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CRISES AND CRASHES: ARGENTINA 1885 – 2003.

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Abstract

The objective of this paper is to study the economic history of crises in Argentina. Following Prebisch´s conjecture, we look for regularities in the behavior of key macroeconomic variables in the neighborhood of the crises. We perform parametric and non-parametric analysis in order to determine whether the Argentinean crises respond to the predictions of first, second or third generation models.

Firstly, we identify crises episodes throughout the Argentine history from 1885 to the present. We apply the Eichengreen, Rose and Wyplosz (1994) methodology to sort crises from non-crises periods, and we distinguish among deep crises (crashes), mild crises and turbulent episodes. Secondly, we split the sample in crises and non-crises years and carried out graphical analysis, and not parametric tests in order to establish weather key macroeconomic variables, namely public expenditure, GDP, external debt, exports, imports and the current account deficit change significantly before, during and after crises. We report the two-sample Kolmogorv-Smirnov test of equality of distributions and the Kruskal-Wallis test of equality of population.

Since the previous studies are intrinsically univariate, we also performed a regression analysis, estimating a logit model. It is found that fiscal variables have an important role in determining the probability of crisis. The domestic macroeconomic effects, measured by GDP growth and real M3 growth are also very strong. An appreciation of the currency (lagged once) also increases the probability of a crisis. We can also see that an impairing of external conditions make a crisis more probable.

JEL Classification Codes: E3, N20

Crises and Crashes: Argentina 1885 – 2003.

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La crisis actual es la misma de 1870, la de 1865, la de 1860, de la 1852, de la 1840, etc. El país ha vivido en esas crisis desde que dejó de ser colonia de España. Podría decirse que no es económica sino política y social. Reside en la falta de cohesión y de unidad orgánica del cuerpo o agregado social que se denomina Nación Argentina, y no es sino un plan, un desideratum de nación. La diversidad y lucha de sus instituciones de crédito, la anarquía de sus monedas, la emulación enfermiza que preside a sus gastos dispendiosos en obras concebidas para ganar sufragios y poder, vienen del estado de descomposición y desarreglo en que se mantienen las instituciones, los poderes, los intereses del país.

Juan Bautista Alberdi
Escritos Póstumos. Estudios Económicos. Tomo I.

En la historia monetaria argentina, a pesar de su confusa apariencia, nótese una serie de períodos de ilimitada confianza y prosperidad, de expansión en las transacciones, de especulación inmobiliaria y fantasía financiera, seguidos de colapsos más o menos intensos, precipitados en pánicos que originan la liquidación forzada de las operaciones, el relajamiento de la confianza, la postración y el estancamiento de los negocios. Sin duda, cada uno de estos ciclos no se presentan exactamente en las mismas condiciones, ni con idéntico carácter, pero, considerados en conjunto, es posible encontrar en ellos, hechos fundamentales que se repiten, cuyo análisis permite formular síntesis acerca de su evolución..... buscaremos demostrar que en nuestras crisis, aparte de las diferencias de menor cuantía, interviene un factor fundamental, ...y peculiar al grado de formación histórica del país.

Raúl Prebisch
Anotaciones sobre nuestro medio circulante (1921)

En los últimos 15 años, la Argentina ha gastado mucho más de lo que producía, omitiendo reponer las inversiones básicas de capital y endeudándose fuertemente en el exterior. ... Más del 80% de los ingresos del Estado se va en sueldos, y ello explica que no haya dinero para hacer viviendas, ni caminos, ni escuelas, ni siquiera para reparar pavimentos o dar más luz a nuestras obscuras calles... La Argentina ha estado viviendo una ficción económica, cuyas consecuencias están claramente a la vista...Todos los gobiernos han coincidido en la necesidad de reducir los elencos administrativos y las crecientes pérdidas de los servicios públicos, pero año tras año, esos gastos y esas pérdidas han ido en aumento ...

Arturo Frondizi
Radio Speech to the People of Argentina.

Memoria Anual 1958, Banco Central de la República Argentina.

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I. INTRODUCTION

Social sciences researchers faced to the Argentinean economic history for the first time, usually get surprised by the repetitiveness in economic episodes[1]. Those that deepen the study get absolutely astonished. Some economic events, like crises, seem to come and go over and over again, creating a sense of *dejà vu*. As sustained by former central banker Raúl Prebisch, more than 80 years ago (see quotation), characters may change, characteristics might be different but some fundamental facts can be traced throughout history.

Why crises are so frequent and of such large magnitude? What are these crises caused by? Do they always recognize the same causes? Which are those "fundamentals" named by Prebish?

Juan Bautista Alberdi and Arturo Frondizi, from different centuries and positions, blamed the irresponsible fiscal policy for the ever-returning crisis in the country (see quotation). However, external factors and expectations about the sustainability of economic policy might have played a role in the crises.

Case studies focused on particular crisis, like della Paolera and Taylor (1999, 2000) that analyze the 1929-32 crisis, seem to confirm the importance of the fiscal link in the crisis, although they stress too other factors like poor regulated financial sector and adverse external conditions. Similar conclusions can be drawn from numerous papers that study more recent crises (See Dornbusch, 1984; Cumby and van Wijnbergen, 1989; Kehoe, 2003; and Veigel, 2004).

The objective of this paper is to study the economic history of crises in Argentina. Following Prebisch´s conjecture, we look for regularities in the behavior of key macroeconomic variables in the neighborhood of the crises. We perform parametric and non-parametric analysis in order to determine whether the Argentinean crises respond to the predictions of first, second or third generation models.

Firstly, we identify crises episodes throughout the Argentine history from 1885 to the present. We apply the Eichengreen, Rose and Wyplosz (1994) methodology to sort crises from non-crises periods, and we distinguish among deep crises (crashes), mild crises and turbulent episodes. As far as we know, there are no comprehensive studies on argentine crises for long periods of time, covering the XIX and XX century as well as the present[2].

[1] Excessiveness is also an outstanding feature of Argentina's economic life. Periods of euphoria and unlimited enthusiasm are followed by frustration and endless delusion without any transition time (see Prebish's quotation)

[2] Studies like those of the Bordo and Vegh (1998) and Saxton (2003) also cover long periods of time but their emphasis is different from ours.

Secondly, we present graphical analysis and non-parametric tests. We split the sample in crises and non-crises years in order to establish whether key macroeconomic variables, namely public expenditure, GDP, external debt, exports, imports and the current account deficit change significantly before, during and after crises. We report the two-sample Kolmogorv-Smirnov test of equality of distributions and the Kruskal-Wallis test of equality of population.

Since the previous studies are intrinsically univariate, we also performed a regression analysis, estimating a *logit* model. The analysis of the macroeconomic variables in the neighborhood of the crises also helps us to test the validity of Alberdi's hypothesis as well as determine whether they respond to the predictions of the first or second-generation models of currency crises. This is particularly important since policy prescriptions are different depending on the type of crisis faced by the country.

The remainder of the paper is organized as follows. Section II sketches some theoretical issues on BOP crises. In Section III we briefly survey the empirical literature on the topic. Section IV is dedicated to the construction a market turbulence index for the 1885 – 2002 period that allows us to identify crises episodes and classify them as deep, mild and minor turbulence. Section V explains the empirical results obtained from the graphic analysis, the non-parametric tests and the regression analysis carried out. Finally, section VI presents some conclusions, conjectures and guidelines for further research.

II. THEORETICAL BACKGROUND

Since Krugman (1979) developed the first canonical model of currency crisis, a great deal of theoretical and empirical literature has surged. Most of the theoretical literature was concerned with the conditions a crisis should fulfilled in order to be considered first, second and/or third generation crisis, while most of the empirical studies tried to identify crises across countries according to this classification.

FIRST GENERATION MODELS

Krugman's seminal paper (1979) showed how inconsistencies between domestic economic conditions and the exchange rate commitment led to the collapse of the currency peg. In his paper, budget deficit fully monetized was financed by Central Bank expending reserves. When such reserves fell to a critical threshold a speculative attack was launched, causing reserves depletion and the abandon of the exchange rate peg.

The canonical crisis model stemmed from a work done by Salant and Henderson (1970) on the stabilization of commodity prices. In international markets, such stabilization would take

place through the operation of international agencies buying and selling commodities. On theoretical grounds, such scheme would be subject to important speculative attacks. The underlying logic of the model described by Salant and Henderson was taken by Krugman, and refined by Flood and Garber (1984), to explain central banks attempts to stabilize the exchange rate.

In the canonical currency crisis model, currency crises are the result of the fundamental inconsistency between domestic policies –generally the persistence money-financed budget deficit- and the attempt to fix the exchange rate. This inconsistency may be sustained while Central Bank has sufficiently large amount of reserves, but when reserves reach enough low level, speculators force currency crises.

Since government fixes the exchange rate, investors wish to hold domestic and foreign assets in fixed proportions. They rebalance their portfolio by exchanging domestic for foreign reserves of the central bank, since there is no internal mechanism to get rid of the excess money supply.

If speculators were to wait until financing the deficit depletes reserves, they would realize that holding foreign exchange is more attractive than domestic currency, leading to a jump in the exchange rate. But since agents are rational, no jump is possible, so they would sell domestic currency before the depletion of reserves, leading speculator to sell even earlier. The speculative attack takes place when the shadow price of exchange rates (the price that would prevail after the speculative attack takes place) equals the exchange rate. At that moment reserves are driven to zero forcing the abandonment of the fixed exchange rate, and the economy switches to a floating rate regime. With reserves depleted, budget deficit is financed by money creation, which in turn causes an increase in inflation rate.

Two important aspects of this model should be highlighted: the first one is that many economies reflect a basic inconsistency between fiscal policy and exchange rate regime. In this framework, speculative attacks are not only possible, but also inevitable. The time in which it will take place is perfectly known forehand, so nobody is taken by surprise. Secondly, even attacks may appear arbitrary and capricious, they can occur in a world where all speculators are completely rational. Rational economic behavior, characterized by smoothly evolution over time, can be associated with dramatic attacks and changes in the exchange rate regimes.

A considerable literature has developed in recent years that has amended and extended the original model. As already mentioned, Flood and Garber (1984) derive explicitly a solution for

the time of collapse in a fixed exchange rate regime. Recently, Agenor, Bhandari and Flood (1992) surveys currency crisis literature extensions in various directions.

SECOND-GENERATION MODELS

After the canonical crisis model failed to explain the European Monetary System crises (1992-1993), new generations of crisis models arose. The so– called second generation models developed by Flood and Garber (1984b) and Obstfeld (1986, 1994) focus on government comparison of the net benefits from changing the exchange rate versus defending it.

Second generation models are based on the existence of multiple equilibria. When investors anticipate that a successful attack will alter policy (even if they are not questioning that currency policy may be consistent with the currency peg) it will be expected that future fundamentals (conditional on an attack's taking place) be incompatible with the peg. In this case, government might defend the currency, but the costs (high interest rate, high unemployment rate) can be so high that government finally devaluates, so market anticipate that action and acts in advance. The government has many good reasons to defend the fixed exchange rate but also to abandon it. Crucially, the cost of defending a fixed exchange rate increases when people expect that the regime will be abandoned.

Why government would wish to abandon the fixed exchange rate? For example, if government has a large debt burden denominated in domestic currency, devaluation would evaporate part of the debt. Or, if the country is suffering high unemployment rates, and nominal wages are rigid, devaluation would diminish real wages.

If government has reasons to devaluate, why it would defend fixed exchange rate? It is often argued that in inflation-prone countries a nominal anchor is a guarantee against high inflation rates. Another argument is that a fixed exchange rate facilitates investment and international trade. Finally, it might be considered as a strong commitment to international cooperation (the case of Sweden in 1992)

Models of self-fulfilling attacks imply that good fundamentals may not suffice to avert currency crisis. The state of fundamentals determines the existence and multiplicity of attack equilibrium. In Krugman's model fundamentals may be consistent with exchange rate or not. In second generation models the same is true for extreme values of fundamentals, but there's also a large middle ground over which fundamentals are neither so strong as to make crises inevitable nor so weak as to make an attack impossible. An important difference between this two models is that in the first you can anticipate the moment of the depletion of

reserves, while in the second the timing is undetermined, so it can happens unexpectedly, and that is why they are considered so dangerous.

THIRD GENERATION MODELS

The standard explanation for speculative attacks had serious shortcoming when applied to the recent Southeast Asian currency crisis in 1997. The conventional currency crisis theory associated with inconsistency in present or future fundamentals missed important aspects in the Asian crisis, specifically the role played by financial intermediaries whose liabilities were perceived to have government guarantee, but were essentially unregulated and therefore subject to moral hazard problems.

In first generation model a la Krugman the collapse is inevitable and is the result of an over expansive fiscal policy, which is inconsistent with the monetary policy. In second generation models, crisis are the result of the predicted impair in fundamentals, or purely the result of self fulfilling prophecy.

As Krugman (1998) points out, none of the fundamentals that led to crises a la Krugman were present in the Asian economies. Second, Asian economies did not face severe unemployment when the crisis begun, nor had any incentive to abandon the peg to carry out expansive monetary policy. Third, in all countries were present a boom-bust cycle in the asset markets. Finally financial intermediaries had a central role in the crisis. A mismatch in the deposits of the banking and non-banking system was present: the institutions borrowed short term money, often in foreign currency, and lent that money in long term domestic currency.

The evidence seems to suggest that Asian crisis was neither the consequence of fiscal imbalances, nor were the incentives to follow an expansive monetary policy, but were the problems with financial intermediaries that drove the crisis. The excessive risk lending led to inflation in the asset prices. When the crisis burst, the asset prices fall, the insolvency of intermediaries were visible, forcing them to cease operations, which in turn implied further deflation in asset prices.

III EMPIRICAL LITERATURE

With the standard first generation models, crisis should have a significant predictable component. Previous to the speculative attack we should observe an expansive fiscal and monetary policy, and a decline in international reserves for long periods.

On the other hand, second generation models imply that speculative attacks should be followed by expansive monetary and fiscal policies.

Third generation models emphasize in the role played by financial intermediaries, so they analyze variables related to them, such as the liquidity coefficient, solvency of the financial sector, external debt maturity, and assets denomination versus liabilities.

Blanco and Garber (1986) using a variant of Krugman-Flood and Garber model, find important insight related to the behavior of macro variables previous, during and after the crisis. It predicts that we should not only observe fiscal deficit, but also growing quantity of money, wages, real exchange rate appreciation, impairing in current account deficit and in the trade balance and an increase in the domestic rate of interest. This work was extended by Goldberg (1993) and by Cumby and van Wijnbergen (1989) for the crawling peg experience in Argentina during the 80's.

These papers focused on specific events and on particular countries. Later studies concentrated upon cross-countries crisis episodes. For example Edwards (1989) studies 39 devaluation in emerging countries during 1962 –1983.

The speculative attack during the 90's challenged the view of researchers that crises respond to irresponsible fiscal and monetary policy. Empirical papers tried to understand the origins of these crises. They studied the behavior of macro and financial variables during crisis episodes and compared with tranquil periods. Eichengreen, Rose and Wyplosz (1995), Sachs, Tornell and Velasco (1996), and Kaminsky, Lizondo and Reinhart (1997) followed this line of research.

The severe crisis in Southeast Asian countries (1997), opened a new branch of investigation. Most papers tried to emphasize in the role of financial variables to explain crises. For example McKinnon and Pill (1998) compare the Southeast Asian crises with the episodes in Mexico and Chile, finding important similarities but they point out that the Asian episodes were exacerbated by the unhedged foreign exchange position of Asian banks.

Recent currency crises raised questions related to the predictability of currency crises. Many empirical works attempt to build early warnings using macro and financial variables, as is the case of Lizondo, Kaminsky and Reinhart(1998)

IV. IDENTIFYING CURRENCY CRISES

There is not a unique definition of currency crisis, however most economists would agreed that a currency crisis is an speculative attack against currency that ends up in a devaluation

if the attack is successful. Nonetheless authorities may ward off the attack by losing foreign reserves and/or by increasing the rate of interest.

One of the key questions to be solved in the analysis of crisis is how to identify speculative attack in foreign exchange rate, and to determine under what circumstances the movement in these indicators represents a crisis. The following questions arise: Is a currency crisis limited to exchange rate devaluation? How large a movement must be to be considered a crisis? How large a devaluation must be to qualify for a crisis in high inflation periods?.

Eichengreen et al (1994) propose a weighted index of speculative attack that includes changes in the exchange rate, in the international reserves and in the interest rates. Each component is weighted by the inverse of its variability. As Moreno and Trehan (2000) point out this approach implicitly assumes that one standard deviation change in the interest rate represents as much as for a currency crisis as one standard deviation change in exchange rates or reserves. Many researchers followed a similar methodology. For example, Kaminsky and Reinhart (1999) construct a similar index, but they exclude interest rate arguing data availability, particularly, that interest rates series are not consistently available for the whole sample they use.

Frankel and Rose (1996) construct the most obvious indicator of crises: changes in the nominal exchange rate. They exclude reserves and interest rates on the grounds that foreign reserve data contains a lot of noise, and few countries have market-determined short-term interest rates. Moreover, since a successful speculative attack ends up in currency devaluation (and that is the case in most emerging countries) only changes in the nominal exchange rate are needed to determine currency crises[3].

The second issue is related to how big a movement in the index should be to be considered a speculative attack. There are also different criteria. Frankel and Rose (1996) propose an absolute cutoff. Most researchers, however, rely on the moments of the distribution (mainly mean and standard deviation) to determine crisis. Some of them use the moments of the distribution of the index (for example Eichengreen et al., 1994, Reinhart and Kaminsky, 1999), while others prefer the moments of the component of the index (Moreno, 1995).

In high inflation episodes, rates of depreciation are consequently high. To ensure we are not considering each of these deprecations as an independent crisis, it is necessary to compute separate standard deviations for those periods. As pointed our by Reinhart and Kaminsky

[3] Some researchers have proposed indexes that weight different components of speculative attacks. However in some cases they are not easy to construct, as is the case in Girton and Roper (1979)

(1999), if standard deviation is computed for the full sample, too many crises may be identified during inflationary episodes.

From the discussion we see that no measure of currency crises is perfect, they all have pros and cons, and there are always elements of arbitrariness. We choose an index similar to the one proposed by Eichengreen et al (1994) and Kaminsky and Reinhart (1999)[4], since we are interested in all speculative attack, successful or not. This specification of the index will allow us to capture episodes like "Tequila", where authorities managed to keep the peg, despite the drainage in reserves and the increase in interest rate.

The index stems from the idea that market pressure increases when exchange rate devaluates (rises), when interest rates increase and when international reserves fall. Under a floating exchange rate regime, we expect abrupt increases in the exchange rate as crisis develops, while under a fixed exchange rate, prior to devaluation, interest rates increase and international reserves diminish.

We use the rate of change of nominal interest rate rather than the difference between the domestic and international rate, as in other papers, due to the inflationary process Argentina went through during several decades. These inflationary processes implied high and volatile rate of interest, and given the relative constancy of the international rate, the difference between domestic and international rate proved to be meaningless to capture turbulent periods. The Market Turbulent Index (MTI) is:

$$MTI = \frac{\hat{e}}{\sigma_e} - \frac{\hat{R}}{\sigma_R} + \frac{\hat{i}}{\sigma_i}$$

Where the symbol $\hat{}$ represents the growth rate of the variable, e is the exchange rate, R stands for international reserves, I is the domestic interest rate and σ_e, σ_R, σ_I are the standard deviations of the growth rate of the exchange rate, international reserves and domestic interest rate, respectively.

The Index is weighted by the inverse of the respective standard deviation to avoid the most variable component dominates the index movements. However, we also used different weights to test the robustness of the index, and the crisis determination proved to be quite robust to different weight specifications.

The index was computed with monthly data from 1885 to 2002[5]. We imposed different criteria to sort crises, but whenever the MTI is greater than the mean (μ) plus ***k*** standard deviations (STD) we identify a "signal" or "turbulent episode".

We require at least two "close" months with ***MTI*** greater than the mean value plus three STD to consider that episode as deep crisis or "crash". If the ***MTI*** is greater than μ plus two STD but less than μ plus three STD, we call it "mild crisis". If ***MTI*** exceeds its mean value in a half STD at least twice the episode is considered "minor turbulence". The remaining episodes, i.e. when the index departs less than one half standard deviation from the average are termed as "non- crisis" or tranquility times. In high inflation episodes (1976 and 1989), we excluded the data for the estimation of the moments, to preclude these data distort the "signals".

In order to determine the boundaries of a given crisis and so avoiding dating twice the same crisis, we require at least six months with no signals between each other.

Table 1. ***Criteria to sort Crises***

Monthly Data		
Criteria		**Classification**
Index	***# of Signals***	
$MTI < 0.5\ \sigma_{MTI}$		Non- crisis
$0.5\ \sigma_{MTI} < MTI < 2\ \sigma_{MTI}$	Two close months	Minor Turbulence
$2\ \sigma_{MTI} < MTI < 3\ \sigma_{MTI}$	Two close months	Mild
$MTI > 3\ \sigma_{MTI}$	Two close months	Deep

The ***MTI*** was computed for five sub periods in order to keep its variance relatively homogeneous. Sub periods were chosen by political, economical and historical events. The sub periods chosen were the following:

(a) 1885-1913: from Roca to the First World War

(b) 1914- 1945: the Interwar Period:

(c) 1946- 1976: from Perón to Perón:

(d) 1976- 1991: from Hyper to Hyper Inflation:

(e) 1992 – 2002: Convertibility, from boom to burst:

[4] We also included the rate of interest in the index but for some sub periods this series is not available on monthly basis.
[5] For the period 1885-1914 monthly data to compute the index were not available, so we used annual data.

With annual data, we arbitrarily classified an episode as "mild crisis" when the market turbulence index exceeds one and a half standard deviations from the mean value in a given year. If MTI is greater than two STD we say that the crisis is "deep" and if MTI only exceeds its mean value in one STD, we term that episode as "minor turbulence".

It is worth remark that the terms "tranquility", "minor turbulence", "mild" and "deep" are referred to the sub period considered and does not intent to be an absolute qualification for the whole period.

DATA

Considerably effort has been devoted on the construction of time series for 117 years. The market turbulence index was computed from monthly data from 1914 to the present. Exchange rates were taken from Vázquez- Presedo (1971 and 1975), Ámbito Financiero (1984) and FIEL. To construct the international reserves series we use data from Vázquez-Presedo (1971 and 1975) International Monetary Fund and Banco Central de la República Argentina (BCRA). Interest rates were taken from Vázquez-Presedo (1971 and 1975), FIEL and BCRA. Monetary, fiscal and international trade variables were obtained from Cortés Conde (1989) and also from BCRA, Ministerio de Economía de la Nación, Vázquez-Presedo and from Gerchunoff and Llach (2003). Recent data of terms of trade as well as exports and imports comes from CEPAL.

THE CLASSIFICATION OF CRISES

We dated **19** crises throughout **117** years of history[6]. *Five* crises were rated as "deep", *nine* as "mild" and *five* as "minor turbulence". Interestingly, the number and magnitude of the crises increases through time (see Table 2). The four "deep crises" identified correspond to the years, 1890-91, 1929-32, 1975-76, 1989-91 and 2001-02.

The 19 crises implied 26 crises years. That is, Argentina was 23% of the 117 years considered in crises, which meant one *crisis year* every 4.5 years. A given year is considered a *crisis year* if the market turbulence index exceeds one standard deviation from the average in at least 2 months consecutive or alternate.

According to our index, the most turbulent period of Argentina's history was 1977 –1991, not only because it registered 4 crises in 15 years, but also because nine of those years were *crisis years*, which meant 60% of these years in crisis (see Appendix, Table 2 A for details).

[6] Eichengreen and Bordo (2000) study dated *crises years* for more than 20 countries in the period 1885 – 1998. They found that Argentina had the poorest performance since it was the country that suffered more crises in the period.

Table 2. ***Crises Summary***

Period	*Years (1)*	*Number of crises (2)*	*Number of* crises years *(3)*	Crises Years *as % of total years (3)/(1)*	*GDP Growth (annual average in%)*	*Type of crisis*		
						Deep	***Mild***	***Minor Turbulence***
*1885-1913**	*28*	*2*	*3*	10	*5.4*	*1*	*1*	
1914 – 1945	32	4	7	22	3.1	1	1	2
1946 – 1976	31	7	10	32	3.8	1	4	2
1977 – 1991	15	4	9	60	0.4	1	2	1
1991-2003	11	2	3	27	2.1	1	1	
Total	***117***	***19***	***26***	***23***	***3.3***	***5***	***9***	***5***

Note: * For the 1885-1913 period the index was built with annual data

V. EMPIRICAL RESULTS

How did the Argentine economy perform in the neighborhood of crises? Is there any regularity in the behavior of the macroeconomic variables around these extreme episodes? Did the Argentine crises respond to the predictions of the first, second-generation or third generation currency crisis models? In order to approach the answer of these questions we perform graphic analysis, non-parametric and regression analysis.

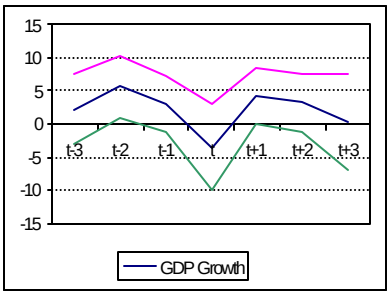
GRAPHIC ANALYSIS

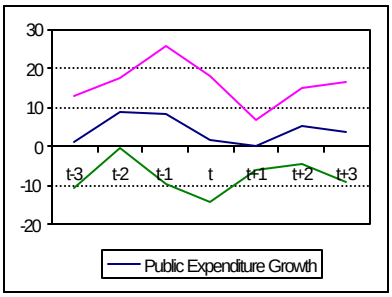
Each of the graphics portrays the movement in a variable of interest three years before and three years after the crisis. As Frankel and Rose (1996) point out, a graphical approach has advantages and disadvantages. Among the first, a graphical analysis imposes no parametric structure on the data, makes only a few assumptions that are necessary in inference statistics, and they are often more accessible and informative than tables with estimations of coefficients. On the other hand, they are informal, and intrinsically univariate.

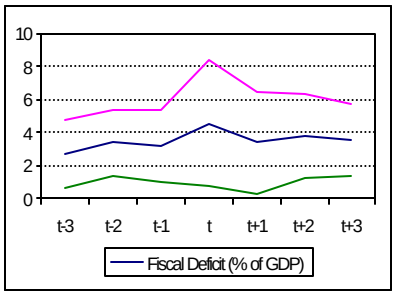
A brief comment on each variable follows.

- *GDP growth* reaches a peak two years before the beginning of crises (on average 5.7%) and the trough at the moment of the crises (-3.6% on average). The difference between peak and trough is 9.3% on average.

- *Public Expenditure Growth*: the peak is observed two periods before the crises (on average, increases 8.7%) and the trough at ***t+1*** with an average value of 0.4% (which means a fall of 8.3%)



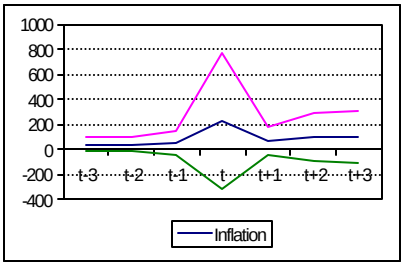


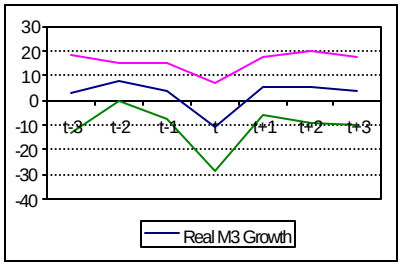


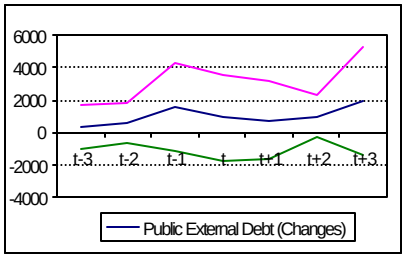
- *Fiscal deficit (as % of GDP)* increases before crises and peaks during the crises at an average level greater than 4%.

- *Inflation*: peaks during the crises and falls abruptly in ***t+1***.

- *Real Money (M3/P):* it reaches a peak in ***t-2*** (18.6% on average) and a trough during the crises, averaging -7.4%.

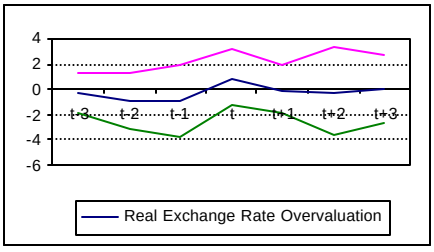


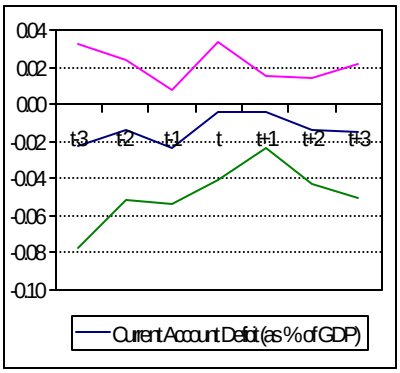


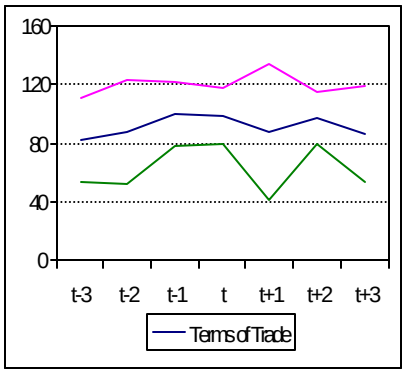


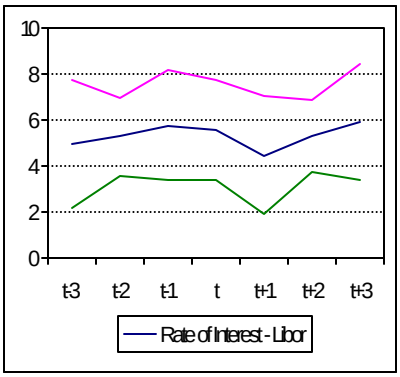
- *Current Account Deficit (as % of GDP)* reaches a peak at ***t-1*** (average -2.33) and a trough at t (-0.38%), i.e. an improvement of 2%

- *Real Exchange Overvaluation*: reaches a peak in t-2 (appreciation) and a trough at ***t***.





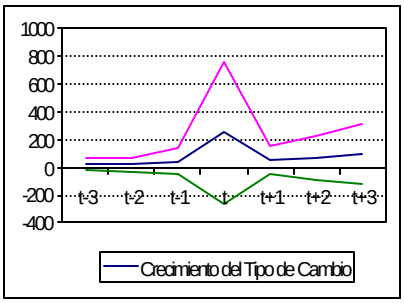


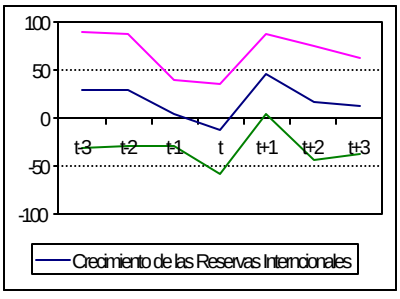


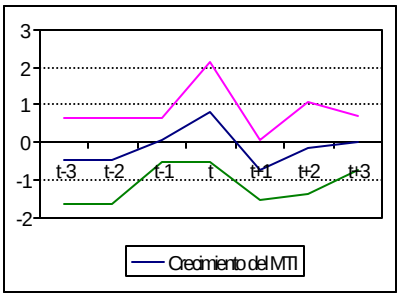
- *International Reserve Growth*: on average they increase at 30% at t-3, and reach a minimum at t with a fall of -11%

- *International Rate of Interest and Terms of Trade (TOT)*: they both reach a peak one period before the crises begin. For emerging economies, the increase in the international interest rate is very important for two reasons. Firstly, it is key to explain the capital inflow and outflow to emerging countries as pointed out by Calvo, Reinhart and Leiderman (1992). Secondly, it impacts on the service of external debt. An increase in the rate of interest is associated with worsening in quasi fiscal deficit and consequently in fiscal accounts. The fall in terms of trade one period before crisis, let us think that in most severe crisis adverse external conditions were present .

- ***MTI*** *and its components*, as we expect, since we use them to sort crisis, behave differently during crisis than in the periods before and after.







Note: color lines above and below the average are the intervals (*u+ STD*) and (*u – STD)* respectively.

NON-PARAMETRIC TESTS

In order to compare crises and non-crises episodes more systematically, we carried out several non-parametric tests. Table 3 shows four tests of equality of population (Wilcoxon,

Median Chi-square, Kruskal-Wallis and van der Waerden) and table 4 contain the Kolmogorv-Smirnov test for equality of distributions. The null hypothesis in the first group of tests is that selected macroeconomic variables do not differ significantly during crises and non-crises periods. The statistics tabulated are values of these tests under the null, so small values lead us not to reject the null of equality of population. Small probabilities value computed let us reject the null (one asterisk indicate values less than 5%, while double asterisk less than 1%). We reject the null for all series, except for CA and TOT, for all the methods reported.

Table 3. Panel A. ***Test of equality of population***.

Method	GDP	Public Expenditure	Public Revenue	Inflation	M3
Wilcoxon/Mann-Whitney	3.8**	2.6**	3.6**	4.4**	2.6**
Med. Chi-square	9.6**	2.8**	11.7**	11.7**	2.3**
Kruskal-Wallis	14.5**	6.9**	13.1**	19.5**	6.8**
van der Waerden	14.3**	7.0**	13.7**	21.6**	8.4**

Note: ** p-value less than 1%

Table 3. Panel B. ***Test of equality of population***.

Method	Exports	Imports	CA/GDP	TOT
Wilcoxon/Mann-Whitney	2.51**	3.09**	0.91	1.87
Med. Chi-square	10.25**	7.08**	0.94	3.05
Kruskal-Wallis	6.31**	9.56**	0.83	3.53
van der Waerden	7.06**	10.16**	0.71	3.01

Note: ** p-value less than 1%

We also tabulated the two-sample Kolmogorv-Smirnov test for equality of distributions. Under the null hypothesis MTI and macro variables have the same distribution in crises and non-crises periods. As in the tests of equality of population, small values of probabilities led us to reject the null for all variables except for Current Account Deficit (CA) and Terms of Trade (TOT).

These results are consistent to the ones obtained by Eichengreen et al (1994). They found significant differences between crises and non-crises periods for emerging economies but none for European countries. These evidence supports the first generation BOP crisis models. As argued by Eichengreen et al (1994), if speculative attacks are caused by self-fulfilling prophecies or simply by changes in expectation (as suggested by the second generation models), there should be no significant differences in macro variables behavior during periods of speculative attacks and tranquility. But if we observe significant differences, the nature of these differences may reflect the inconsistent macroeconomic policies.

Differences in monetary and fiscal policy indicators during periods of crisis versus non-crisis may shed light on whether an expansionary monetary and fiscal policy may trigger speculative attack as in Krugman first generation model.

On the other hand some internal or external indicators may give a sign that the cost of maintaining the peg is too high for the government, leading to a shift in expectations that may trigger a speculative attack, as in second generation model. For example a high rate of unemployment or a current imbalance as suggested by Obstfeld (1994) and Drazen and Masson (1994)

Table 4. Panel A. ***Kolmogorov- Smirnov Test.***

	GDP*	Public Expenditure *	Public Revenue*	Inflation	M3*
Kolmogorov Smirnov	0,45	0,32	0,44	0,51	0,51
P-value	0,00	0,02	0,00	0,00	0,00
Corrected	0,00	0,00	0,00	0,00	0,00

Table 4. Panel B. ***Kolmogorov- Smirnov Test***.

	Exports*	Imports*	CA/GDP	TOT
Kolmogorov Smirnov	0,36	0,42	0,14	0,12
P-value	0,01	0,00	0,71	0,88
Corrected	0,00	0,00	0,63	0,83

REGRESSION ANALYSIS

The graphical and non-parametric studies are intrinsically univariate. These results can be enriched and complemented by incorporating a multivariate analysis. We estimate a logit model whose binary dependent variable takes the value 0 for no-crises years, and 1 for crises years. Independent variables were classified into three groups: (i) ***Domestic Macroeconomic Indicators***: real public expenditure growth, GDP growth, Real M3 growth. (ii) ***External Indicators***: CAD, Reserves/Imports Ratio, Real Exchange Rate Over Valuation[7], External Debt. (iii) ***Foreign Variables***: International Rate of Interest, TOTRather than testing specific models of BOP crises, we try to characterize the crises suffered by Argentina in 117 years of history.

[7] The degree of overvaluation of domestic currency is measured as the deviation from the trend

Three alternative models were estimated using maximum likelihood[8]. Results are tabulated in Table 5. Since logit coefficients are not directly interpretable, we report the effect of a change in variables on the probability of crisis. We also tabulated z-statistics with null hypothesis of no effect. We also report McFadden R squared.

Table 5. ***Regression Results***.

Variable	Model 1	Model 2	Model 3
C	3.90 (1.18)	-0.93 (-0.27)	-0.85 (0.25)
GDP growth	-0.17 (-2.99)	-0.17 (-2.76)	-0.17 (2.76)
Public expenditure growth	0.05 (2.55)	0.04 (2.29)	0.04
Real M3 growth	-0.08 (-2.79)	-0.09 (-2.60)	-0.08 (2.60)
External Debt	-6.05E-06 (-0.06)	1.45E-05 (0.13)	
Terms of Trade (TOT)	-0.06 (-2.10)	-0.03 (-1.14)	-0.03 (-1.18)
Current Account Deficit	-4.90 (-0.78)		
Current Account Deficit (-1)		-22.41 (-2.39)	-22.22 (-2.41)
LIBOR	0.23 (1.19)		
LIBOR (-1)		0.56 (2.37)	0.55 (2.36)
Reserves /Imports	-1.62 (-2.13)	-1.42 (-2.07)	-1.41 (-2.04)
Real Exchange Rate overvaluation	0.41 (2.51)	0.44 (2.59)	0.44 (2.60)
Real Exchange Rate overvaluation (-1)	-0.47 (-2.31)	-0.48 (-2.28)	-0.48 (-2.28)
LR statistic (11 df)	52.67285	60.28001	60.26328
Probability (LR stat)	8.56E-08	3.21E-09	1.19E-09
McFadden R-squared	0.42324	0.484366	0.484
Obs with Dep=0	92	92	92
Obs with Dep=1	26	26	26

Note: Z statistic in parenthesis below coefficient

Most of the variables included are statistically significative at usual levels. It is found that the probability of crisis increases when GDP, real M3 growth, and the ratio reserves to imports fall. It crises are also more likely when the local currency appreciates (lagged once), and TOT impairs (although this variable is not statistically significative at standard values).

[8] We also estimated by probit and Linear Probability Model, but results do not differ significantly

On the other hand, an increase in public expenditure growth, in the current account deficit (lagged one period), in the external debt (not significative in Model 1), and an increase in the international rate of interest also increase the probability of crisis.

Interestingly enough, the results of the regression let us conclude that fiscal variables have an important role in determining the probability of crisis. The domestic macroeconomic effects, measured by GDP growth and real M3 growth are very strong. An appreciation of the currency (lagged once) also increases the probability of a crisis, but contemporaneously it has the opposite sign as expected, since during crisis devaluation has already taken place. However we can also see that an impairing of external conditions (measured by an increase in international rate of interest or by a worsening in TOT) makes a crisis more probable.

VII. CONCLUSIONS

Alguna vez nos deja pensativos la sensación "de haber vivido ya ese momento".
Jorge Luis Borges,
La doctrina de los ciclos. En Historia de la Eternidad. Emecé Editores Buenos Aires 1998. Página 109

Since its independence, Argentina was involved in several crisis episodes. These episodes have been more frequent and deeper since 1930. Why crises are so frequent and of such large magnitude? What are these crises caused by? Do they always recognize the same causes? Why do governments, from different political parties, always get involved in large fiscal imbalances? What is the role of institutions?

This paper, does not aim to answer all these questions, but is aiming at understanding best Argentinean crises.

Firstly, we dated crises and classified them in "turbulent episodes", "mild" and "deep", by means of a *Market Turbulence Index*, defined as the weighed rate of change of exchange rate, reserves and interest rates, for the period 1885-2002.

Secondly, we use different techniques to analyze the behavior of macroeconomic and financial variables in the neighborhood of crises and to characterize the set of currency crises suffered by Argentina in most of its life as an independent nation.

The *graphical analysis* showed that key variables, namely public expenditure, GDP, external debt, exports, imports and the current account deficit change significantly before, during and after crises. In particular, the behavior of public expenditure coincides with the predictions of the first generation models of currency crises and the reversion in the current account supports the sudden stop theory.

We split the sample in crises and non-crises years and performed non-parametric test (the two-sample Kolmogorv-Smirnov test of equality of distributions and various tests of equality of population) that rejected the null hypothesis of equal distribution and population for most macroeconomic variables.

Finally, we carried out a regression analysis, estimating a logit model. We found that domestic macroeconomic effects, measured by GDP growth and real M3 growth, and the fiscal variable (public expenditure growth) were very strong. An appreciation of the currency (lagged once) also increases the probability of a crisis and impairing of external conditions make a crisis more probable.

With all this evidence at hand, some preliminary conclusions can be drawn:

- Fiscal imbalances were always present, which is consistent with the predictions of first generation speculative attack models. In that sense, Frondizi and Alberdi were right.

- In most of the crises, regularities in the behavior of macrovariables can be detected. In that sense, Prebisch was right

- Adverse foreign factors had also a key role in explaining crises: an increase in international rate of interest and an impairing in TOT increases the probability of crisis.

Although most of the evidence presented here supports mainly the first generation speculative attack models or *à la Krugman*, we also detect some elements of sudden stop theory and third generation models.

The severity and persistence of currency crises in Argentina, the high vulnerability to external shocks regardless of the type of government (*de facto* or constitutional) and the political party in office, seem to reveal problems at the roots of the country rather than associated to particular economic policies or specific adverse shocks. It all seems to point out at the institutional design. In that sense, Alberdi was right.

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Table 1 A.. ***Crises Characteristics: 1914 – 2002.*** Monthly Data

Crisis	Exchange Rate					International Reserves					Interest Rate					Crisis breath			Market Turbulence Index					Crisis Type
	Trough		Peak		Change %	Peak		Trough		Change %	Trough		Peak		Change %	Beginning	End	# months	I > 3	I > 2	I > 1.5	I > 1	I > ½	
	$/U$S	month	$/U$S	month		mm	month	mm	month		%	Month	%	Month										
1914	2351	Mar-14	2368	May-14	-0.72	232.1	Apr 14	196.39	Jul-14	-15.39	7.50	Apr 14	8.75	Aug 14	16.7	May-14	Jul-14	3	0	2	0	0	1	Mild
1920/21	2330	Apr 20	3454	Jul-21	-32.54	470.6	Jul-20	470.6	May-21	0.00	7.38	Oct-20	8.13	Apr 21	10.2	Jul-20	May-21	11	0	0	1	1	5	Turbulence
1929/31	2375	Jan 29	4260	Oct-31	-44.25	502.6	Jan 29	256.9	Feb-32	-48.88	6.13	Dec 28	7.87	May-31	28.4	Mar-29	Dec 31	22	**3**	**6**	1	6	4	**Deep**
1937/38	3291	Jun-37	3903	Apr 38	-15.68	476.4	Jun-37	343.1	apr 38	-27.99	5.14	Oct-37	5.75	Jan 39	11.9	Mar-37	Apr 38	14	0	0	0	4	5	Turbulence
1948/49	475	Apr 48	1650	Nov-49	-71.21	3737	Feb-48	2067	Jul-49	-44.69						Mar-48	Nov-49	16	**1**	**1**	2	2	2	Mild
1951	1374	Jun-50	2950	Sep-51	-53.42	2689	Dic-50	1866	Dic-51	-30.61						Jan 51	Aug 51	8	0	1	0	2	1	Turbulence
1958	3720	Dec 57	7350	Oct-58	-49.39	461120	May-57	101270	Oct-58	-78.04						Jan 58	Oct-58	10	**1**	1	1	1	2	Mild
1962	8420	dec 61	14840	Nov-62	-43.26	497765	Ago-61	120865	Oct-62	-75.72						jan 62	Oct-62	10	**1**	1	0	0	5	Mild
1964 /65	14040	May-64	28570	Jul-65	-50.86	321365	May-64	117180	Jun-65	-63.54						Jun-64	Jun-65	13	0	1	2	0	5	Turbulence
1971	41750	Feb-71	97750	Nov-71	-57.29	743825	Oct-71	194289	Jun-72	-73.88						Jun-71	Jul-72	14	0	**2**	2	2	3	Mild
1975 /76	14	Jun-74	333.5	Mar-76	-95.80	1536531	May-74	293346	Aug 75	-80.91						Jul-74	Mar-76	21	**2**	**4**	2	5	2	**Deep**
1981/82	1986.5	Dec 80	61568.2	Nov-82	-96.77	7343.891	Jul-80	2425.136	Nov-82	-66.98	4.31	Oct-80	10.82	Jul. 81	151.04	Dec 80	Nov-82	24	1	2	1	6	1	Mild
1983/84/85	94650	May-83	9520454.6	Aug 85	-99.01	3244.84	Jan 82	973.53	Feb-85	-70.00	10.00	May-83	31.40	May-85	214.00	Jul-83	Apr 85	22	0	0	5	3	6	Turbulence
1987	8951.0526	Jun-86	143100	Sep-88	-93.74	3718.56	May-86	958.39	Ago-87	-74.23	4.20	Jun-86	19.30	Jul-88	359.52	Aug 86	Jun-88	23	0	3	0	3	5	Mild
1989/90/91	143100	Sep-88	98790000	May-91	-99.86	2652.47	Nov-88	898.91	Jan 90	-66.11	8.35	Sep-88	83.20	Jun-89	896.41	Jan 89	Feb-91	26	**11**	**1**	0	2	1	**Deep**
1995	1	Dec 94	1	Mar-95	0.00	9967.07	Nov-94	5958.6	Apr 95	-40.22	0.60	Oct-94	1.50	Apr 95	150.00	Dec 94	Mar-95	4	0	2	2	0	0	Mild
2001/02	1	May-01	3.69	Nov-02	-72.87	27547	Sep-00	9031	Oct-02	-67.22	0.58	Aug 00	4.86	Jul-02	737.93	Oct-00	Oct-02	25	**9**	**1**	1	2	4	**Deep**

Note: the rate of growth of exchange rates and international reserves were computed from a peak to trough, considering the behavior of these variables six months before and after the signal given by the *Market Turbulence Index* announces the beginning and end of the crisis.

Table 1A. Panel A. ***Mean and Standard Deviation of Crises and non Crises Episodes***.

	Parameter	Growth Rate (%)				
		GDP	Public Expenditure *	Public Revenue*	Inflation	M3/P
Crises	Mean	-0.5	-1.5	-2.9	237.7	-3.7
	Standard Deviation	6,3	15.4	14.2	617.4	29.2
Non-crises	Mean	5.0	8.1	8.5	15.0	12.4
	Standard Deviation	7,6	20.6	15.8	36.4	27.9
Total	Mean	3,6	6.1	5.1	81.7	7.6
	Standard Deviation	7,8	21.6	16,1	352.3	29.1

Table 1A. Panel B. ***Mean and Standard Deviation of Crises and non-Crises Episodes***.

	Parameter	Growth		Current Account/GDP	Terms of Trade
		Exports	Imports		
Crises	Mean	-0.37	-3.68	-3.6	97.4
	Standard Deviation	20,31	29,87	6.9	17.8
Non-crises	Mean	10,84	13,14	-2.3	102.0
	Standard Deviation	19,67	27,82	5.4	17.6
Total	Mean	7.0	7.58	-2.7	100,5
	Standard Deviation	20.52	29.12	5.9	17,7