of the aggregate supply and demand components as well as their levels of relative variability are similar, in general, to those observed in other economies. However, some characteristics seem to be specific to the Uruguayan economy : procyclical and low-volatility public sector expenditure, cyclical lag of monetary aggregate fluctuations and countercyclical interest rates. Exports, *ex-ante* real interest rates in local currency and the GDP of neighbour countries Argentina and Brazil behave as leading indicators of the reference cycle of the Uruguayan economy

Key words: cyclical fluctuations, Hodrick-Prescott filter, leading indicators, reference cycle, signal extraction, unobserved components, volatility

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1. Introduction

This paper analyzes the main stylized features of the cyclical fluctuations of the Uruguayan economy between 1975 and 1994. More specifically, it aims to: *a)* describe the main features of trend evolution and cyclical fluctuations of GDP in the period, *b)* estimate trend and cyclical components for a broad range of quarterly macroeconomic time series of the Uruguayan economy, *c)* carry out a description of the Uruguayan macroeconomic cycle, indentifying the empirical regularities observed in real and nominal macroeconomic magnitudes, and *d)* compare cyclical fluctuations of the Uruguayan economy with those observed in other countries

Summarizing business cycle regularities in macroeconomic time series is important for various reasons. First, it provides a synthetic vision of the complex relationships existing among macroeconomic aggregates. In this respect, the analysis of cyclical fluctuations requires the estimation of transitory and permanent components. As a result, a description of interrelations among the different variables is obtained, yielding information on the long-term evolution and the transmission mechanisms underlying the short-run dynamics of the economy. In particular, it illustrates the existence of leading indicators of economic activity. Second, it allows an approximate estimate of the magnitude of fluctuations in the different macroeconomic variables. Finally, it provides an empirical basis against which to test the validity of alternative theoretical models.

The systematic study of business cycles has its origins in the work of Burns and Mitchell (1946). The authors used an empirical approach that had a fundamentally descriptive purpose. Based on the study of isolated episodes, correlations between the evolutions of the different variables were analyzed, in order to determine leads and lags among them Lucas (1977) defines the general macroeconomic cycle as the recurrent and serially correlated movements in the GDP which happen around its smooth long-term trend. Likewise, he defines the empirical regularities of the economic cycle as the common movements observed among cyclical components of the different aggregate macroeconomic time series. The tendency of many macroeconomic variables to move together in a predictable way along the cycle is known as comovement.

The theory of Real Business Cycles (RBC) appeared at the beginning of the 80's and rapidly became the dominant paradigm when modelling the business cycle (Kydland and Prescott,

1982, and Long and Plosser, 1983). According to this line of thought, technological shocks are the fundamental cause of economic fluctuations The work of Kydland and Prescott (1982) was the first to demonstrate that a RBC model was capable of generating time series with properties that resembled those of the economy of the United States in the second postwar period. Backus and Kehoe (1992). among others, extended the RBC framework to an open economy context.

A substantial body of literature has documented a wide range of empirical regularities in macroeconomic fluctuations. Among others· Kydland and Prescott (1990), Dolado, Sebastián and Valles (1993), Danthine and Girardin (1993), Fiorito and Kollintzas (1994); Backus, Kehoe and Kydland (1995) and Stock and Watson (1997). Nevertheless, nearly all the research has concentrated on industrial countries Only recently attention has been focussed to developing countries (Agenor, *et al.*, 1997 and Kydland and Zarazaga, 1997)

The rest of the paper is organized as follows Section two describes the methodology used to estimate cyclical components for quarterly macroeconomic time series. Section three comments on the fundamental findings of the research and offers a complete description of the business cycle regularities of the Uruguayan economy. The final section provides concluding remarks which relate the international empirical evidence with the one corresponding to the Uruguayan economy and highlights some specific features of the Uruguayan business cycle

2. Methodological Aspects

To describe the empirical regularities which characterize the cyclical fluctuations of an economy, it is necessary to define a method of estimation of trend and cyclical components (unobserved) in the different macroeconomic series. When designing a method to analyze the business cycle it should be taken into account that the distinction between trend and cyclical components is controversial, both from the point of view of the economic theory and the strictly statistical perspective. On the one hand, the modern theory of the dynamic general equilibrium casts doubt on the pertinence of such distinction, based on the fact that growth and business cycles are determined fundamentally by the same factors. On the other hand, from a statistical point of view, there is no consensus about the definition of what is understood by trends and cycles. Basically, there is a fundamental disagreement concerning the statistical properties of trend

components of macroeconomic time series and their relationship with the estimation of cyclical components. Likewise, the use of different detrending methods could give rise, and actually does. to different quantifications of short-run macroeconomic fluctuations (Canova,1993).

In the past, detrending of economic time series was carried out in a very simple way. The trend was represented by a time polynomial, which was assumed to be independent of the cyclical component, and was estimated through simple regression methods. An unsatisfactory implication of this approximation is that the long-run evolution of the time series is of a deterministic nature and therefore perfectly predictable. This vision is the basis of the standard explanation of the business cycle: the natural level of output grows at an approximately constant rate, whereas fluctuations in the product are temporary deviations from their path of long-run trend growth.

This traditional approach to estimate unobserved components in macroeconomic time series has been questioned by several studies since the beginning of the 1980's Undoubtedly, the work of Nelson and Plosser (1982) had a devastating effect on the conventional vision of the business cycle. The authors found that the majority of the macroeconomic annual time series in the American economy, corresponding to periods from 60 to 120 years, could be represented by low-order ARMA univariate models, where, in general, the hypothesis of existence of a positive unit root in the autoregressive polynomials could not be rejected. The existence of a unit root implies that economic time series admits a random walk - or the random walk with drift - representation. This kind of stochastic processes is characterized by the fact that non-anticipated shocks alter the long-term projection of the series. The random walks processes are also known as processes with stochastic trends because although they exhibit growth, they do not evolve around any deterministic path

2.1 Signal Extraction in Time Series

The problem of estimation of unobserved components in time series has been extensively analyzed by the literature on signal extraction Traditionally, signal extraction in time series (Z_t) is carried out over four types of unobserved components. *i)* trend (T_t) which represents the underlying evolution of the series, *ii)* seasonal (S_t) which condenses quasi-regular systematic oscillations of the series within the year; *iii)* cycle (C_t) which agglomerates systematic trend deviations which are not

seasonal; *iv)* irregular (I_t) or residual noise. Therefore, the original time series can be additively decomposed as [1]:

$$Z_t = T_t + S_t + C_t + I_t \qquad (1)$$

Different methods have been proposed in the last years to estimate unobserved components. Among the univariate ones, the literature usually distinguishes between empirical methods and those based on statistical models Empirical methods carry out the decomposition based on lineal filters whose structure and parameters do not depend on the nature of the data but have fixed values. The most representative empirical procedures in economics are the X-11 method or its subsequent extension X-11 ARIMA, the method of exponential smoothing and especially, the Hodrick-Prescott filter.

Methods based on models explicitly propose an univariate representation for each of the components from which the signal extraction is implemented These procedures take into account the individual characteristics of each time series and have a growing literature which provides them with theoretical support From the very beginning, the approach of these methods is more trustworthy and satisfactory than the empirical one, and there is a growing trend towards its use. Among the several available procedures, we find the methods based on reduced-form models (Maravall, 1994). These define the structure of the filter based on the specific univariate model estimated for the time series.

2.2 Methodologies for the Estimation of Cyclical Components

The procedure followed in this paper to estimate the cyclical components of quarterly macroeconomic time series for the Uruguayan economy has three stages. The first stage specifies and estimates an univariate ARIMA model for each of the time series analyzed [2]. The second stage uses a signal extraction procedure based on univariate models of reduced form to estimate a

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1 If the decomposition of the time series was multiplicative, we would reach an expression analogous to equation (1) by simply taking logarithms

2 The estimation results of ARIMA models for the different macroeconomic time series are available from the authors upon request.

specific trend-cycle component for each time series The third and final step applies the Hodrick-Prescott filter to the trend-cycle estimates obtaining the final cyclical components.

a) Specification of Seasonally Multiplicative ARIMA Models

This paper analyzes time series corresponding to the period between the first quarter of 1975 and the fourth quarter of 1994 The Methodological Appendix briefly describes the data used in this paper The univariate modelling has been carried out over a logarithmic transformation of the original data, except in the case of variables defined as percentages or ratios. The TRAMO program (**T**ime Series **R**egression with **A**rima Noise, **M**issing Observations and **O**utliers) developed by Gómez and Maravall (1995) was used for the specification of univariate models. This program automatically carries out the identification, estimation and validation of seasonally, multiplicative ARIMA models. Also, TRAMO proceeds to detect and correct for different types of outliers through the application of the intervention analysis. The procedure of identification and automatic correction of these type of outliers is an improved version of the one put forward by Chen and Liu (1993).

b) Signal Extraction in ARIMA Models

The signal extraction method based on ARIMA models enables to extract unobserved components of a time series based on the specific characteristics of its univariate model. The SEATS program (**S**ignal **E**xtraction in **A**RIMA **T**ime **S**eries), developed by Maravall and Gómez (1994), implements this methodology in an efficient way.

Given the automatic modelization provided by TRAMO, we obtain an ARIMA model for each time series.

$$\Phi(L)\, Z_t = \mu + \theta(L)\varepsilon_t \qquad (2)$$

where $\Phi(L)$ represents the autorregresive polynomial that includes all autorregressive roots and μ is a constant. SEATS descomposes the series such that

$$Z_t = \sum_{i=1}^{4} Z_{it} \qquad (3)$$

where Z_{it} represents an unobserved component. The decomposition assumes that each of the components admits an ARIMA representation of the form

$$\Phi_i(L)Z_{it} = \mu + \theta_i(L)\varepsilon_{it} \qquad (4)$$

where $\Phi_i(L)$ and $\theta_i(L)$ are finite polynomials in the lag operator, L, of order p_i and q_i, respectively, which can contain unit roots, and the ε_{it} are independent white noise processes with variance σ^2_i. Furthermore, unobservable components are orthogonals, so that the polynomials Φ_i and Φ_j, $i \neq j$ have no common roots

Consistency between the aggregate univariate model and the model for the components implies that:

$$\Phi(L) = \prod_{i=1}^{4} \Phi_i(L) \qquad (5)$$

and

$$\theta(L)\varepsilon_t = \sum_{i=1}^{4} \theta_i(L)\Phi_{ni}(L)\ \varepsilon_{it} \qquad (6)$$

where $\Phi_{ni}(L)$ is the product of all the autorregresive polynomials of the components except $\Phi_i(L)$.

The decomposition of the original time series in its different components is based on the roots of the autoregressive part of the ARIMA model estimated for each time series The additional assumption that there are no common roots between the autorregresive polynomials of the different components allows a simple factorization of $\Phi(L)$ that generates directly the polynomials $\Phi_i(L)$. In the empirical application carried out in this paper, the autoregressive roots are attributed to the different components as follows:

Trend unit roots corresponding to the zero frequency, directly associated to the long-run evolution of the time series, and the real stationary autoregressive roots of positive sign and modulus greater than 0.5.

Seasonal: autoregressive roots located in the neighbourhood of seasonal frequencies.

Cyclical: the regular structure of the ARIMA model which cannot be included in the two previous components.

Irregular· white noise residual.

The estimation of unobserved components through this method is subject to an identification problem (Maravall 1994). To identify components in a unique way we refer to the so called canonical property which implies the impossibility to extract any additive white noise from a component which is not the irregular one. This is the same as imposing the restriction that the irregular component absorbs the maximum variability (i.e, the maximum variance). so that the rest of the components are as stable as possible, being compatible with the stochastic nature of the model considered in equation (2).

c) Estimation of Final Cyclical Components

Since we have used SEATS's default options to estimate the trend component, the resulting time series for this component cannot be considered as an approximation to the long-run evolution of the original series, but it should be interpreted as a trend-cycle component, TC_t, where fluctuations clearly related with the business cycle are included.[3] The estimation of the final cyclical components corresponding to each of the Uruguayan macroeconomic time series is obtained by adding up the cyclical component estimated by SEATS (if there is one) and an estimation of the cycle obtained through the application of the Hodrick-Prescott filter (HP) to TC_t.

The estimates of the final cyclical components considered in this section offer two advantages over the ones usually obtained in the empirical literature on this subject. On the one hand, we proceed to extract cyclical components from time series that has been previously seasonally adjusted using a method which explicitly considers the specific characteristics of the data generating process of the variable in question. This implies a more adequate estimation of the seasonal component On the other hand, given that irregular components are excluded from the estimation of the final cyclical components, correlations considered in the characterization of the business cycle are not affected by non-systematic oscillations (noises) of the time series.

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[3] The SEATS options used in this paper imply that the impulses variables introduced by TRAMO are assigned to the irregular component, while step and transitory level variables are assigned to the trend component (trend-cycle).

The HP filter allows to decompose the TC_t time series in a trend component T_t, and a cyclical component C_t. The trend component estimated by means of the HP filter is stochastic in nature, moves continously and smoothly along time and it is uncorrelated with the cyclical component. The smooth trend is imposed by assuming that the total sum of the squared second differences of T_t is small. Formally, the T_t estimation can be obtained by minimizing the following loss function:

$$\min_{T_1, \ldots, T_N} \sum_{t=1}^{N} (C_t)^2 + \lambda \sum_{t=2}^{N-1} [(T_t - T_{t-1}) - (T_{t-1} - T_{t-2})]^2 \qquad (7)$$

subject to

$C_t = TC_t - T_t$

The first term of the minimization is the sum of the squares of the cyclical deviations and can be considered as a measure of "goodness of fit" of T_t to TC_t. The second term indicates the degree of smoothness of T_t. The Lagrange multiplier is a positive number that controls the smoothness of the trend component. As λ increases, penalization imposed on the fluctuations in the trend component also increases and the T_t path becomes smoother. Obviously, the smoother T_t, the worse the adjustment to TC_t, and this is the trade off underlying the minimization problem. The estimate of the cyclical component is obtained as $C_t = TC_t - T_t$ and this is the time series used to characterize cyclical fluctuations of the variable.

The usual practice when working with quarterly series is to set the λ parameter equal to 1600, which is the one used in this paper. The value of 1600 implies that the HP filter extracts cycles of an average duration between four and six years (Canova, 1993).

Although the use of the HP filter has been subject to various criticisms[4], we have chosen to use it in this paper to estimate the cyclical components of macroeconomic series in the Uruguayan economy, setting the λ parameter equal 1600. The HP filter is a simple and flexible procedure and leads to reasonable estimates of the trend and cyclical components. Furthermore, given that the HP filter is the procedure used in most of the empirical research carried out on the subject, in order to

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[4] Basically, they refer to the lack of a statistical theory to support it and because its application can alter the characteristics of cyclical components as well as the degree of persistence of the filtered series. For comparisons between the HP filter and other detrending methods see King and Rebelo (1993), Harvey and Jaeger (1993) and Cogley and Nason (1995).

compare the empirical regularities of the Uruguayan macroeconomic cycle with those observed in other countries, it is neccesary to use a similar method to avoid comparisons being hampered by methodological options taken. Finally, the estimation of cyclical components resulting from the application of the HP filter aims at setting a reference point for further studies on the sensitivity of the Uruguayan macroeconomic cycle regularities using other methods of signal extraction

3. Characterization of the Uruguayan Macroeconomic Cycle

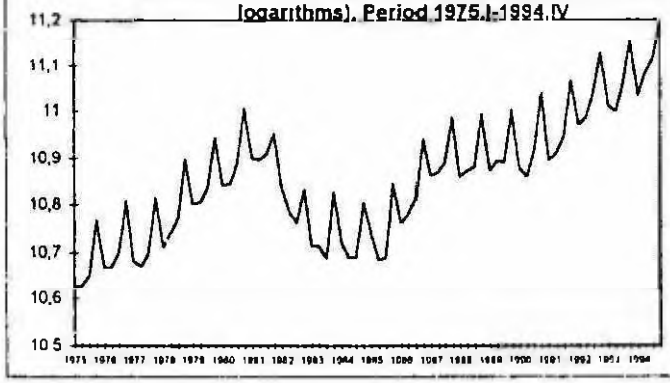
This section describes the macroeconomic cycle in the Uruguayan economy. The analysis begins with a description of the most important features of the reference cycle. Next, we present the summary statistics used in the literature to characterize macroeconomic cycles. Finally, we present the empirical regularities detected in short-run movements of a great number of macroeconomic variables and we comment the main findings

3.1 The Reference Macroeconomic Cycle

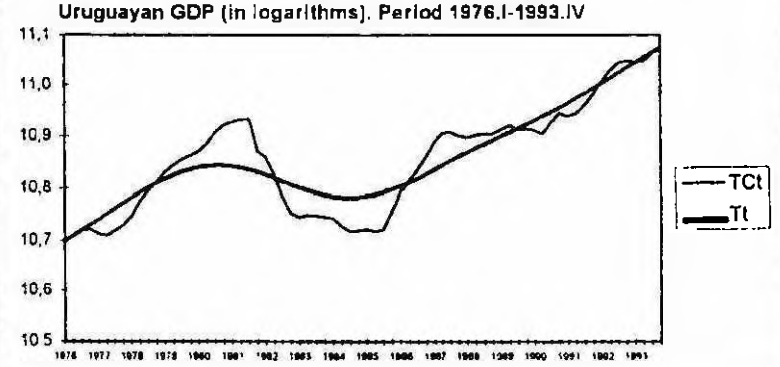
In order to characterize short-run fluctuations in a given economy, it is necessary to define the macroeconomic magnitude which best represents the reference cycle. In this paper we have chosen the real GDP series, since this is, among the variables available, the one that most accurately measures the concept of economic activity at the aggregate level.

Quarterly data on the logarithm of real Uruguayan Gross Domestic Product (GDP) from 1975 to 1994 is plotted in Graph 1. Clearly, the predominant macroeconomic fact during the last 20 years has been the growth trend of GDP. Measured in constant values, the GDP grew 76.5% between the first quarter of 1975 and the fourth quarter of 1994, which implies an annual growth rate of approximately 3% Also evident in Graph 1 is the existence of marked seasonal oscillations. The presence of this kind of intra-annual fluctuations is a fairly common characteristic in economic activity time series. This seasonal behavior is dominated by seasonal peaks in the fourth quarter which are compensated with reductions of the activity during the first quarter of the calendar year. The presence of seasonal oscillations has important empirical and theoretical implications. On the one hand, the study of cyclical fluctuations requires the elimination of oscillations at seasonal

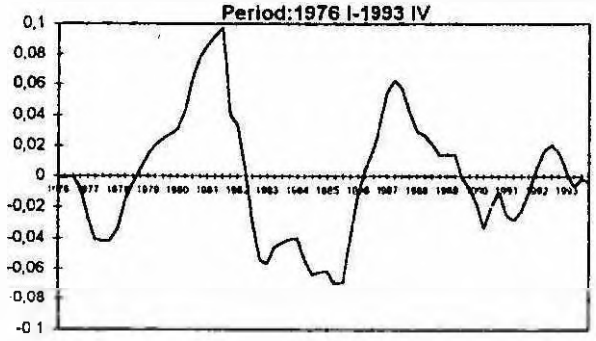
Graph 1
Quarterly Uruguayan GDP, in constant 1983 prices (in logarithms). Period 1975.I-1994.IV



Graph 2
Trend-Cycle and Trend Components of Quarterly Real Uruguayan GDP (in logarithms). Period 1976.I-1993.IV



Graph 3
Cyclical Component of Quarterly Real Uruguayan GDP Period:1976 I-1993 IV



frequencies. Furthermore, authors that have recently studied seasonal fluctuations explicitly, point to the fact that this kind of fluctuations provide interesting evidence on the nature of fluctuations of aggregate activity along the economic cycle (Barsky and Miron, 1988, Beaulieu and Miron, 1993)[5].

Graph 2 plots the GDP quarterly trend-cycle component obtained through the method of signal extraction described in section 2.2 and the estimates of the trend component resulting from the application of the HP filter It is worth noting that the growth trend of the Uruguayan economy presents a variable nature in the period Graph 2 shows that the Uruguayan economy has gone through three clearly differentiated phases. Graph 3 plots an estimate of the cyclical component of the GDP time series. We can observe that in the period under study there were important deviations of the real GDP with respect to its trend evolution, which can be attributed to a sequence of expansions and recessions. Evidently, the business cycle is an enduring feature of the Uruguayan economy.

Figure 1 shows the volatility and persistence of the GDP's cyclical component. We note that cyclical movements in real output are strongly and positively autocorrelated, which reflects a high persistence in the fluctuations of the macroeconomic cycle. Similarly, cyclical fluctuations observed in output are almost twice more volatile than those in industrialized countries. An important feature of the time profile of the cyclical component observed in graph 3 is that the amplitude of cyclical fluctuations has been modified along time. In particular, during the last years, macroeconomic fluctuations in GDP have been dampened.

Figure 1

Volatility and Persistence of the Reference Cycle (GDP)

Period 1976.I-1993.IV

CYCLICAL AUTOCORRELATION					CYCLICAL VOLATILITY	RESIDUAL VOLATILITY
(t-1)	(t-2)	(t-3)	(t-4)	(t-5)	Standard Deviation (%)	Standard Deviation (%)
0,93	0,81	0,65	0,46	0,27	3,93	1,98

Source Own estimations based on cyclical components obtained using HP filter

[5] This papers highlight the quantitative importance of changes in the preferences as a source of aggregate fluctuations; the synergy in the production through the seasonal cycle and the importance of movements in the use of labor and capital as the source of short-term fluctuations of productivity.

3.2 Characterization of Business Cycles

Starting with the important work of Hodrick and Prescott (1980), it has become increasingly popular to characterize the business cycle using a set of statistics that summarize all the information about short run macroeconomic fluctuations The empirical regularities observed in the cyclical fluctuations are described basically using the structure of autocorrelations and cross-correlations of the cyclical components From now onwards, when we mention certain macroeconomic series X_{it}, $t=1, \ldots, T$, we are refering to its cyclical component. The statistics used in the description are·

a) Standard Desviation (σ_x). This statistic offers a measure of volatility or relative amplitude of the cyclical fluctuations of the variable considered.

b) Cross-correlation coefficient between a certain macroeconomic series X_{it} and the cyclical component of real GDP in t, $\rho_t(j)$, $j \in (0,\pm1,\pm2,\ldots)$). The value of $\rho_t(j)$ for $j=0$ gives information on the direction and degree of contemporaneous comovement of the variable relative to GDP. A positive value near one indicates that the variable is highly procyclical, while the same value of opposite sign implies that the variable is countercyclical A value not significatly different from 0 implies that the variable is uncorrelated with the reference cycle, and thus no systematic relationship between the short run fluctuations of that variable and the cyclical behaviour of the GDP exists. For $j \neq 0$, the cross correlation coefficients try to capture the possible phase shift of the cyclical component of X_{it} relative to the cycle of aggregate output. In line with the existing literature, we say that X_{it} leads (lags) the cycle of GDP if $|\rho_t(j)|$ reaches a maximum for $j<0$ ($j>0$). If the maximum value in absolute terms is reached for $j=0$, it is said that X_{it} synchronizes or coincides with the reference cycle.

c) First order serial autocorrelation coefficient of X_{it}. This stastistic is used as a measure of persistence or degree of inertia of deviations relative to trend This univariate measure of persistence must not be confused with those put forward by Campbell and Mankiw (1987) or Cochrane (1988) which try to measure the effect of a stochastic shock on the long run level of the variable.

3.3 Empirical Regularities of the Macroeconomic Cycle of Uruguay

This section describes the main empirical regularities observed in short-run movements of the real and nominal macroeconomic variables of the Uruguayan economy[6]. Figure 2 presents a summary of the empirical evidence obtained. This figure shows the kind of comovement observed between each of the variables analyzed and the reference cycle: *i)* procyclical, *ii)* acyclical, and *iii)* countercyclical. It also indicates the phase change of the variable with respect to the reference cycle: *i)* leads, *ii)* synchronizes, or *iii)* lags, as well as the relative volatility of the cyclical components of each variable with respect to the GDP's cyclical component. For such purpose, levels of cyclical volatility are classified according to the following convention: *i)* high (relative volatility greater than 2), *ii)* medium (relative volatility between 1 and 2) and *iii)* low (relative volatility smaller than 1)[7].

Next, we will comment on the main findings based on the evidence summarized in figures 3, 4 and 5[8]. Figure 3 presents information on the cross-correlations of cyclical components of the different variables with respect to GDP's cyclical component. This information illustrates on the procyclical or countercyclical character of macroeconomic variables and on its possible phase shift with respect to the reference cycle. In order to ease the reading of the figures, the contemporaneous correlation is shadowed, the maximum value of the correlations in absolute terms is in bold (phase change) and the values which are not statistically significant at 5% level appear in italics.

Figure 4 shows volatility and persistence estimates of the cyclical components of the variables. Standard deviations of the estimated cyclical components and its ratio with respect to the standard deviation of the reference cycle are presented This is the measure of relative volatility usually considered in the empirical analysis of the business cycle. This information enables to determine the amplitude of cyclical fluctuations and to compare with results at an international level. Figure 4 also shows standard deviations of the residuals (innovations) of estimated ARIMA

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[6] Following Baxter and King (1995), the initial four and the last four sample observations have been previously eliminated to calculate correlations among cyclical components

[7] Standard deviations are only comparable across series when the series have the same units Accordingly, relative cyclical volatility is only presented for series expressed in logarithms, whose units correspond to percentage deviations from trend.

[8] Kamil (1997) provides a more detailed analysis of the empirical regularities found

Figure 2

Pattern of Cyclical Fluctuations of the Uruguayan Economy. 1975.I-1994.IV

VARIABLE	COMOVEMENT	PHASE SHIFT	CYCLICAL VOLATILITY
Total Private Consumption	procyclical	lags	medium
Durable Consumption (Imports)	procyclical	lags	high
Durable Consumption (Domestic Production)	procyclical	synchronizes	high
Gross Fixed Domestic Investment	procyclical	lags	medium
Investment in Construction	procyclical	lags	high
Private Investment in Machinery and Equipment	procyclical	synchronizes	high
Goverment Expenditure	procyclical	synchronizes	low
Exports	procyclical	leads	medium
Imports	procyclical	synchronizes	high
Trade Balance /PBI	countercyclical	lags	-----
Industrial Production	procyclical	synchronizes	medium
Hours Worked (Industrial Sector)	procyclical	synchronizes	low
Labour Productivity (Industrial Sector)	procyclical	lags	low
Unemployment	countercyclical	synchronizes	----
Real Wages	procyclical	lags	medium
Private Capital Stock	acyclical	lags	low
Public Capital Stock	acyclical	-----	low
Inflation	countercyclical	lags	-----
Monetary Base	procyclical	lags	high
M2	procyclical	lags	high
Nominal Interest Rates (nat /c)	countercyclical	lags	-----
Real Interest Rates (nat./c)	countercyclical	leads	-----
Real Exchange Rate (7 Countries)	countercyclical	lags	medium
Real Exchange Rate (9 Countries)	countercyclical	lags	medium
Terms of Trade	procyclical	lags	medium
Argentinean GDP	procyclical	leads	low
Real Bilateral Exchange Rate (Argentina)	countercyclical	lags	high
Brazilian GDP	procyclical	leads	low
Real Bilateral Exchange Rate (Brazil)	countercyclical	leads	high

Source Own estimations based on cyclical components obtained using HP filter

Figure 3

Cross-Correlations of Cyclical Components with respect to the Reference Cycle (GDP)
Period 1976.I-1993.IV

VARIABLE X	Cross-Correlations between GDP(t) and Variable X in (t-5)	(t-4)	(t-3)	(t-2)	(t-1)	(t)	(t+1)	(t+2)	(t+3)	(t+4)	(t+5)
CONSUMPTION	0,35	0 47	0 59	0 70	0,80	**0,86**	**0,89**	0,83	0 71	0 56	0 33
FIXED INVESTMENT	*-0,02*	*0 19*	0,39	0,52	0 62	**0,68**	**0,69**	0 64	0 60	0,53	0,46
Investment in Construction	-0,29	*-0 15*	*0,01*	*0,18*	0,37	**0,52**	0 62	0,68	**0,70**	0,69	0,65
Private Investment in Machinery	*0 21*	0 37	0 55	0,69	0 76	**0,77**	0 74	0 60	0 47	0,31	*0,16*
GOVERMENT EXPENDITURE	0 51	0,56	0 60	0 63	**0,65**	**0,65**	0,60	0,50	0 35	*0,19*	*0 01*
DURABLE CONSUMPTION											
Domestic Production	0,47	0,58	0,68	0,75	0 81	**0,82**	0,79	0,69	0 54	0,34	*0,12*
Imports	*-0,03*	*0,17*	0 37	0,56	0,71	**0,81**	**0,85**	0 82	0,74	0,61	0,45
EXPORTS	0,57	**0,60**	**0,60**	0,55	0 43	**0,25**	*0,04*	*-0,15*	-0,31	-0,42	-0 46
IMPORTS	0,31	0,48	0,63	0,75	0,85	**0,90**	**0,90**	0,85	0 74	0 59	0 41
TRADE BALANCE / GDP	*-0,20*	-0,27	-0,37	-0,47	-0,58	**-0,68**	-0,75	**-0,76**	-0,72	-0,63	-0,43
INDUSTRIAL PRODUCTION	0,34	0,52	0 69	0,81	0,87	**0,89**	0,87	0,71	0,55	-0,37	*0,19*
HOURS WORKED[A]	0,43	0 54	0 65	0,73	0,77	**0,78**	0 64	0 49	0,33	*0,17*	*0,01*
LABOUR PRODUCTIVITY[A]	*-0,13*	*-0,05*	*-0 07*	-0,20	0,35	**0,50**	**0,52**	**0,52**	0,50	0,48	0,49
UNEMPLOYMENT	-0,35	-0 52	-0 68	-0,80	**-0,87**	**-0,87**	-0,84	-0 70	-0,56	-0,41	*-0,22*
REAL WAGES	*-0,02*	*0,12*	0 26	0,38	0,49	**0,58**	0 66	**0,70**	0,69	0,63	0 55
PRIVATE CAPITAL STOCK	-0,63	-0 56	-0 45	-0,31	*-0,14*	*0,05*	0 24	0 40	0,53	0 62	**0,67**
PUBLIC CAPITAL STOCK	*-0,11*	*-0,11*	*-0,12*	*-0 14*	*-0,15*	***-0,15***	*-0 12*	*-0,06*	*0,01*	*0,09*	*0 18*
INFLATION	0,35	*0,19*	*0 02*	*-0,16*	-0,34	**-0,48**	-0 58	-0,64	**-0,65**	-0 63	-0 58
MONETARY BASE	*0,15*	*0,19*	0,23	0,27	0,30	**0,31**	**0,33**	0,30	0,25	*0,19*	*0,11*
M2	*-0,12*	*0,08*	0,29	0 50	0,66	**0,77**	**0,81**	0,80	0,74	0,66	0,54
Nominal Deposit Interest Rates	*-0,04*	*-0 14*	-0,25	-0,35	-0,45	**-0,50**	**-0,50**	-0,47	-0,38	-0,23	*-0,07*
Nominal Loan Interest Rates	*0,04*	*-0,03*	*-0,11*	*-0,22*	-0,32	**-0,41**	**-0,46**	**-0,46**	-0,41	-0,30	-0,17
Real Deposit Interest Rates	**-0,56**	-0,54	-0,51	-0,47	-0,42	**-0,33**	*-0,19*	*-0,06*	*0,13*	0 31	0 45
Real Loan Interest Rates	**-0,58**	-0,54	-0,49	-0,47	-0,43	**-0,35**	0,25	*-0,13*	*0,06*	0,24	0,41
REAL EXCHANGE RATE (7 Countries)	*-0,08*	*-0,16*	-0,25	-0,34	-0,45	**-0,57**	-0,65	**-0,66**	-0,60	-0,52	-0,34
REAL EXCHANGE RATE (9 Countries)	*-0,13*	*-0,22*	-0,32	-0,42	-0,53	**-0,64**	**-0,71**	**-0,71**	-0,63	-0,54	-0,34
TERMS OF TRADE	*0,17*	*0,20*	0,24	0,29	0,37	**0,44**	**0,45**	0,40	0,34	0,26	*0,16*
ARGENTINA											
GDP[B]	0,48	0,55	**0,58**	0,57	0,53	**0,44**	0,32	*0,19*	*0,04*	*-0,11*	-0,25
REAL EXCHANGE RATE	*0,16*	*0,13*	*0 06*	*0 00*	*-0,09*	***-0,22***	-0,36	-0 44	**-0,48**	-0,44	-0 37
BRAZIL											
GDP	0 67	0 72	**0,73**	0,69	0 62	**0,53**	0 44	0,36	0,25	*0,12*	*-0,04*
REAL EXCHANGE RATE	-0 51	-0 55	-0 58	**-0,59**	-0 55	**-0,53**	-0 48	-0 37	*-0,22*	*-0,09*	*0 10*

Source Own estimations based on fitted ARIMA models and HP filter

(A) cross-correlations of cyclical components with respect to cyclical Industrial Production
(B) estimation period 1975 I-1990 IV

Figure 4

Volatility and Persistence of Cyclical Components

Period 1976.I - 1993.IV

VARIABLE	CYCLICAL VOLATILITY Standard Deviation (%)	CYCLICAL VOLATILITY Relative Deviation	RESIDUAL VOLATILITY Standard Deviation (%	RESIDUAL VOLATILITY Relative Deviation	FIRST ORDER AUTOCORRELATION
CONSUMPTION	6 45	1 64	5 03	2 54	0 88
FIXED INVESTMENT	6 51	1 65	11 74	5 93	0 75
Investment in Construction	10 84	2 75	7 38	3 73	0 91
Private Investment in Machinery	19 84	5 04	23 06	11 65	0 76
GOVERMENT EXPENDITURE	2 48	0 63	5 06	2 56	0 91
DURABLE CONSUMPTION					
Domestic Production	19 76	5 02	14 71	8 08	0 94
Imports	46 68	11 80	26 67	14 19	0 69
EXPORTS	4 68	1 19	10 47	5 29	0 89
IMPORTS	9 20	2 34	11 78	5 95	0 96
TRADE BALANCE / GDP	2 61	____	2 88	1 45	0 79
INDUSTRIAL PRODUCTION	6 06	1 54	3 56	1 80	0 83
HOURS WORKED	4 26	0 68**	3 47	1 11**	0 88
LABOUR PRODUCTIVITY	3 76	0 59**	3 87	1 23**	0 74
UNEMPLOYMENT	1 26	____	0 36	0 18	0 87
REAL WAGES	6 26	1 54	3 53	1 78	0 90
PRIVATE CAPITAL STOCK	1 80	0 45	0 46	0 23	0 92
PUBLIC CAPITAL STOCK	0 78	0 19	0 13	0 07	0 91
INFLATION	2 05	____	2 80	1 41	0 93
MONETARY BASE	12 23	3 11	7 26	3 67	0 85
M2	8 35	2 12	4.18	2 11	0 90
Nominal Passive Interest Rates	8 16	____	4 39	2 22	0 88
Nominal Active Interest Rates	12 96	____	4 06	2 05	0 91
Real Passive Interest Rates	4 65	____	3 99	2 02	0 72
Real Active Interest Rates	5 07	____	5 02	2 54	0.81
REAL EXCHANGE RATE (7 Countries)	6 45	1 64	4 17	2 11	0 81
REAL EXCHANGE RATE (9 Countries)	6 25	1 59	4 20	2 12	0 79
TERMS OF TRADE	5 57	1 41	7 11	3 59	0 77
ARGENTINA					
GDP	3 11	0 71	3 38	1 86	0 82
REAL EXCHANGE RATE	8 43	2 14	4 71	2 38	0 74
BRAZIL					
GDP	2 96	0 75	2 41	1 22	0 87
REAL EXCHANGE RATE	9 81	2 49	4 05	2 05	0 83

Source Own estimations based on fitted ARIMA models and HP filter

** relative deviations with respect to cyclical Industrial Production

Figure 5

Cross-Correlations between Innovations in Macroeconomic Variables and Innovations in GDP

Period 1975.I-1994.IV

VARIABLE X	Cross-Correlations between GDP(t) and Variable X in (t-5)	(t-4)	(t-3)	(t-2)	(t-1)	(t)	(t+1)	(t+2)	(t+3)	(t+4)	(t+5)
CONSUMPTION	-0,04	-0,01	-0,01	0,25	0,04	0,23	0,21	**0,31**	-0,01	0,17	0,23
FIXED INVESTMENT	-0,09	-0,14	0,11	0,19	-0,12	0,28	**0,28**	0,00	0,16	0,16	0,04
Investment in Construction	0,00	0,03	0,16	0,05	0,00	0,33	0,19	0,09	0,17	0,03	0,08
Private Investment in Machinery	0,01	-0,13	0,04	0,14	-0,14	0,16	0,01	0,07	0,01	-0,06	-0,09
GOVERMENT EXPENDITURE	0,02	-0,13	0,22	0,10	0,09	0,06	**0,23**	0,15	0,17	0,20	0,03
DURABLE CONSUMPTION											
Domestic Production	0,08	0,08	0,15	0,01	0,02	0,40	0,08	0,34	0,13	0,18	-0,11
Imports	0,03	0,20	0,08	0,23	0,15	0,37	0,05	0,13	0,04	0,04	-0,02
EXPORTS	0,01	0,19	0,06	0,20	0,03	0,36	0,12	-0,23	0,11	-0,12	-0,07
IMPORTS	-0,05	0,11	0,10	0,24	-0,01	0,21	**0,28**	0,05	0,26	0,03	0,02
TRADE BALANCE / PBI	-0,03	0,06	0,00	-0,13	0,05	-0,06	-0,15	-0,18	-0,06	-0,07	-0,17
HOURS WORKED[A]	0,23	-0,02	0,13	0,22	-0,13	0,38	-0,07	0,09	0,08	-0,04	0,00
LABOUR PRODUCTIVITY[A]	-0,05	-0,14	-0,09	-0,01	-0,06	0,07	0,15	0,08	0,04	0,08	-0,03
UNEMPLOYMENT	0,05	0,03	**-0,25**	-0,08	-0,22	0,04	-0,13	-0,18	0,12	-0,10	0,05
REAL WAGES	**-0,23**	0,08	-0,12	-0,03	-0,11	0,07	0,18	0,18	-0,02	0,14	0,07
PRIVATE CAPITAL STOCK	-0,13	-0,04	-0,10	0,12	0,16	0,08	0,21	0,08	0,18	-0,08	0,19
PUBLIC CAPITAL STOCK	-0,05	0,08	-0,13	-0,08	-0,06	0,06	0,11	-0,04	**0,27**	0,14	0,05
INFLATION	0,05	0,03	0,10	0,18	-0,08	-0,13	-0,15	-0,16	0,01	0,00	-0,16
MONETARY BASE	-0,10	**0,26**	-0,07	0,00	0,03	0,22	0,06	-0,03	0,01	0,06	-0,09
M2	-0,19	0,04	0,01	0,13	**0,24**	0,12	0,13	0,05	-0,03	0,06	0,12
Nominal Passive Interest Rates	0,06	0,08	0,01	0,07	-0,01	0,33	**-0,14**	-0,23	-0,10	-0,05	0,03
Nominal Active Interest Rates	0,09	-0,08	0,10	0,16	**-0,31**	-0,21	-0,06	-0,14	-0,17	-0,13	0,14
Real Passive Interest Rates	-0,05	-0,16	-0,07	-0,09	-0,05	-0,11	-0,03	**-0,28**	0,21	0,09	-0,06
Real Active Interest Rates	-0,09	-0,12	0,10	0,05	-0,06	0,02	-0,06	-0,15	**0,23**	-0,11	-0,01
REAL EXCHANGE RATE (7 Countries)	-0,12	0,16	-0,07	-0,10	-0,07	0,11	0,05	-0,15	-0,19	0,01	0,07
REAL EXCHANGE RATE (9 Countries)	-0,01	**0,24**	-0,12	0,00	-0,04	0,14	0,00	-0,13	-0,02	0,09	0,04
TERMS OF TRADE	-0,01	-0,15	-0,03	-0,03	-0,13	0,25	-0,01	0,12	0,12	0,12	0,20
GDP (ARGENTINA)[B]	0,13	0,17	0,14	-0,05	0,03	0,21	-0,05	0,01	0,08	-0,02	-0,08
GDP (BRASIL)	**0,22**	0,20	-0,04	0,11	0,10	0,10	0,02	0,15	0,11	0,03	-0,15

Source Own estimations based on fitted ARIMA models

(A) cross-correlations of innovations with respect to innovations in Industrial Production

(B) estimation period 1975 I-1990 IV

models and the ratio between them and the residual standard deviation of the GDP. These values provide information on the degree of basic unpredictability of each variable. In all cases the estimation of the uncertainty was carried out based on the information provided by the past of the variable in question, and therefore, it is a quantification which allows to establish comparisons between variables. The last column of the chart shows the first order autocorrelation coefficient of the cyclical components.

Finally, in the analysis of some variables we will refer to the structure of contemporaneous and cross-correlations between innovations of ARIMA models estimated for the different variables and the innovations of the univariate model corresponding to GDP (Figure 5). In line with Blanchard and Fischer (1989), it is particularly interesting to consider this information when making hypotheses about the mechanisms of propagation of stochastic disturbances which affect the different real and nominal variables of the Uruguayan economy.

a) Internal Absorption

Based on the cross-correlations in figure 3, total consumer spending is highly procyclical (contemporaneous correlation of 0.88), it slightly lags the reference cycle, is 70% more volatile than the GDP and has a lower persistence. The procyclical character of private consumption of the Uruguayan economy, clearly observed in Figure 4, confirms the international evidence.

An important caveat in interpreting consumption evidence is that in Uruguay's National Accounting System, consumption is obtained as a difference between the aggregate supply (domestic output plus imports) and the rest of the components of the demand This can account, in part, for the strong correlation of cyclical consumption with output. More important, the excess of volatility of consumer spending could be explained by the same fact, given that errors and methodological changes in the measurement of all the other variables are included in the consumption data, eventually leading to an overestimation of the volatility of this component.

The high volatility observed in private consumer spending - which seemingly contradicts the life-cycle hypothesis - could also be due to the fact that such variable includes expenditure in consumer durable goods. The convenience of distinguishing this component from the rest of the consumer spending is based on the fact that expenditure in consumer durable goods represents an

intermediate situation between current expenditure and investment. Consumer durable goods can be considered as assets subject to depreciation which yield a flow of services that generate utility for many periods after they were purchased[9].

At the time of this research, there were no available data of consumer spending on durable goods for the Uruguayan economy. Hence, in order to analyze the cyclical behaviour of the variable, it was necessary to build indicators of the evolution of domestic consumption of this type of goods. Two quarterly time series were built: one representing the evolution of the output of durable good-producing industries that was destined to domestic consumption (DDC), and the other one capturing durable imports (IMPD). The strong changes registered in relative prices during the last 20 years suggested to disaggregate both indicators. Therefore, the cyclical fluctuations of both variables were analyzed independently[10].

Graph 5 presents the evolution of the DDC and IMPD, corresponding to the period between the first quarter of 1975 and the fourth quarter of 1993. The most outstanding feature arising from the analysis of this graph is that in mid-1987 there was a substantial change in the evolution of these variables. Before that time, the series showed relatively similar paths despite having been built using very different information sources. In 1987 there was a strong expansion of the DIMP while the DDC shows a declining trend. The disparity observed in the evolution of both indicators reveals the substitution imported products for domestic production. The explanation of this phenomenon is related to trade liberalization, particularly, the strengthening of trade links with Argentina and Brazil; the reduction of the relative price of imported goods in a context of real appreciation of the local currency, and the limited international competitiveness of the Uruguayan consumer durable goods industry.

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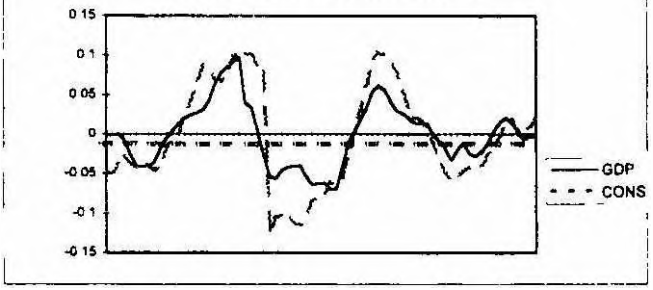
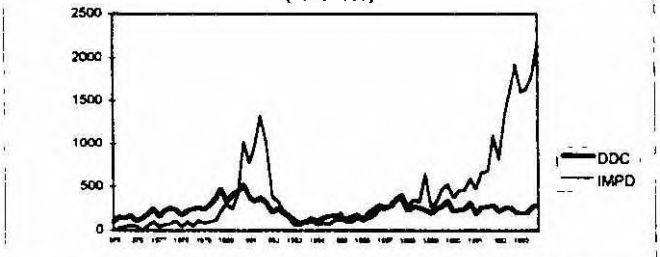
9 This distinct features of consumer durable goods have implications in terms of economic policy response. In principle, the impact of contention policies of the aggregate demand (credit restrictions, increase of interest rates, etc.) on the different components of family consumer expenditure should be very different: the expenditure on durables goods would be affected a great deal more.

10 Kamil (1997) presents the DDC and IMPD time series and describes in detail the methodology used for their construction. These time series aim to measure the quantities acquired by consumers of this kind of goods. Ideally, a series of durables should measure the services imputed to the stocks of these goods, since it is not the TV set which generates utility but the service flow derived from it.

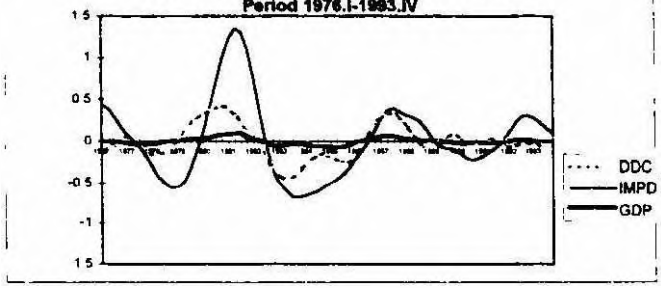
Graph 4
Cyclical Components of Real GDP and Private Total Consumption. Period 1976.I-1993.IV



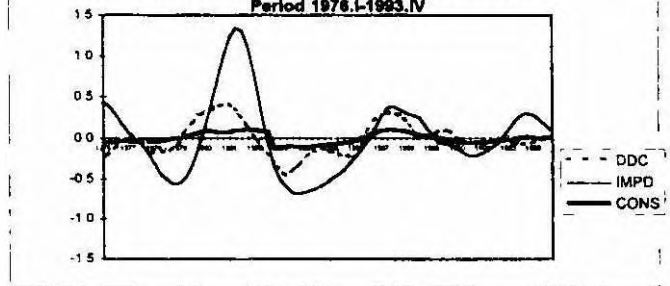
Graph 5
Indicators of Private Consumption of Durable Goods: Domestic Production and Imports. Period 1975 I-1993.IV (1983=100)



Graph 6
Cyclical Components of Real GDP and of Private Expenditures in Durable Consumption Goods. Period 1976.I-1993.IV



Graph 7
Cyclical Components of Total Private Consumption and of Expenditures in Durable Consumption Goods Period 1976.I-1993.IV



The analysis of the cyclical components of DDC and DIMP reveals several aspects of interest. First, cyclical components of both indicators are much more volatile than the reference cycle (graph 6) and than the cyclical component of the total consumer spending (graph 7). Standard deviations of cyclical components of DIMP and DDC are more than 11 and 5 times larger than the standard deviation of the cyclical component of GDP, respectively. These results are in line with the empirical evidence for other economies, and could indicate that part of the excess of volatility of consumer spending could be due to the volatility of durable consumption. The disparities observed in terms of volatility stress the need to separate durables goods from the rest of consumption, when studying consumer spending in Uruguay.

Second, both indicators behave in a procyclical way[11]. The DDC indicator is in phase with the reference cycle, whereas the IMPD tends to lag it in one quarter This different dynamic response is indicating the existence of some kind of asymmetry between cyclical behaviours of domestic production and imports of this kind of goods. In this respect, the lag in the response of DIMP could be attributed to the fact that it is relatively expensive to keep inventories of imported durable goods.

Third, graphs 6 and 7 show that the cyclical pattern of DDC is a lot smoother than the one of IMPD. Even in the consumption boom registered at the beginning of the 80's during the exchange-rate stabilization, the magnitude of the cyclical fluctuations of imports was much greater than the one registered in domestic real output. This could be evidence of the inability of domestic supply to provide a fast response to the expansions of the domestic demand.

The cyclical dynamics of the consumption of durables provides evidence on the existence of a strong reaction from the consumers when facing changes in the perception of their current income level. Given the traditional dependence of consumption of durable goods to the availability of credit, this could suggest that there are segments of consumers facing liquidity constraints. This evidence is in line with results that highlight the role of credit as a determinant of consumer spending in the short run (Copelman, 1994; Noya, Lorenzo and Grau, 1996). In this respect, the strong correlation detected between innovations of ARIMA models for GDP and both IMPD and DDC, shown in figure 5, provides additional evidence of strong consumer's reaction to income

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11 The volatile and procyclical nature of durable goods' output and consumption has been emphasized by Zarnowitz (1985) as a defining feature of business cycles

shocks and seems to contradict theories that explain booms in durable goods consumption during a stabilization plan due to an increase of the permanent income perceived by agents.

The analysis of the cyclical behaviour of fixed domestic investment (FDI) indicates that this variable is strongly procyclical, although its contemporaneous correlation with output is slightly below to the estimated for total consumption (0.68). Surprisingly, investment volatility at business cycle frequencies has been only marginally higher than aggregate consumption. The structure of cross-correlations indicates that time relationships with the reference cycle are stronger when considering lag values of FDI. In other words, the FDI tends to have a lagging response with respect to the reference cycle, in fact, a quarter later. Furthermore, investment is the most unpredictable component of the aggregate demand - almost six times more unpredictable than GDP - and its inertia is markedly lower than the one in GDP.

Government expenditure in the Uruguayan economy is procyclical[12]. It seems to lead or coincide with the reference cycle, its cyclical component is less volatile and its evolution is considerably more unpredictable than GDP's. The procyclical nature of the variable could be interpreted as evidence in favor of the dynamics of a fiscal policy depending on tax revenue, since there is no evidence that public expenditure has been used systematically to dampen short-term fluctuations, but rather has reinforced the business cycle Literature on cyclically-adjusted fiscal deficit emphasizes that a temporary increase in economic activity tends to raise the revenue and causes a transitory reduction of the deficit. In this sense, the fiscal balance may be an inappropriate indicator to characterize the fiscal policy through the cycle and it may be poorly informative in terms of assesing the intertemporal sustainability of the fiscal policy. Nevertheless, we understand that the important issue is that the transitory revenue increase creates a certain "fiscal illusion" which relaxes the fiscal discipline and expands public expenditure in constant terms, which accounts for its procyclical behaviour

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12 The procyclical nature of government spending is consistent with the evidence presented by Talvi and Vegh (1997) for a group of ten Latinamerican countries, but in sharp contrast to the evidence for OECD countries

b) External Sector

Exports of goods and services present a low positive contemporaneous correlation with the reference cycle, which agrees with the international evidence. On the other hand, the structure of cross-correlations with respect to the reference cycle is sharply asymmetrical: exports tend to lead in three of four quarters GDP's cycle, while current output variations are negatively correlated with future cyclical behaviour of exports. Thus, an increase in output, and therefore in domestic demand, is associated with a reduction in export balances several quarters later. This asymmetrical pattern is confirmed in the dynamic structure of cross-correlations of innovations from the univariate models for exports and GDP (Figure 5). Furthermore, there is evidence that this particular dynamic response of exports through the cycle detected in the Uruguayan economy, is in fact a regional phenomenon. Indeed, the Argentinean economy also presents a negative correlation between cyclical movements of output and the cycle of exports several quarters later (Kydland and Zarazaga, 1997).

Imports of goods and services are highly procyclical (contemporaneous correlation of 0.90) and their short-run movements synchronize with the reference cycle. Likewise, imports present almost six times more uncertainty than the product. The fact that imports and investment present similar residual relative volatilities could be an indicator of the important role played by investment decisions and consumer expenditure in durables on the propensity to import.

Trade balance as a percentage of GDP is highly countercyclical. This suggests that comovement in the trade balance is dominated by the behaviour of imports. Cyclical fluctuations of this variable tend to lag the reference cycle in two periods.

Variables of the external sector present a higher cyclical volatility than GDP's, which is consistent with the international evidence. It is important to point out that the period analyzed coincides with an important liberalization of trade, which led to a considerable increase in the degree of openness of the economy (measured as the ratio between the sum of imports and exports and GDP), which grew from 0.25 in 1975 to 0.46 in 1994. The progressive openness of the economy leads to an increase in trade volumes which tends to be accompanied by an increase in volatility.

c) Monetary Variables

The results obtained indicate that there exists a negative correlation between output and inflation and that the inflation rate reacts several quarters later to the cyclical path of GDP It is particularly interesting to point out the high persistence observed in the cyclical behaviour of the Uruguayan inflation, since it sheds some light on the extent to which inertial factors govern the dynamics of inflation In countries with chronic inflation, people get used to live with inflation, and several indexation mechanisms, whether formal or informal, are developed that tend to perpetuate it.

Correlations presented in figure 3 indicate that real monetary aggregates considered are procyclical and lag the reference cycle[13]. The wider the definition of the monetary aggregate, the stronger the correlation with the reference cycle. It is worth noting that there is a significant phase-change between output and the monetary aggregate M2 The cross-correlations with M2 show that output leads the cyclical evolution of the monetary aggregate Overall, the analysis of the cyclical behaviour of monetary variables indicates that contrary to what happens in many industrialized economies, money does not lead output fluctuations.

Nevertheless, it is noteworthy that monetary aggregates are the only macroeconomic variables considered for which evidence based on cyclical components (Figure 3) and innovations (Figure 5) are strongly contradictory. Indeed, while the analysis of cross-correlations of innovations of monetary aggregates suggest that disturbances to monetary aggregates anticipate shocks to output, the analysis of cyclical components suggest a cyclical lag of monetary aggregate fluctuations This fact could be explained by the instability of cyclical patterns in different subperiods or by the presence of possible "spurious cycles" (Cogley and Nason, 1995) due to the signal extraction methodology applied.

Finally, all cyclical components of the interest rates in local currency, whether they are nominal or real, loan or deposit rate, present a negative comovement with the reference cycle[14]. In

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13 Analyzing the comovements between monetary aggregates and real activity is not straightforward, since it requires defining and measuring "money". The growth of the financial sector and, specially, the process of dollarisation undergone by the Uruguayan economy casts doubt on the importance of monetary aggregates expressed in national currency

other words, interest rates are countercyclical variables On the other hand, nominal interest rates tend to lag the reference cycle in one or two quarters. The lag with respect to GDP cycle is a characteristic of all nominal variables in the Uruguayan economy. Real rates tend to lead cyclical GDP movements in more than one year. The information considered seems to indicate that interest real rates in local currency represent a leading indicator of the movements of the reference cycle.

d) International Variables

Innovations in terms of trade are positive and contemporaneously correlated with innovations in GDP, but most correlations at short leads and lags are close to cero. This suggests that terms of trade shocks (basically oil prices, and non-traditional exports prices) are transmitted quickly to real activity in the Uruguayan economy.

Figures 3 and 4 summarize the cyclical properties of the variables corresponding to Argentina and Brazil: GDP and real bilateral exchange rates (RBER). In the case of Argentina, the cycles of GDP are positively correlated with the reference cycle of the Uruguayan economy, and they tend to lead it by three quarters (graph 8). Macroeconomic fluctuations in that country are smoother and have a lower inertial component.

Likewise, fluctuations in Brazil's GDP are procyclical, they lead the reference cycle in three quarters too and are strongly correlated with the cyclical behaviour of the Uruguayan economy (graph 9). Cross-correlations with respect to the Brazilian GDP are higher than the ones corresponding to the Argentinean GDP.

Interesting results can be drawn out from the analysis of the RBER with Brazil. In the first place, it has a countercyclical behaviour, which is a common feature to all definitions of real exchange rates considered. Secondly, both RBER - with respect to Argentina and to Brazil - have higher cyclical volatility than those defined for a group of industrialized countries (Figure 4) .This indicates the instability of the region in the period under consideration, signed by a string of unsuccesful stabilization plans.

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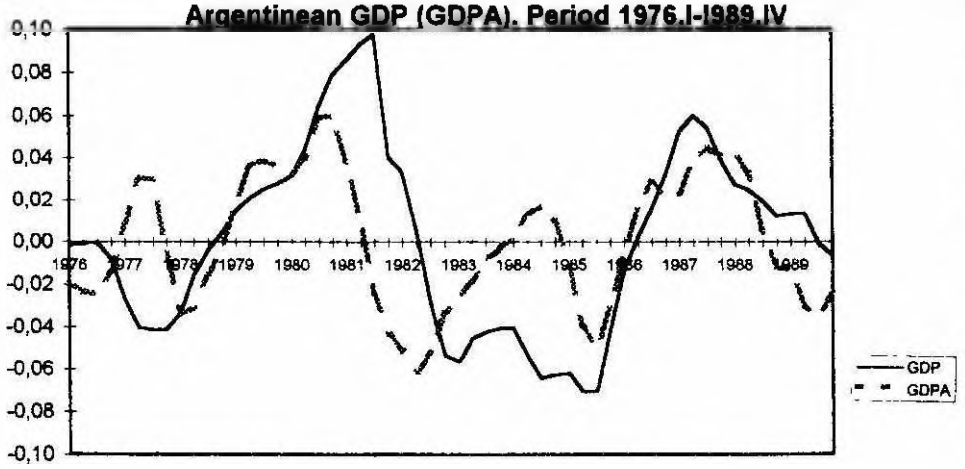
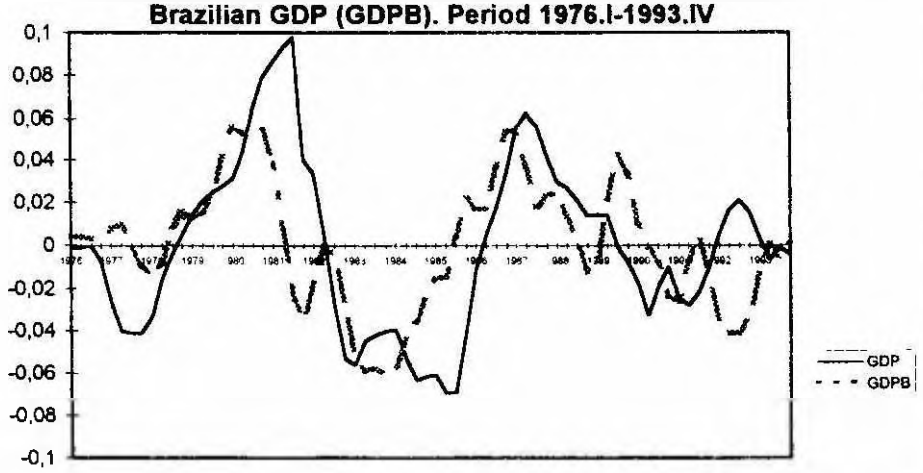
[14] The real interest rates in local currency considered are *ex-ante*. The methodology used to elaborate this time series is found in Noya, Casacuberta and Lorenzo (1996).

Graph 8
Cyclical Components of Real Uruguayan GDP and Real Argentinean GDP (GDPA). Period 1976.I-1989.IV



Graph 9
Cyclical Components of Real Uruguayan GDP and Real Brazilian GDP (GDPB). Period 1976.I-1993.IV



The analysis of the relationship between the reference cycle of the Uruguayan economy and the regional variables sheds some light on several aspects. In the first place, the strong correlation detected between regional economic aggregates and Uruguayan GDP gives empirical support to the widely held view that regional cyclical patterns influence Uruguay´s macroeconomic behaviour. In the second place, fluctuations in Argentina and Brazil's GDP are leading indicators of the reference cycle of the Uruguayan economy. This pattern has been stable nearly over the full sample, as shown in Graphs 8 and 9 Finally, and opposite to the vision generally accepted by experts, cycles in Brazil's GDP are more synchronized and they lead Uruguayan macroeconomic fluctuations in a stronger fashion than the Argentinean GDP.

The above results are consistent with the analysis of cross-correlations between the innovations in regional GDPs and Uruguayan output. In this respect, unexpected movements in the economic activity of Brazil registered four or five quarters in advance are positively correlated with stochastic disturbances in Uruguayan's GDP. The analysis of Argentina's GDP innovations reveals the existence of statistically significant correlations only at the contemporaneous level, although there is evidence of the existence of positive correlations of certain magnitude in lagged periods.

4. Summary and Final Remarks

In sum, the study of macroeconomic relations over the business cycle is important both for providing benchmarks against which to judge macroeconomic models and for guiding economic policy. Furthermore, as long as aggregate fluctuations displayed in small open economies, like the Uruguayan one, are similar to time series properties observed in high-income countries, there are important implications for the design of stabilization and adjustment programs. In this respect, the comparative analysis reveals that, in the first place, there is a group of empirical regularities in the Uruguayan economy which are similar to the ones found in other countries, such as:

i) strong procyclical nature of investment and consumption,
ii) relative volatility of investment greater than 1,
iii) high relative volatility of exports and imports,
iv) low contemporaneous correlation of exports with the reference cycle,
v) countercyclical trade balance, and

vi) imports a lot more procyclical and volatile than exports.

In the second place, the results indicate that variables of aggregate demand (except government spending), of the external sector and the industrial sector in the Uruguayan economy show contemporaneous correlation coefficients with the reference cycle which have identical sign to those found in other economies.

In the third place, in the real sector of the economy, differences with industrialized economies are basically associated with the level of volatility of macroeconomic variables. Cyclical fluctuations observed in output and private consumption of the Uruguayan economy, are practically twice as volatile as those in industrialized economies. However, fixed domestic investment presents a lower relative variability than that found internationally.

In the fourth place, there is a total absence of common cyclical patterns in policy variables. There are some specific characteristics of the Uruguayan economy which have not been detected in the majority of the economies analyzed These are· procyclical and low-volatile public expenditure, lag of M2 fluctuations with respect to the reference cycle and countercyclical interest rates.

Similarly, the results obtained in this paper indicate that private expenditure in durables has played an important role in macroeconomic fluctuations in the period analyzed In particular, the cyclical dynamics of the consumption of durables - highly volatile and strongly procyclical - seems to underline the importance of imperfections in credit markets as an important factor in the cyclical dynamics of consumer expenditure in these kinds of goods.

On the other hand, exports, *ex-ante* real interest rates in local currency, the RBER with Brasil, Argentina's and Brazil's GDP, are all variables which lead the Uruguayan macroeconomic cycle. The fact that variables consistently anticipate the business cycle suggests that they can be used as leading indicators to predict the future evolution of the economy.

The evidence presented confirms that the magnitude of cyclical oscillations observed in a small and open economy such as Uruguay, are closely related to external shocks, especially those coming from the regional environment. The presence of a regional demand for non-tradable goods (tourist services), the existence of preferential trade agreements and the smuggling activity, are

factors that contribute to explain the importance of regional shocks as generators of cyclical fluctuations in the Uruguayan economy.

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METHODOLOGICAL APPENDIX

Definition of Variables

Quarterly macroeconomic series used in this paper come from the data-base of the Centro de Investigaciones Económicas (CINVE) and cover the period 1975.I - 1994.IV, except in some cases in which the source or corresponding sample period is explicitly stated.

1. **Output and aggregate supply and demand components** Series of aggregate output, supply and demand components are expressed in constant prices (in thousands of pesos) of 1983. The Central Bank of Uruguay has elaborated quarterly series of the components of the aggregate supply and demand since 1983. Quarterly data between 1975 and 1983 was obtained through the method of related series of Chow-Lin (1971) The Balance of Trade as a percentage of the GDP is the ratio between the difference of exports and imports of goods and services measured at constant prices, divided by output at constant prices.

2. **Industrial variables**. The Output Index of the Manufacturing industry (QIM) is expressed on the basis 1982=100, and was build as a weighted average of the indexes of each of the branches of industry, except Oil Refinery (3530), classified four digits from the International Standard Industrial Classification (ISIC). The weighting factors were the aggregate value added of each branch in 1982. The Index of Industry Labor Hours is expressed on the basis 1982=100 and is the weighted average of the Index of Labor Hours (ILH) of each of the branches of industry, except Oil Refining (3530), weighted by the total number of hours worked in each branch in that year The Index of Labour Productivity at the industrial level is expressed on the basis 1982=100 and comes from the ratio between QIM and ILH defined before

3. **Production Factors**. The rate of unemployment and the Real Wage Index with basis 1983=100 are elaborated by the Instituto Nacional de Estadística, INE (National Institute of Statistics). The series of private and public capital stocks are expressed in constant values of 1983 and were obtained through the method of Permanent Inventory.

4. **Monetary Variables**. The inflation rate has been calculated using monthly data on the Consumer Price Index elaborated by INE The monetary base and the monetary aggregate M2 come

from the Central Bank of Uruguay and are expressed at constant prices of 1983, using the Consumer Price Index as a deflator.

5 **Interest rates in the local currency**. Nominal interest rates are published by the Central Bank and correspond to 90 days-deposit. Real ex-ante interest rates were build based on the the estimates of the expected inflation made by Noya, Casacuberta and Lorenzo (1996).

6. **International Relative Prices**. The real exchange rates are provided by the Central Bank. The real exchange rates are expressed as indexes with basis 1983=100 and they are defined as the ratio between the Indexes of Wholesale Prices expressed in a common currency, using the official exchange rates of the Central Banks. Real exchange indexes were built for: i) Argentina, ii) Brazil, iii) a group of seven countries - The United States, The United Kingdom, The Netherlands, Germany, Italy, Japan and France, and iv) a group of 9 countries - The United States, The United Kingdom, The Netherlands, Germany, Italy, Japan, France, Brazil and Argentina The weights used to aggregate the indexes of each country were provided by the Central Bank.

7 **Regional Variables**. Argentinean GDP correspond to the period 1975.I-1990.IV (FIEL Fundación de Investigaciones Económicas Latinoamericanas - Foundation of Latin American Economic Research). Brazil's GDP is elaborated by IBGE (Centro de Documentación y Diseminación de Información).

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