Characterization of the Argentine Business Cycle

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ABSTRACT

This paper provides a characterization of the business cycle regularities of the Argentinean Economy from 1988 to 2006, using quarterly data. The method of estimation of the cyclical components is based on the application of the Hodrick-Prescott filter to the trend-cycle component estimated by the software TRAMO-SEATS. This method used to estimate the cyclical components takes into account the characteristics of the data generating process. In addition, the correlations used to characterize the cyclical behaviour of the variables are not affected by the noise in the data, given that the irregular component is excluded from the estimation of the final cycle component. The results show that –overall- the regularities found in the Argentine Business Cycle are similar to those at the international level. An analysis of the comovements of the cycles of the Argentine GDP and other countries is also provided in this paper.

1. INTRODUCTION

The purpose of this study is to characterize the business cycle regularities of Argentina, during the period 1988-2006. More specifically, the objectives are: a) Analyze the cyclical fluctuations of Argentina's Real GDP and its components, characterizing them in terms of persistence, volatility and type of cyclical comovement, b) Compare this cyclical behaviour with the international empirical evidence, c) Examine the cross-correlation between the cyclical fluctuations of the Real GDP of Argentina and other selected countries, contrasting also the volatility and persistence observed in the series.

Studying these facts of the business cycles is important because of several reasons. First, understanding the causes and characteristics of the cyclical fluctuations, is crucial to macroeconomic policy-making. Societies prefer a steady growth path, therefore large cyclical swings might call for stabilization programmes. For that reason, it is important to analyze the causes or driving forces behind the economic fluctuations (for instance, if they are real factors or nominal ones) in order to select the most adequate government policy. Furthermore, is a way of reducing uncertainty: knowing in which moment of the cycle is the economy it might be possible to anticipate when a phase shift of the cycle will occur. Second, the cross correlation structure among the cyclical components of the variables gives information about the leading indicators of the economic activity of a country. These variables could then be used as predictors of the future course of the economy. Finally, comparing the business cycle regularities with the international evidence may be important in order to better understand which factors could be responsible for the economic fluctuations[1].

[1] As Kydland and Zarazaga (1997) explain in their article, if Argentina's business cycle regularities are similar to those of the United States or Europe, then the business cycles of all these countries may be manifestations of essentially the same phenomenon. Therefore, real factors could play an important role in accounting for Argentina's business cycles, just as, according to previous research, they do in the United States and Europe. By contrast, if Argentina's business cycles show important anomalies with respect to the evidence available

Despite the evidence suggests that economic fluctuations are much severe in developing countries, and understanding what drives such highly volatility is of particular interest, most of the theoretical and empirical research of business cycles has focused on developed countries. One region that is particularly under-researched is Latin America. In the case of Argentina, few published studies were found related with this field of research. Kydland and Zarazaga (1997) is one of the most important papers (These authors described the business cycle regularities of Argentina in the period 1970-1995, and compared them with international empirical evidence). Thus, the possibility of enhancing the business cycle literature in a relatively unexplored context is one of the principal motivations of this study. Particularly, extending the period of analysis involving 2001 Argentine Financial Crisis, as well as considering other variables in the analysis such as the GDP of several countries, represents one of the most important contributions of this article.

The remainder of the paper is organized as follows. Section 2 provides a brief review of the business cycle definitions. Section 3 explains the cycle characteristics in the time domain (volatility, persistence, contemporaneous comovement and phase shift) and in the frequency domain (spectral analysis). Section 4 gives a summary of the business cycles regularities at the international level. Section 4 explains the methodology used in this study to estimate the final cycle components. Section 6 presents the results: some comments of the reference cycle and the cycle characteristics. Section 7 provides an analysis of the cyclical behaviour of the output components, the international comparison, and the cross-correlation between the cyclical fluctuations of the Real GDP of Argentina and other selected countries. Section 8 presents the main conclusions.

2. BUSINESS CYCLE DEFINITIONS

for other countries, then the possibility of real factors playing an important role in its business cycle diminishes.

The first definition of business cycles which was followed by the economic discipline, was provided by Burns and Mitchell (1946), and is the one adopted by the National Bureau of Economic Research (NBER):

Busyness cycles are a type of fluctuation found in the aggregate economic activity of nations that organize their work mainly in business enterprises: a cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions and revivals which merge in the expansion phase of the next cycle; this sequence of changes is recurrent but not periodic; in duration business cycles vary from more than one year to ten or twelve years; they are not divisible into shorter cycles of similar character with amplitudes approximating their own.

The comovement among individual economic variables –taking into account possible leads and lags in timing- was the centrepiece of Burns and Mitchell's methodology.

At the beginning of the 80's the Real Business Cycle (RBC) theory emerged, and rapidly became the dominant paradigm in the modelization of the business cycle (Kydland and Prescott, 1982). This theory holds that the business cycle is caused by random fluctuations in the productivity level (i.e. technological shocks). As Kydland and Zarazaga (1997) point out, economists were surprised when Kydland and Prescott (1982) showed that one could account for two-thirds of the U.S economic fluctuations with a dynamic stochastic general equilibrium model from which nominal variables were totally absent.

The prevailing conception of the business cycle in the RBC literature follows Lucas (1977) conception, which identifies the business cycle with "movements about trend in gross national product". According to this author, these movements are typically irregular in period and in amplitude; regularities are only observed "in the comovements among different aggregative time series". The difference with Burns and Mitchell (1946) definition is that this author proposes the centrality of the product, and

emphasises the importance of analyzing the characteristics of the comovement of the rest of the aggregate variables with respect to it.

Lucas (1977) does not suppose that the long quarter trend must be necessarily constant; he considers it can grow or decrease along time. However, the author does not provide a meaning of trend, nor he explains how to estimate it. Kydland and Prescott (1990) complete Lucas conceptualization, defining the trend of a variable as that which results from applying the Hodrick Prescott filter to the raw data. According to these authors "the trend component for real GNP should be approximately the curve that students of business cycles and growth would draw through a time plot".

3. CYCLE CHARACTERISTICS

The following statistics are used in order to identify the regularities or *stylized facts* of the business cycles:

a) Standard Deviation (σc): indicator of the volatility of cyclical fluctuations, and hence of the magnitude of the business cycles.
b) Auto-correlation coefficient: measures the persistence of cyclical fluctuations. An auto-correlation coefficient closer to 1 indicates more persistent, and therefore less frequent, fluctuations.
c) Cross Correlation coefficients: measure the extent to which macroeconomic variables comove in line with the reference indicator[2] (Real GDP). Correlations between the cyclical components of the variables of interest are computed.

Two types of comovements can be analysed with the cross correlation coefficients:

- Contemporaneous comovement: A macroeconomic variable can be characterized as: a) *procyclical* (if the correlation with the reference

[2] Measuring business cycles requires choosing a reference indicator; that is, the macroeconomic variable that is the most representative of aggregate economic activity. Real GDP appears to be the most suitable variable. The cyclical component of this variable is the *reference cycle*.

cycle is positive), b) *countercyclical* (if the correlation is negative), c) *acyclical* (if the correlation is not statistically different from zero).

- Non-contemporaneous comovements (phase shift): pair-wise correlations are computed up to five lags/leads in order to analyze the phase shift. A macroeconomic variable can be characterized as: a) *leading* (if max.ρ (j) in absolute value is reached when the variable is lagged or $j<0$), in this case the variable changes before the reference cycle; b) *coincidental* (if max. ρ (j) in absolute value is reached when $j=0$), in this case the variable changes at the same time the reference cycle does; c) *lagging* (if max. ρ (j) in absolute value is reached when $j>0$), here the variable changes after the reference cycle.

The previous characteristics are the dimensions of the analisis in the *time domain*. In this study, also a brief analysis in the *frequency domain* (spectrum analysis) is provided. According to Kaiser and Maravall (2001) "this approach represents an alternative way to view and interpret the information contained in the second-order movements of the series. In the same way that a density function is the model counterpart of the usual histogram, the spectrum is the model counterpart of the frequency histogram (properly standardized)". This kind of analysis considers that the behavior of the variable over the time is the result of the combination (addition) of cycles of different amplitude and length. In this way, the spectral analysis allows to study in which way the different periodicities or frequencies contribute to the explanation of the total variability of the series.

4. INTERNATIONAL EMPIRICAL EVIDENCE

Kamil and Lorenzo (1998) provides a summary of the business cycles regularities at the international level (Table 1). The authors sum up the main empirical regularities in the aggregate demand and supply as follows:

- In general, the components of the aggregate demand and supply are procyclical.

- Both the Gross Fixed Investment and the consumption are strongly procyclical and coincidental with the reference cycle. Regarding the volatility, the investment is almost two or three times more volatile than the GDP, whereas the consumption is almost as volatile as the output.
- The imports are more volatile and procyclical than the exports, and both variables are more volatile than the GDP. The exports have a low correlation with the reference cycle.

Table 1: Cyclical Behaviour of GDP and its main components –International Evidence

Variable	Comovement	Phase Shift	Relative Volatility[2]
Total Consumption[1]	procyclical	coincidental	low
Gross Fixed Investment	procyclical	coincidental	high
Exports	procyclical	n.c.p	high
Imports	procyclical	coincidental	high

[1] Source: Kydland and Zarazaga.
[2] relative volatility is classified as: i) high (relative volatility bigger than 2), ii) medium (relative volatility between 1 and 2), iii) low (relative volatility lower than 1).
n.c.p: no clear pattern.
Source: based on Kamil and Lorenzo (1998).

5. METHODOLOGY

Data

This study makes use of quarterly data, from 1988:1 to 2006:12[3]. The sources are Ecowin (for the Spanish and U.S GDP series), Banco Central Uruguay (for Uruguay's GDP), Banco Central Chile (Chilean GDP) and INDEC (for the Argentinean data).

Variables

Nine variables are used:

[3] The series of the cycle components cover the period 1988:1-2008:4, as the forecasted values of TRAMO for the years 2007 and 2008 are included for the estimation of the cycle component.

-*Argentine Real Gross Domestic Product (GDP)*: this is considered the reference cycle.
-Main components of the Argentine Real GDP: i) *Total Consumption*[4], ii) *Imports*, iii) *Gross fixed Investment (GFI)* and iv) *Exports*.
-Regional Variables: i) *Chilean Real GDP* and ii) *Uruguay's Real GDP* (Index).
-International Variables: i) *U.S. Real GDP* and ii) *Spanish Real GDP*.

The business cycle literature is concerned with percentage (rather tan absolute) deviations from trend in growing series. Therefore, all the variables are expressed in natural logarithms.

Methodology for the Estimation of the cyclical components

The study of business cycles first requires a decomposition of time-series into a trend and a cyclical component. The problem of the estimation of unobserved components has been widely analyzed. Basically, a time series can be expressed as the sum of four unobserved components[5]:

$Y_t = T_t + S_t + C_t + I_t$, where:

-T_t (trend): includes long-quarter fluctuations.
-S_t (seasonal): refers to systematic fluctuations with periodicity shorter than one year.
-I_t (irregular): residual effect (high-frequency random shocks).
-C_t (cycle): systematic deviations with respect to the trend, but different from seasonality.

In this study, the methodology for the estimation of the cyclical components of the variables is based on the application of the Hodrick-Prescott Filter (HP filter) to the trend-cycle components estimated with the

[4] This variable includes both private and government consumption because until 1993 the series of aggregate demand did not discriminate these two components.

[5] In the case of a multiplicative model of the form $Y_t = T_t*S_t*C *I_t$, we would arrive to an analogue expression of $Y_t = T_t + S_t + C_t + I_t$ taking logarithms.

TRAMO-SEATS software. More specifically, the methodology applied in this article consists of the following steps:

a) Specification of the Model and Signal Extraction

TRAMO ("Time Series Regression with ARIMA Noise, Missing Observations and Outliers") adjusts the model and Seats (signal extraction in ARIMA Time Series) –based on the adjusted model by TRAMO- estimates the trend cycle component, separating it from the seasonal and transitory-irregular components. In this way, the statistics that summarize the cycle characteristics are not affected by the noise of the series (irregular component).

The specification of the model was done through the automatic procedure parameter of TRAMO (RSA=4) [6].

b) Application of the Hodrick-Prescott Filter

The HP Filter is applied to the trend-cycle component of each variable, in order to estimate the final cycle component.

This filter is used to obtain a smoothed non-linear representation of a time series, one that is more sensitive to long-quarter than to short-quarter fluctuations. There is a "trend component", denoted by τ, that minimizes:

$$\sum_{t=1}^{T}\left(y_t-\tau_t\right)^2+\lambda\sum_{t=2}^{T-1}\left[\left(\tau_{t+1}-\tau_t\right)-\left(\tau_t-\tau_{t-1}\right)\right]^2.$$

The first term is the sum of the squared deviations $d_t=y_t-\tau_t$ .The second term penalizes variations in the growth rate of the trend component (The larger the value of λ, the higher is the penalty).

[6] The program tests for the log/level specification, interpolates missing observations (if any), and performs automatic model identification and outlier detection. The model is decomposed and optimal estimators and forecasts of the components are obtained, as well as their mean squared error. These components are the trend-cycle, seasonal, irregular and (perhaps) transitory component. If the model does not accept an admissible decomposition, it is replaced by a decomposable one.

Although the HP filter has become popular in the literature, it has been subjected to multiple critics. According to Kaiser and Maravall (2001) the filter presents the following limitations:

1) Lack of a proper foundation for the derivation of λ: this can induce arbitrariness in the measurement of the cycle. (Still, the success of the λ=1600 value may indicate that it roughly approximates the frequencies of interest to applied business-cycle analysts).

2) Poor performance of the filter at the end of the series: the filter implies large revisions for recent periods (roughly, for the last two years). The imprecision in the cycle estimator for the last quarters implies, in turn, a poor performance in early detection of turning points.

3) Noisy behaviour of the cyclical signal: the output of the filter could be contaminated with high frequency variation (such as the one associated with intraseasonal frequencies, as well as a large amount of the noise component present in the observed series), which is contrary to the desirable properties of a cyclical filter.

The methodology applied in this article deals properly with these last two problems. Regarding end point estimation, application of the filter to series extended with forecasts is, on occasion, recommended in practise. In this study, the HP-Filter is applied to the trend-cycle component of the series, which includes a forecast of two years (generated by TRAMO-SEATS). Regarding the noisy behaviour of the cyclical signal, as already mentioned, the HP-Filter is applied to a series which does not include the seasonal and transitory-irregular components.

Analysis of the Cycle Component

Autocorrelation function, cross-correlations and descriptive statistics were the techniques used to analyze the characteristics of the cycle components of the variables. The software applied was Gretl.

6. RESULTS

TRAMO Output Summary

As it can be viewed in Table 2, overall the statistics of the residuals are fine. Therefore we can conclude that the fitted models by TRAMO are adequate. Only in the case of Uruguay's GDP the normality is a little bit affected by the skeweness of the data. The economic crisis that strongly affected this country during the years 2001-2002, may be responsible of the asymmetry observed. In the case of Spanish GDP, the result is not very clear as normality seems to be well, but skeweness is observed on the data.

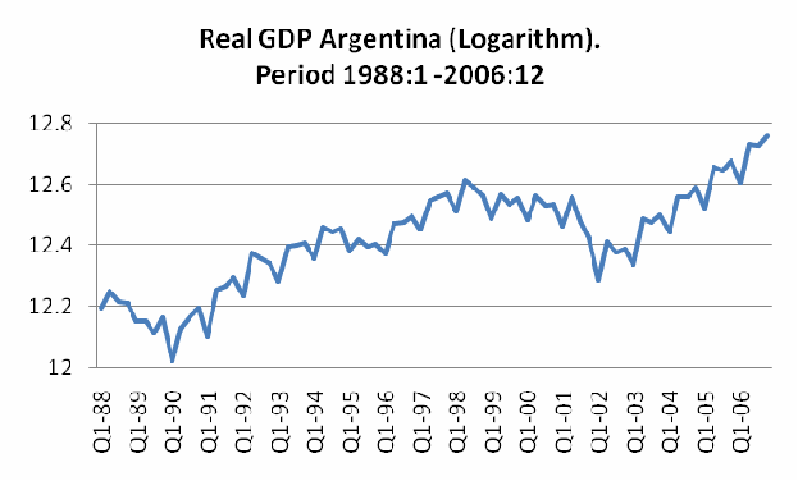
Table 2: Fitted Model and Summary Statistics of Residuals

Variable	Model (p,d,q)x(P,D,Q)	SE (res)	Q-val	N-test	SK (t)	KUR (t)	QS	Q2	RUNS
1 - GDP Argentina	(0, 1, 1)x(0, 1, 1)	0.0228	9.701	0.069	-0.26	0.002	2.44	10.53	1.97
2 - Imports	(1, 1, 0)x(1, 0, 0)	0.0718	12.99	1.02	0.256	0.977	0.	10.59	-1.20
3 - Total Consumption	(0, 1, 1)x(0, 1, 1)	0.0198	14.07	1.02	0.990	0.202	0.396	16.07	0.739
4 – GFI	(1, 1, 0)x(0, 1, 1)	0.0575	16.52	2.17	1.27	0.757	0.764	8.502	1.48
5 - Exports	(1, 0, 0)x(0, 1, 1)	0.0504	6.243	0.245	-0.47	-0.14	0.	23.82	0.482
6 - GDP Chile	(0, 1, 0)x(0, 1, 1)	0.0128	6.578	2.70	-0.08	-1.64	0.	**32.76**	0.248
7 - GDP USA	(0, 1, 2)x(0, 0, 0)	0.0047	9.717	0.199	0.006	-0.45	1.67	11.97	-0.47
8 - GDP Spain	(0, 1, 1)x(0, 1, 0)	0.0086	16.40	5.52	**-2.11**	1.03	0.	17.76	1.00
9 - GDP Uruguay	(0, 1, 0)x(0, 1, 1)	0.0235	10.29	**6.28**	**2.07**	1.41	0.	12.45	-0.49

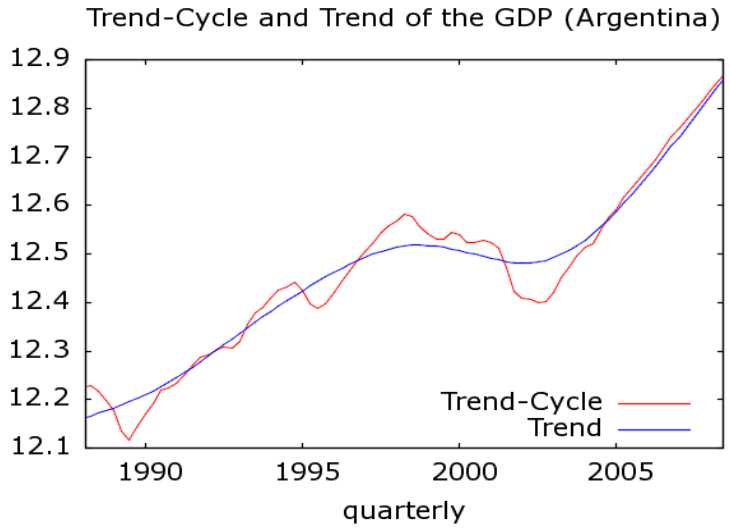
Reference Cycle

As the next graph shows, Argentina's GDP exhibits a growing trend over the last twenty years. During the period 1988:1-2006:4 the GDP experienced an increase of 76%. Two important crisis that affected the economic activity -the Hyperinflation of 1989 and the Financial Crisis of 2001- are the responsible of the strong decline in the GDP during the years 1989 and 2002, respectively. As it can be seen in the graph, the period 1990-1998 presents a steady growth, followed by a recession which persisted until the year 2003, when a period of recovery began.

The graph also shows the seasonality of the data, with decreases in the economic activity in the first quarter and higher increases in the second quarter of the year.

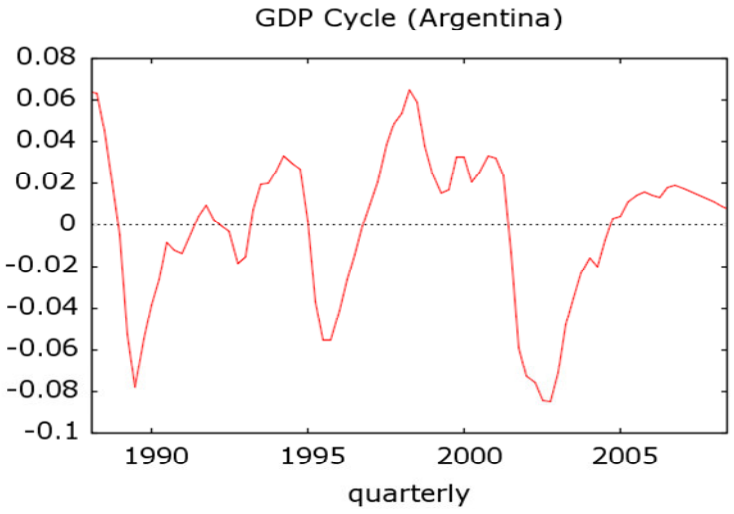


The following graph shows the trend-cycle and the trend of the GDP, obtained by TRAMO-SEATS.



As it can be viewed, the trend curve presents a smoother evolution than the trend-cycle. Consistent with the analysis done in the previous paragraphs, the trend does not present a stable evolution as three different periods (expansion-contraction-expansion) can be clearly distinguished in the graph.

The next graph presents the GDP cycle, obtained from the application of the HP filter to the trend-cycle component.



We can see that the cycle presents important deviations from its underlying trend. At the beginning of the period of analysis, the economic activity is in a phase in which the GDP is positioned above its long term growth trend. Then it experiences a contraction phase, and a thorough is observed in the third quarter of 1989, period in which the Real GDP is almost an 8% below of its trend. This recession period is surpassed in the third quarter of 1991, where the GDP is again situated above its trend. This is followed by a short period of contraction (1992:2-1993:1) after which a phase of recovery started, and finally a peak is observed in the second quarter of 1994 (the GDP is 3,3% above the trend).

From that moment, again it begins a period of contraction, with a thorough in the fourth quarter of 1995[7]. This is followed by a recovery period until the second quarter of 1998, where the economic activity reached the higher peak of the history until that moment[8].

After 1998's peak, a long recession period started, which ended up in the worst financial crisis of the history of Argentina (December 2001 Financial Crisis). A thorough is observed in the fourth term of 2002, with

[7] In this year there was a big crisis in Mexico ("Tequila Crisis", devaluation), that negatively impacted Argentina's economic activity (Tequila crisis generated pressures of devaluation in Argentina due to a great amount of cash flows that began to leave the country).

[8] The current statistics of the GDP position it in a level above the historical maximum of 1998.

the GDP almost 8,5% below its trend. From 2003 until now the GDP has been growing steadily at a rate of 8,5% annually, approximately. The most important reasons of this growth rates are the favourable international economic context (highest commodity prices, low FEDs and ECB -Europe Central Bank- interest rates, and China's economy growing strongly) and Argentina's devaluation[9].

Cycle Characteristics

Table 3 presents the volatility (standard deviation), relative volatility (relative deviation with respect to the reference cycle) and persistence of the cycle component of the variables.

Table 3: Volatility and Persistence of the Cyclical Components

Variable	Cyclical Volatility		Persistence
	Standard Deviation	Relative Deviation	First Order Autocorrelation
1 - GDP Argentina	3.6%	1.00	0.8966
2 - Imports	**18.3%**	5.15	0.8917
3 - Total Consumption	5.1%	1.43	**0.9050**
4 – GFI	**14.3%**	4.03	0.8975
5 - Exports	3.6%	1.03	0.8807
6 - GDP Chile	1.4%	0.38	0.8541
7 - GDP USA	0.8%	0.23	**0.9134**
8 - GDP Spain	0.9%	0.24	0.8764
9 - GDP Uruguay Index	3.3%	0.93	**0.9030**

According to Table 3, the most persistent series are the cycles of US GDP, Total Consumption and Uruguay's GDP. Argentina's GDP, Imports, GFI and Exports present a similar persistence in their cyclical behaviour. Chilean and Spanish GDP have the lower autocorrelation coefficients. Regarding volatility, the percentage standard deviation from trend of Argentina's real

[9] In addition, at the end of 2004 Argentina reached an agreement with its creditors (bond holders) which allowed the country to succeed in the negotiation process with them.

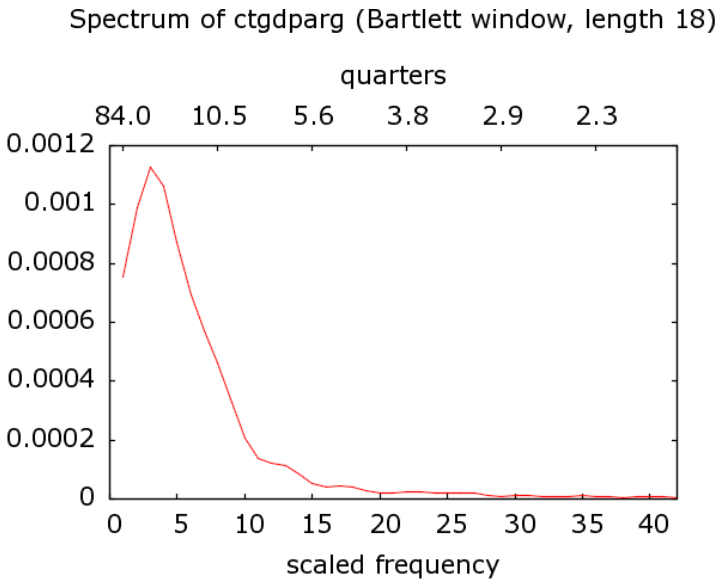
GDP is roughly 4 times larger than for more developed economies like US or Spain. Further analysis of the volatility of the variables is provided in the next section.

In Table 4 we can see the cross-correlations of the cyclical fluctuations with respect to the reference cycle. These coefficients are used to analyse the phase shift and contemporaneous comovements.

Table 4: Cross correlations of the cyclical components with respect to the reference cycle

Lag	Imports	Total Consum.	GFI	Exports	GDP Chile	GDP USA	GDP Spain	GDP Uruguay (Index)
-5	0.0160	0.1182	0.0274	0.1801*	-0.0697	**0.4496*****	0.1918*	0.3536***
-4	0.2439**	0.3082***	0.2374**	0.3132***	0.0310	0.4475***	0.1466	0.5575***
-3	0.4805***	0.5079***	0.4689***	0.3961***	0.1202	0.4382***	0.0810	0.7046***
-2	0.6888***	0.6815***	0.6774***	**0.4007*****	0.1829*	0.4256***	-0.0013	0.7721***
-1	0.8215***	0.8099***	0.8281***	0.3320***	0.2435**	0.3995***	-0.0893	**0.7805*****
0	**0.8507*****	**0.8646*****	**0.8888*****	0.2189**	0.2885***	0.3448***	-0.1885*	0.7301***
1	0.7415***	0.7616***	0.7796***	0.1084	0.3036***	0.2992***	**-0.2105***	0.6033***
2	0.5594***	0.5799***	0.5885***	0.0552	0.3090***	0.2431**	-0.1876*	0.4462***
3	0.3622***	0.3722***	0.3769***	0.0720	0.3092***	0.1829*	-0.1576	0.2934***
4	0.1733	0.1690	0.1845*	0.1358	0.3068***	0.1137	-0.1292	0.1682
5	0.0165	-0.0109	0.0253	0.2127	**0.3165*****	0.0221	-0.1017	0.0698

The following graph shows the spectrum of Argentina's GDP cycle. Analyzing the spectral density, the maximum is reached in 28 quarters, and the next higher value corresponds to 21 quarters. Therefore, it can be concluded that the average length of the cycle that most contributes to explain the variance of the series is between 5 and 7 years.



7. ANALYSIS

Based on the results presented in table 3 and 4, the following table provides a summary of the regularities of Argentina's Business Cycle as well as the cross-correlations with other countries.

Table 5: Summary of the regularities of Argentina's Business Cycle, and cross-correlations with other countries

Variable	Contemporaneous Correlation[1]	Phase Shift	Cyclical Volatility[2]
Imports	Strongly procyclical	coincidental	High
Total Consumption	Strongly procyclical	coincidental	Medium
GFI	Strongly procyclical	coincidental	High
Exports	Weakly procyclical	anticipates	Medium
GDP Chile	Weakly procyclical	follows	Low
GDP USA	Weakly procyclical	anticipates	Low
GDP Spain	Acyclical	follows (*)	Low
GDP Uruguay (Index)	Strongly procyclical	anticipates	Low

(*) low significance

[1] A series is i) procyclical if: $\rho>0.2$. (Strong if $\rho>0.5$ and weak if $0.2<\rho<0.5$), ii)countercyclical if $\rho<-0.2$ (Strong if $\rho<-0.5$ and weak if $-0.5<\rho<-0.2$), iii) acyclical if $-0.2<\rho<0.2$.

[2] Cyclical Volatility is classified as i) high (relative volatility>2), ii) medium (reative volatility between 1 and 2), and iii) low (realtive volatility<1).

a) Cyclical behaviour of the Output Components

Imports

The percentage standard deviation from trend of the imports is approximately 5 times larger than the volatility of the GDP. This variable is strongly procyclical and changes at the same time real GDP does.

Total Consumption

The relative volatility of this variable is 1,43. The fact that this variable is more volatile than the output is remarkable and different arguments try to explain that anomaly: it could be attributed to measurement errors of the series –as it is computed as a residual-, or problems of imputation of some goods that should be contabilized in the GFI component. Regarding comovemnts with the GDP, this variable is strongly procyclical and its phase shift is coincidental, as it would be expected.

Gross Fixed Investment

The cyclical fluctuations of this variable are 4 times larger than the volatility of the GDP. This is not surprising in countries like Argentina that have a higher risk associated to the investment decisions, which produces large fluctuations in this variable. The contemporaneous correlation with GDP shows that GFI is strongly procyclical, and its phase shift is coincidental.

Exports

The relative volatility of this variable is 1,03. Regarding the contemporaneous comovement, it is interesting to analyze how the direction of the movement changes if different subsamples are set. Considering the whole sample, this variable is weakly procyclical (ρ=0.2189). If the sample is set from 1992:1 to 2001:4 (convertibility period-exchange rate 1U$S=1$), the exports are acyclical (ρ=0.12). For the period 2002:1-2006:4 the exports are strongly procyclical (ρ=0.7393) as it could be expected in a devaluation context (exchange rate 1U$S=3$),

where this variable becomes one of the motors of the economy. With respect to the phase shift, this variable leaders the GDP cycle in two quarters (if we consider the whole sample period). However it is coincidental for the period 1995:1-2008:4.

b) International Comparison

The cyclical behaviour of the components of the GDP is according to the facts that exhibit the international cyclical fluctuations. The exceptions are that at the international level:
-the relative volatility of the exports is higher.
-the relative volatility of consumption and GFI is lower.
-the exports do not present a clear pattern of phase shift.

c) Cross-correlation between the cyclical fluctuations of the Real GDP of Argentina and other selected countries

The costs and benefits of deep regional economic integration -as currently pursued by the countries of the Mercosur and Chile- will depend to a large extent on the similarities of their business cycles.

Chilean GDP cycle is weakly procyclical, and follows the reference cycle in five quarters. The relative volatility is low (σ=0.38). Argentina and Chile present a great opportunity for expanding their bilateral commerce as these two economies are complementary in many productive processes. Therefore, I consider that the cycles of these two countries will tend to become more similar in the future, facilitating the integration process. Regarding **Uruguay's GDP cycle**, the cross-correlation structure shows that the cycle component of this variable is strongly procyclical and leads the reference cycle in one quarter. This result is rather strange, and is not according to the findings of Kamil and Lorenzo (1998) and Badagian (2006), that found that Uruguay's GDP anticipates the Argentina's GDP in three and one quarter, respectively. This may be due to differences in the sample periods. The relative volatility is very similar to Argentina (3,3%).

Regarding **US GDP cycle**, this variable is weakly procyclical with respect to the reference cycle, and anticipates it in five quarters (as would be expected due to the importance of this economy and the impact of the FED interest rate announcements). The relative volatility is lower (σ=0.23). **Spanish GDP cycle**, does not show a correlation significantly different form zero with the reference cycle (uncorrelation) and the relative volatility is 0.24.

8. CONCLUSIONS AND SUGGESTIONS FOR FUTURE RESEARCH

This study presents a characterization of Argentina's Business Cycle. Overall, the regularities found are similar to those at the international level. The most salient differences are:

-The higher volatility of Argentina's GDP cycle.

-The higher relative volatility of consumption and GFI.

-The lower relative volatility of the exports.

Another characteristic found is that the average length of the cycle that most contributes to explain the variance of Argentinean GDP series is between 5 and 7 years.

The cross-correlation analysis of the GDP cycles of Argentina and other countries reveals that:

-As expected, the U.S. GDP anticipates Argentina's GDP cycle in five quarters. This variable is weakly procyclical with respect to the reference cycle.

-Contrary to previous findings, Uruguay's GDP leads the reference cycle in one quarter. Consistent with other studies, this variable is strongly procyclical.

- Chilean GDP is weakly procyclical and follows the reference cycle in five quarters. However, due to the growing commercial relationship with Argentina, and the potential integration of this country to the MERCOSUR, it

is expected that the cycle of this country becomes more sincronized with the Argentinean in the future.

- Spanish GDP cycle appears to be not correlated with the reference cycle.

This study did not to verify if the correlation coefficients that were used to characterize the comovement and shift change of the variables with respect to the reference cycle, are stable over time. This could be assessed computing the evolution of the contemporaneous correlation coefficients, setting different subsamples (for instance eliminating the first period and adding one at the end, and so on).

Other variables could have been included in the analysis, for instance other European countries with a stronger commercial relationship with Argentina, or some aggregate of the OECD economic activity. Brazilian GDP is another variable that should have been included due to the strong relationship between this country and Argentina[10]. It would also be interesting to characterize the cyclical behaviour of the Brazilian imports with respect to Argentina's GDP (Argentina is highly dependent on Brazil imports). Other variables related with real facts like productivity, employment and hours per worker, could complement the analysis. Nominal factors like inflation and some monetary aggregate would also be interesting to analyse due to the high inflation process that Argentina has been going through since 2002 (caused principally by the constant issue of money of the government in order to sustain the exchange rate). It would also be interesting to examine the relationship of Argentina's country risk with the business cycle.

[10] Data was not available for the whole period of analysis.

REFERENCES

Burns, A. and Mitchell, W. 1946. "Measuring business cycles", *NBER*.

Kaiser, R. and Maravall, A. 2001. "Measuring Business Cycles in Economic Time Series". Lecture Notes in Statistics. *Springer*.

Kamil H., and Lorenzo, F. 1998. "Caracterización de las fluctuaciones cíclicas en la economía uruguaya". *Revista de Economía*. Segunda época, vol. V, n1, p. 83-141 - Banco Central del Uruguay.

Kydland, F., and Zarazaga, C. 1997. "Is the Business Cycle of Argentina "Different"?. *Economic Review (Federal Reserve Bank of Dallas, Fourth quarter)*, pp.21–36.

Kydland, F. and Prescott, E. 1990. "Business Cycles: Real Facts and Monetary Mith". Federal Reserve Bank of Minneapolis. Quarterly Review, 14, pp.3-18.

Badagian, A. 2006. "El ciclo macroeconómico del Mercosur tres años después de la crisis: Un análisis integrando el dominio del tiempo y de la frecuencia". Monographic Paper. Statistics Department, Universidad Carlos III de Madrid.