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Towards a new set of leading indicators of currency crisis for developing countries: an application to Argentina

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1- Introduction

Growth plays a key role for development in the economy of every country, especially in developing ones where another key issue is that of the vulnerability of their economies. As is usually said, there can be growth without development but not development without growth. Economic activity in less developed countries is subject to shocks (internal or external) that frequently end in crises. The main crises being those related to the financial sector and currency crises that soon spill into the rest of the economy. In most of the cases emergency policies are implemented as a reaction to the problems that arise from the crisis. Sometimes these actions taken by the economic authorities lead to a deepening of the crisis, to a decline in economic activity or to volatility in the production. An example of this types of actions are rises in tax rates and cutting of expenditures (mainly public investment and social expenditures). As a consequence poverty and unemployment rise, with all the social and political consequences that this increase has. An important issue regards to at which extent crises can be reverted by appropriate policies implemented by the government or other key actors. From this central issue arises the question about the probability of predicting this type of crisis and which variables could signal with enough anticipation the developing of these crises. There are plenty of problems and difficulties in the forecasting of currency crises: some of them related to the availability of appropriate data, some related to the volatility of indicators and some related to the heterogeneity of crises between countries which makes impossible to extrapolate the crisis experience in one country to explain other country experience.

A currency crisis can be defined in the context of a flexible exchange rate regime as a sharp change or correction in the nominal exchange rate. In the context of a fixed exchange rate regime it can be defined as a sharp change in international reserves due to the government defense of the nominal exchange rate or also as the abandonment of the peg. As the IMF (1999) points out, currency crises are costly, especially regarding the effect on economic activity through the misallocation or subutilization of resources that lead sometimes to output falls. Near 60% of currency crises have ended in output losses. As can be seen in Table 1 the average recovery time for a currency crisis is 1,6 years and the average output loss is 4,3%. It is also evident here the difference between industrial countries where the average loss is 3,1% and the emerging markets where is 4,8%. If a currency crisis occurs simultaneously with a banking crash the situation is even worse with average output losses of 14,4%

Table 1: Costs of Crisis in Lost Output relative to Trend

	Number of Crises	Average Recovery Time (in years)	Cumulative Loss of Output per Crisis	Cunmulative Loss of Outpout per Crisis with Output Loss
Currency Crises	158	1.6	4.3	7.1
Industrial Countries	42	1.9	3.1	5.6
Emerging Markets	116	1.5	4.8	7.6
Currency Crashes	55	2.0	7.1	10.1

Industrial Countries	13	2.1	5	8
Emerging Markets	42	1.9	7.9	10.7
Banking Crashes	54	3.1	11.6	14.2
Industrial Countries	12	4.1	10.2	15.2
Emerging Markets	42	2.8	12.1	14

Source: IMF – World Economic Outlook – May 1999.

Many factors and variables have been studied in order to explain accurately, with different degrees of success, this type of currency crises: exchange rate factors, political factors, financial sector factors, external conditions, macroeconomic policies. Some of these indicators succeeded in explaining currency crises as the ones in the 1970s, others explained crises like the ones in the early 1990s. The literature on currency crises got a boost after the Mexican and, fundamentally, the Asian crises. But there were a number of crises that could not be explained from just one of this point of view, not to say they could not be forecasted with enough anticipation.

A currency crisis that was not accurately forecasted was the one suffered by Argentina between 2001 and 2002 . There have been many explanations about the causes and consequences of Argentina´s crisis. Most of them are based on the observation of the evolution of key economic variables. Fiscal, monetary, financial variables have been analyzed in order to give an explanation. Nevertheless, most of these explanations were given post crisis and literature did not give a set of indicators that could have been taken on account in order to anticipate the crisis. The indicators were not clear in announcing with enough anticipation the occurrence of this crisis that ended in a hard devaluation of the local currency that soon translated into an increase in prices. The particularities of the Argentinean economy made indicators such as the ones in Kaminsky et al. (1997) or Kaminsky (1999) fail in giving a good prediction of the 2001-2002 crisis despite being good early warning systems of crises for other countries episodes.

The goal of an Early Warning Systems (EWS) of currency crisis is to predict the possibility of a crisis in a given country. In countries with weak fundamentals, this can be easily done just by watching the evolution of certain key macroeconomic or financial variables. In that situation, the question is not if the crisis will occur or not, but when will it happen. And the main policy goal will be to anticipate them. The main objective of an EWS then should be to give enough

[1] *Years 2001 and 2002 are the date of the crisis climax but output had already become stagnant in mid 1998. In all, Argentina´s recession lasted 4 and a half years with a total output loss of almost 20%.*

crisis signals with enough anticipation to allow the policymakers to react to them and try to avoid this approaching crisis.

In our analysis of Argentina´s crisis we have chosen to work mostly with monthly data because quarterly official data often has a three month lag in its publication (and also some lag on its elaboration). It is more useful as a policy tool to work with monthly data which is available almost immediately with a fifteen/twenty days lag in the worst cases. The use of monthly data gives the policymaker a faster knowledge of the proximity of a crisis and a faster reaction capacity when the indicators start sending signals. We have also used quarterly data in the case of some essential external variables (Balance of Payments, Private Capital flows variations) which are only available with this periodicity

Also we have chosen to include pre and post crisis data in order to have a longer series and to see the reaction of the variables and indicators in the aftermath of the crisis.

This paper is organized as follows: In section 2 we will give a brief overview of Argentina´s crisis, in section 3 we will explain the methodology used by authors like Kaminsky and Reinhardt to establish leading indicators systems as an early warning. In section 4 we will evaluate some of these indicators for Argentina showing that most of them failed to send crises signals with enough anticipation and, finally, in section 5 we propose some new indicators that could have signaled the 2001-2002 crisis.

2- Argentina´s 2001-2002 Currency Crisis

After two hyperinflationary episodes in 1989 and 1990 Argentina established on April 1991 a currency board system with a fixed exchange rate pegged to the U.S. dollar. This currency board system was sustained up to its collapse more than ten years later, in January 2002.

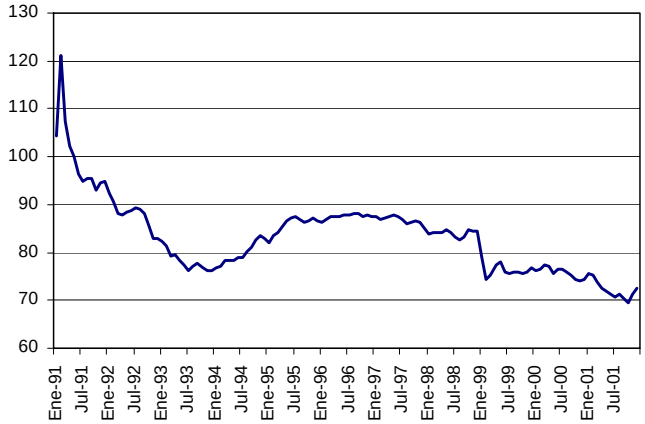
Table 2: Argentina – Relevant economic indicators 1988 - 2002

Indicator	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
GDP Growth (in %)	-2.0	-7.0	-1.3	10.5	10.3	6.3	5.8	-2.8	5.5	8.1	3.9	-3.4	-0.8	-4.4	-10.9
Consumer Price Inflation (in%)	388	4924	1344	84.0	17.5	7.4	3.9	1.6	0.1	0.3	0.7	-1.8	-0.7	-1.5	41.0
Wholesale Price Inflation (in%)	374	5386	798	56.7	3.2	0.1	5.8	6.0	2.1	-0.9	-6.3	1.2	2.4	-5.3	118.2
GDP per habitant	4,047	2,565	4,345	5,751	6,845	6,983	7,501	7,421	7,727	8,210	8,277	7,751	7,675	7,184	2,681
Real Exchange Rate (1991=100)	262.7	354.9	162.2	99.61	85.13	76.41	79.55	86.69	91.32	90.08	82.74	75.07	76.31	77.19	184.7
Public Sector Fiscal Balance (as % of GDP)	-7.93	-7.81	-4.73	-1.42	-0.45	-0.01	-1.67	-2.89	-3.16	-1.5	-2.42	-4.51	-3.3	-7.03	-0.81
Primary Public Sector Fiscal Balance (as % of GDP)	-5.15	-3.66	-3.08	0.03	1.69	1.42	-0.17	-0.93	-1.24	0.8	-0.22	-1.11	0.76	-1.96	1.84

Source: Ministry of Economy, INDEC and Central Bank of Argentina

Pegging the exchange rate to the dollar and backing up all monetary emission with international reserves nominated in dollars succeeded at first in reducing inflation. As can be seen in Table 2, the Consumer Price Index that had an increase in 1990 of 1344% had a reduced growth in 1991 (84%) and 1992 (17.5%). The same happened with the wholesale prices that in 1990 arose 798% and in 1991 56.7%, being almost stabilized in 1992 (3.2%). Also, GDP that had fallen three consecutive years reverted to growth in 1991. The currency board was a useful tool to import price stability and also to give some credibility to the macroeconomic policy that the government was originally going to follow. As we may see, this system also had its drawbacks, mainly its rigidity.

Figure 1: Argentina - Real Exchange Rate 1992-2004



Source: Central Bank of Argentina

As can be seen in Figure 1, after setting the currency board the Real Exchange Rate experienced an appreciation against a basket of foreign currencies weighted by their participation in Argentina´s commerce (multilateral real exchange rate) from April 1991 reaching a first maximum in late 1993. This was consistent with a period of high growth and low inflation after the currency board was settled. Growth slowdown in 1994 and the Mexican crisis had its impact on the Real Exchange Rate causing a depreciation during 1994 and half of 1995. After this depreciation as a consequence of the Mexican crisis and its impact in Argentina, the real exchange rate started a new appreciation process following the dollar appreciation of 1995 – 1998. Two and a half consecutive years of growth (1996, 1997 and the first half of 1998) also further appreciated the Argentinean real exchange rate.

A combination of external shocks, contagion and sudden stops in capital flows along with the incapacity of the peg to react to this shocks, a lack of monetary policy due to the currency board scheme and lax fiscal policies are among the causes that are always cited as paving the path for the 2001-2002 crisis. The row of external shocks suffered by Argentina since 1997 were very important in explaining the depression that started in mid 1998. The devaluation of the Brazilian currency in January 1999 was of crucial importance in the deepening of the crisis. Being Brazil the main trading partner of Argentina this devaluation led to a huge appreciation in the Argentinean multilateral real exchange rate, reaching the maximum since the instauration of the pegged system (Figure 1). The Brazilian devaluation had an impact mainly in Argentina´s industrial sector, in certain branches like the Automobile sector or the textile one that saw their competitivity eroded fastly.

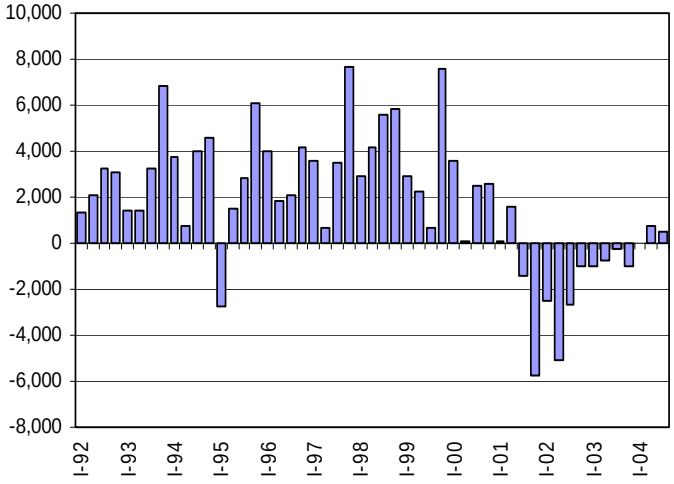
After the capital flows diminished critically in the beginning of 2001´s second half and due to the heavy appreciation of the U.S. Real Exchange Rate that was eroding Argentina´s competitivity with its main trading partners (fundamentally the devaluated Brazil that receives almost 30% of Argentina´s exports), the government tried to face this circumstances creating a "widened convertibility" that was going to be fixed to a basket of U.S. Dollar and Euro. This system was going to be implemented when the nominal exchange rate of the Euro

was going to be equal to one dollar. This was going to be similar to a depreciation of the real exchange rate close to 8%. The markets saw this change in the currency board scheme as a sign of devaluation and the reversal of capital flows deepened in the second semester.

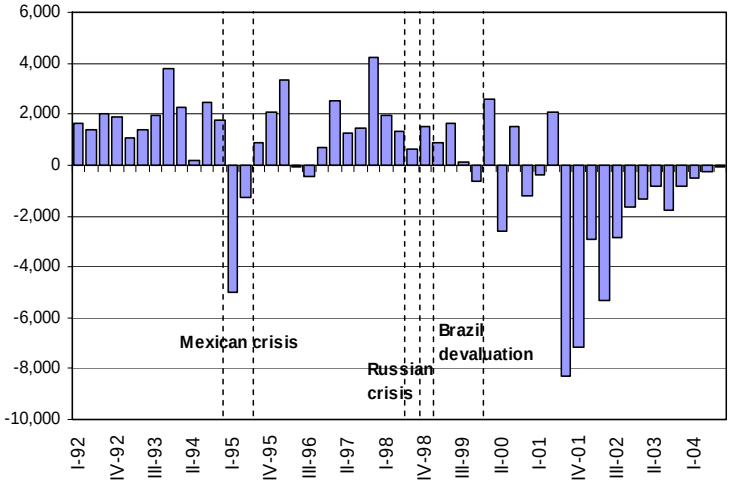
A diminishing quantity of capital flows where one of the main features in the collapse of the Argentinean currency. Capital flows diminished after all external shocks, being strongly reversed after the Mexican Crisis and starting a bigger reversal in mid 2001. Debt markets were closed for Argentina in mid 2001 and that accelerated the collapse.

Figure 2: Argentina - Capital Account 1992-2004

a) Overall Capital Account



b) Private Sector Capitals



Source: Ministry of Economy

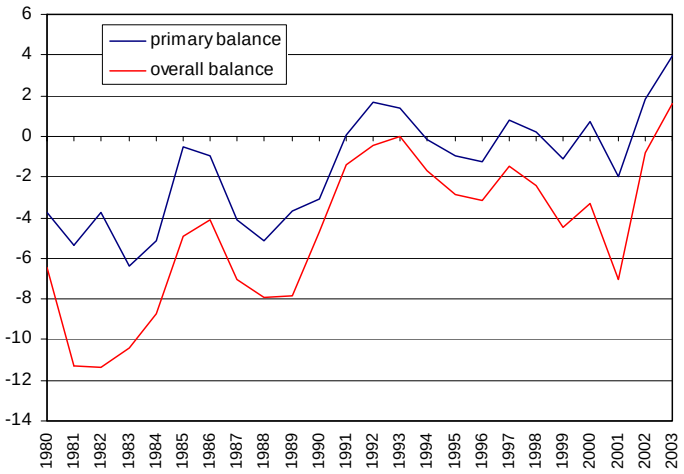
As can be seen on Figure 2 the overall capital account had a strong reversal only in the second half of 2001 but it had started to become stagnant in mid 1999 when positive capital inflows started to lower their magnitude. This is more evident while looking to Figure 2-b) that shows the evolution of Private Sector Capitals. Here is evident the impact that the successive crises had on the capital flow to Argentina.

The fiscal policy

In the first years after the setting of the pegged exchange rate Argentina´s fiscal deficit was reduced through an increase in tax revenues due to the price stabilization scheme, through privatization of public enterprises (that had a double role of reducing expenditures and increasing capital revenues in the government´s balance sheet). This lead to an almost

equilibrated fiscal primary balance[2] (without taking on account the payment of debt interests) and a small primary surplus in 1992 and 1993

Figure 3: Argentina – Fiscal Balance (as % of GDP) 1990-2003



Source: Ministry of Economy

In 1994 part of the social security system was privatized taking a source of revenues for the public sector. This had to be partially compensated with some tax reforms (raising the VAT rate, for example). But growing expenditures, specially in electoral years and increasing interest debt payments eroded the public sector balance. As can be seen in Figure 3, in the late nineties interest payments grew considerably and this is evident in the diference between the primary and overall balances line.

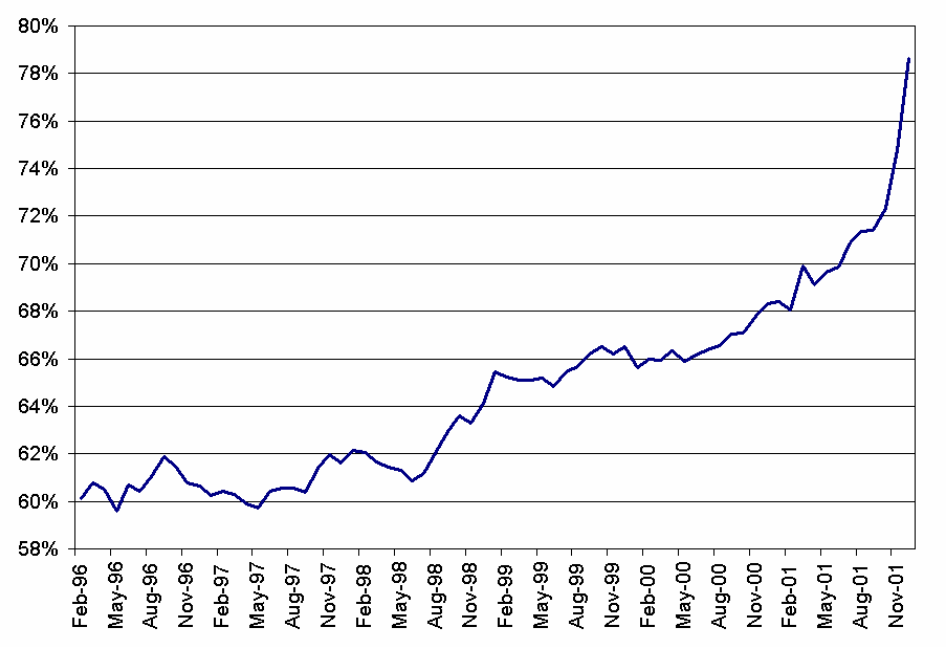
Public sector´s deficit that in the seventies and eighties were financed through monetary emision and in the nineties through privatization of public enterprises and mainly through debt emission faced a lack of instruments to be financed when capital flows reverted. The government that assumed in late 1999 tried to downsize the fiscal deficit with a big tax reform but that was clearly not enough and at the same time had a big impact on activity, stopping a possible reactivation. In July 2001 the government created a "zero deficit" law that was subsequently violated in October 2001 (in less than three months). After that, came the collapse

[2] *It is noticeable that Argentina only had an overall fiscal surplus in 2003, mostly due to lower interest payments derived from the defaulting of a big part of the public debt.*

The financial sector

One of the main reasons of the December 2001 government resignation was the banking crisis that Argentina was facing in late 2001. This crisis lead to a heavy reduction through withdrawal in bank deposits and on November 30th the government issued a decree by which clients could not withdraw more than 250 pesos (still equivalent to 250 dollars) per week ("corralito bancario"). This led to public demonstrations that finally ended in the resignation of the authorities.

Figure 4: Dollarization of Argentina´s Credits and Deposits



Source: Central Bank of Argentina

The reduction of deposits that led to this political crisis was not a new thing for Argentina. In the past many times the country had suffered from bank runs and financial crisis (the 1977 and 1989 ones being the most studied ones) . At the same time, after the hyperinflationary process of the late eighties there was no confidence on local currency. A variable that can be analyzed with easiness is the degree of dollarization in the Argentinean banking system: the proportion of dollarized credits and deposits shows that after establishing the currency board the foreign currency that functioned as an anchor for prices [3] (the dollar) started replacing the domestic currency for financial operations. As can be seen in Figure 4, in 1996 deposits and credits in dollars represented over 60% of the overall deposits and credits. As external shocks hit the domestic economy this proportion started to grow reaching almost 80% of the total.

After the collapse of the currency board, deposits and credits were turned into local currency in what was called "assimetric pesification". Deposits were turned into pesos and adjusted by inflation and credits were also converted and adjusted by a wages index. The problem was

[3] *It is always said that Argentina "imported price stability from the U.S.A. by implementing the currency board scheme".*

that dollarized deposits had to be returned to clients at current exchange rate (that was close to 3 pesos per dollar) and credits had to be adjusted at a rate of 1,40 pesos per dollar. This led to a big amount of central bank help to banks through 2002 because of the dislocation in the banks balance sheets produced by this asimetric procedure. Banking system only started recovering in late 2003.

The crisis aftermath

After the collapse of the currency board regime Argentina went directly into the deepening of the worst recession in its history with a fall in GDP of 10,9% (in the first quarter of 2002 the fall in GDP was close to 20%). Heavy interest payments that impacted in the past in the fiscal results were diminished by declaring an unilateral default on private debt.

Inflation rose to almost 80% annual (average consumer and wholesale prices index) increasing poverty in a dramatic way. Almost 50% of the population where considered poor in the May 2002 survey done by the National Statistics Office (INDEC). Almost 25% of the population was considered living in conditions of extreme poverty.

Public sector kept their expenditures low in real terms while tax revenues increased thanks to the effect of inflation in the VAT and the introduction of an export tax that has become a fundamental part of the tax system since then. This effect, along with the recovery on activity beginning on them second semester of 2002, lead to a surplus in 2003 and 2004. Needless to say that the magnitude of the crisis made almost impossible to generate any kind of development policy.

It remains a big question if these consequences could have been avoided if a signals system had been developed correctly.

Theoretical models of currency crisis

To explain the causes that turn into a currency crisis the literature has developed at least three types of models. The first generation models, derived from works like the one by Krugman (1979) , show that the crisis in the local currency arises from the exhausting of international reserves when facing speculative attacks. This speculative attacks where generated by the perception that the local government is pursuing fiscal and monetary policies that are not coherent with the fixed exchange rate that the country is trying to maintain. These models were useful to explain the currencies crisis suffered by Latin American countries in the seventies.

A basic framework of these types of models, which can be empirically evaluated, could be (all the variables are in logarithms):

$$m_t - p_t = \alpha_{0,t} + \alpha_{1,t}.(i_t) \qquad (2.1)$$

$$m_t = c_t + r_t \qquad (2.2)$$

$$p_t = p_t^* + e_t \tag{2.3}$$

$$i_t = i_t^* + \Delta e_t \tag{2.4}$$

where p_t is the domestic price level, p_t^* is the external price level, e_t is the nominal exchange rate, m_t is domestic money supply, c_t is domestic credit, r_t are international reserves in domestic country, i_t is the domestic interest rate, i_t^* is the international interest rate and the $\alpha_{i,t}$ are positive coefficients. Equation (2.1) and (2.2) determine the money market equilibrium, equation (2.3) is simply Purchasing Power Parity and equation (2.4) is interest rate parity.

Just replacing the last three equations into (2.1):

$$c_t + r_t - (p_t^* + e_t) = \alpha_{0,t} - \alpha_{1,t}.(i_t^* + \Delta e_t) \tag{2.5}$$

If the government commits to a fixed exchange rate or a peg, then equation (5) is reduced to

$$c_t + r_t - p_t^* - \overline{e} = \alpha_{0,t} - \alpha_{1,t}.i_t^* \tag{2.5´}$$

If all the international variables are exogenous, then $p_t^* = i_t^* = 0$

$$c_t + r_t - \overline{e} = \alpha_{0,t} \quad \text{or} \quad c_t + r_t = \alpha_{0,t} + \overline{e} \tag{2.5´´}$$

This equation shows that if the nominal exchange rate is constant, the whole right side of the equation has to be constant too. An increase in domestic credit must be offset by a decrease in international reserves. The inconsistency of monetary policies leads to a loss of international reserves due to the defense of the fixed exchange rate. An example of this credit expansion could be the monetization of fiscal deficits. Eventually, the fixed exchange rate regime is abandoned when reserves reach a critical low limit.

Some factors like persistent loss of international reserves, expansionary fiscal policies with persistent deficits, appreciation of the real exchange rate, current account deficits might be signals of a currency crisis in this type of models.

The second generation models, derived from studies like the one by Obstfeld (1986) focus their attention on the role of expectations. In this type of models domestic interest rates have an important role in explaining the development of crises. When trying to stop a speculative attack (even when there are no problems in the macroeconomic fundamentals) the policy followed by the authorities must be to raise the interest rates. The authorities may decide to abandon the fixed exchange rate if they think that the possible effects of measure taken to sustain it could have a negative effect on other economic variables that are of key importance for the authorities. Under certain circumstances the benefits of mantaining the peg are surpassed by its costs.

In this type of models the government has an optimizing behavior trying to minimize a social loss function of the type:

$$\min L = \frac{w}{2}.d^2 + \frac{(d - d^e - z - \varepsilon)^2}{2} \qquad (2.6)$$

where d is rate of depreciation of the domestic currency, d^e is the expected rate of depreciation of the domestic currency price level, z is a shock with mean equal to zero and variance equal to σ^2 and s is a measure of distortion.

On this models the crisis can be self fulfilled because of the existence of multiple equilibriums that have implicit a trade-off between keeping the fixed exchange rate and other goals that the government could find as important. It is possible also that the crisis is just a jump from the fixed exchange rate equilibrium to the floating exchange rate one.

This models were helpful to explain the early nineties currency crises of some European countries that had strong fundamentals. Some indicators that are used in this type of models are: unemployment rate growth, public debt excessive growth, output volatility and increase in interest rates.

A third generation of models where developed after the crisis in the East Asian countries in 1997. In July 1997 the Thailand devaluation triggered a row of currency crises in countries like Malaysia, Indonesia, Singapore and Korea. The Asian crisis had spillovers even in distant countries like Russia and Brazil. As most of the macroeconomic variables were solid enough in the Asian countries, this crisis took everybody by surprise. One of the explanations given to this phenomenon was the strong financial linkage that exists between the East Asian economies. Rapid movements in international capital flows and financial and banking weaknesses unleashed the crisis.

The third generation models focus on domestic financial system frailty as one of the major causes in the currency crisis. Financial sector problems may lead to or generate a currency crisis. Some key variables in this type of models are: government bailouts to the banking sector, maturity of debt, currency in which is nominated the public debt (local currency versus foreign currency). Into this group of models we can count the ones that consider contagion between countries.

Some countries may suffer of contagion despite having solid fundamentals and this is enough to trigger a currency crisis. That is why much attention has been paid by international financial organizations to this problem in recent crises like the Mexican in 1994-1995 and the European Monetary System in 1992-1993. This lead to heavy interventions by these organizations to avoid the spreading of the crisis.

There are plenty of channels through which this type of crisis can spread. One of these channels is the loss of competitiveness that will suffer the country that is being affected by the contagion phenomena. If a country currency collapses after a crisis, the contagion effect on other country could be the loss of competitiveness of the later through the relative increase of the price of its exports (in comparison to the country that devaluated its currency). Also, there is a second channel for contagion: financial links among countries. In this case, a crisis in one country can make investors manage their risk and balance their portfolios against other countries or even against a region.

A third channel in which contagion can be spread is through external trade. The country that has suffered a collapse of its currency will decrease fast enough its imports due to the sudden increase in its prices and also through the decrease in income. This has a direct effect on the trade partners of the country that started the contagion. The size of international trade among the countries is fundamental to see the magnitude of the contagion effect.

Authors like Masson (1998) classify contagion crises in three types: moonsoonal effects, spillovers and pure contagion. In the first type the shocks in developing countries have a close relationship with economic shifts in developed countries. The second type ones are the sort of crises that spill from one country to others. Pure contagion is the type of contagion crisis that occurs simultaneously in several countries. This later crises are linked to self-fulfilling behavior or self-fulfilling speculative attacks. Investors may perceive that fundamentals have a high risk of collapsing and they will take all their assets out of the market, unleashing a crisis. That is what happened in the 1998 Russian crisis that spilled over to East European Countries and Latin America.

Indicators used to study contagion crises are, among others: a reduction in commodity prices, growth of international real interest rates and reduction of world aggregate demand.

Nevertheless, a fundamental issue that concerns many economists is the related to generate a system of variables that can predict a currency crisis. Particularly, the choice of indicators that can forecast the crises with enough anticipation.

3- Leading Indicators as an early warning system

There have been many studies about leading indicators of currency crises, some of them based on logit or probit models, which show, based in multiple variables, if the crisis will occur or not, and others based in multiple indicators called Early Warning Systems (EWS). This approach is based in considering certain variables from the three theoretical models considered on the previous section.

The leading indicators presented in works like the ones by Kaminsky et al. (1997) and Kaminsky-Reinhart (1999) focus on a group of monetary, financial, fiscal and macroeconomic variables that when a currency crisis is approaching issue signals that can be helpful to anticipate them.

To define the moment in which a crisis is developing Kaminsky elaborates an Exchange Market Pressure Index (EMP), constructed as a weighted average between monthly variations in real exchange rate (ΔRER_t) and monthly changes in international reserves.($\Delta \mathrm{Res}_t$).

The index has the form:

$$I_{1,t} = w_1 \Delta RER_t - w_2 \Delta \mathrm{Res}_t \qquad (3.1)$$

where $\Delta RER_t = \left(\frac{RER_t - RER_{t-1}}{RER_{t-1}} \right)$ and $\Delta \mathrm{Res}_t = \left(\frac{\mathrm{Res}_t - \mathrm{Res}_{t-1}}{\mathrm{Res}_{t-1}} \right)$

where w_1 and w_2 are the weights for each variable. The weights are calculated making the condicional variance of both indicators equal. Then, thresholds that signal the moment of the crisis are fixed (in the case of the ones developed in Kaminsky (1998) the value of the threshold is equal to three standard deviations over the mean of the index).

Authors like Eichengreen et al. (1994) also include as a fundamental variable in this EMP index the interest rate because it is another policy instrument that can be used to defend the local currency. When facing a speculative attack to the peg or fixed exchange rate system the government has at least three options to react: a) it can defend the local currency by doing exchange market operations with international reserves, b) it can abandon the fixed exchange rate system and let the rate float, c) it can raise interest rates in order to stop capital reversals. In the case that this three variables are used we can set an indicator of this type:

$$I_{2,t} = w_1 \Delta RER_t + w_2 \Delta i_t - w_3 \Delta \mathrm{Re}\, s_t \qquad (3.2)$$

where $\Delta i_t = (i_t - i_{t-1})$

Each time the index crosses a threshold it issues a crisis signal. A currency crisis can be defined either if a sharp depreciation of the local currency occurs or if there is a sharp decrease in international reserves used to sustain a fixed exchange rate. Frankel and Rose (1996) have defined, somewhat arbitrarily, a currency crisis as a depreciation of the local currency of at least 25% in a year. As the authors remark, this is an arbitrary value for this movement in exchange rate.

Then, some variables or indicators must be chosen and analyzed in a similar way. Thresholds on each of these indicators are established in order to see when they will issue a crisis signal.

This signals that this indicators issue must anticipate or be inside a "crisis window" (established as 12 or 24 months before the EMP index issues the crisis signals). With less anticipation the policymaker may not have enough time to "correct the wrong signals". A matrix like the following can be developed in order to evaluate the accuracy of each of the indicators:

Table 3: Accuracy of the indicators

	Crisis	No Crisis
Indicator issues signal (12 or 24 months before crisis signals)	A	B
Indicator does not issue a signal	C	D

Kaminsky uses a "noise to signal ratio" to determine which is the optimal threshold for each indicator. She also creates some composite indicators in order to classify the signals according to their strength; in order to consider the deterioration of the fundamentals in the considered country and in order to compare the accuracy of the signals as crises predictors. One of the major drawbacks of this approach is that the threshold values are somewhat arbitrary (as the weights of the EMP index are) both in the case of the EMP index and also in the case of the indicators.

Then, an index of "currency fragility" is calculated. This index is defined as the number of indicators sending signals for each month. A desirable property of this index is that it will increase with enough anticipation before a crisis erupts. As we will see this was not the case for Argentina.

This "currency fragility" index is the first of the composite indicators. It simply sums the number of indicators that are making signals of crisis in a point of time:

$$CI_{1,t} = \sum S_{i,t} \tag{3.3}$$

To emphasize the role of those indicators that are more effective in predicting crises there is a second composite indicador elaborated:

$$CI_{2,t} = \sum \frac{S_{i,t}}{r_i} \tag{3.4}$$

Where r_i is the noise to signal ratio of indicator i. These indicators are developed in order to give more weight to the more reliable indicators. We will return to this ratio later.

In the next section, we will focus on this type of early warning indicators in order to show that many of them did not issue a warning signal or sent weak signals before the collapse of Argentina´s currency board.

The threshold values of the leading indicators are set by minimizing the noise to signal ratios of each of the indicators. This ratio is defined, in terms of the indicators in Table 3 as:

$$NTSR = \frac{\frac{B}{(B+D)}}{\frac{A}{(A+C)}} \tag{3.5}$$

Berg and Patillo (1999) tested the Kaminsky (1998) indicators for eight Asian and Latin American countries and they found that in only 4% of the cases the probability of crisis was over 50% in a 24 month window crisis. The period used in this estimation was May 1995 to December 1997. If they use instead of the 50% of probability a 25% they found that the percentage of cases rose to 25%.

Table 4 shows the number of studies done in Kaminsky et al. (1997) for each indicator and the proportion of statistically significative cases for predicting a currency crisis.

A last thing must be remarked before starting the calculations of the indicators for Argentina, It is strongly recommendable to difference between in-sample experiments (using all data that was available at the time of the crisis or months before it develops) and out-sample experiments which use data that was not available at the time of the crisis (this is an ex-post experiment that is useful only to determine which are the indicators that showed an abnormal behavior in the developing of the crises).

Table 4: Statistically Significant Indicators in Kaminsky et al. (1997)

Sector	*Indicator*	*Number of studies*	*Statistically significant cases*	*% of statistically significant cases*
Monetary Sector	International Reserves	12	11	91.7%
	M2/Int. Reserves	3	3	100%
	Credit Growth	7	5	71.4%
	Central bank credit to banks	1	1	100%
	Real Exchange Rate	14	12	85.7%
	Real interest Rate	1	1	100%
Fiscal Sector	Public sector deficit	5	3	60%
	Credit to Public Sector	3	3	100%
Macroeconomic Variables	Real GDP Growth	9	5	55,6%
	Unemployment Rate	3	2	66.7%
Foreign variables	Foreign interest rate	4	2	50%
	Foreign GDP growth	2	1	50%
External sector	Exports	3	2	66.7%
	Terms of Trade	3	2	66.7%
	Trade balance	3	2	66.7%

4- An experiment with leading indicators for Argentina

Trying to construct all the indicators that the literature offers to predict currency crises has some difficulties for Argentina due to the lack of information regarding some of the variables that must be used. Another difficulty for long series are the changes in methodology in some official series that makes them not useful for comparative purposes. We are using on this paper series starting on 1996, because they have been homogenized and in order to see if they issue warning signals before the currency board collapse. Table 5 shows the indicators that we have chosen using availability and homogeneity in the series criteria.

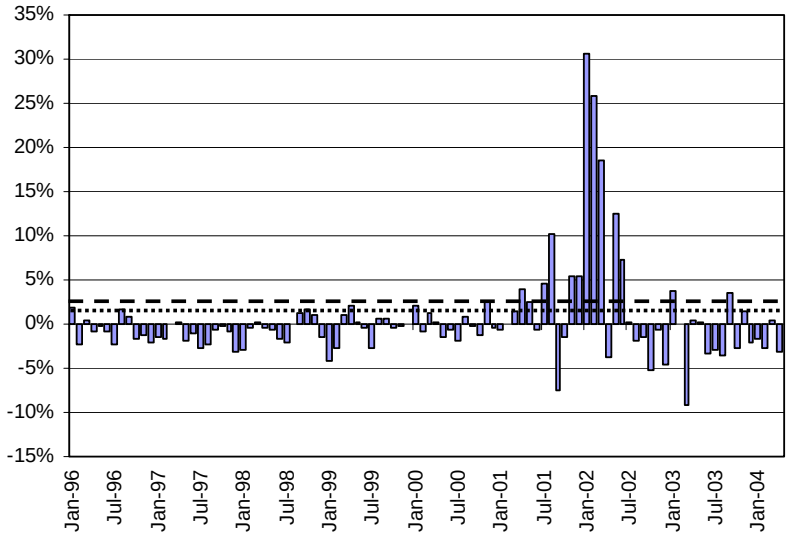
Table 5: Selected indicators for Argentina

Type of Indicator	Indicator

Macroeconomic Variables	Investment/GDP, Per capita GDP variation
Financial Indicators	Int. Reserves/GDP, Int.. Reserves/Imports, Int. Reserves variations, Total Banking Credit/GDP, Monetary Base / GDP, Banking Credit Variation, M1, M1 variation, M2/Int. Reserves, Federal Reserve Interest Rate, Int. Reserves/Monetary Base, Public Sector Banking Credit, Total Bank Deposits Variation.
Prices	Consumer Prices Index (CPI), CPI Variation, Wholesale Prices Index (WPI), WPI Variation,
Fiscal Variables	Public Sector Interest Payments, Interest Payments / GDP, Public Debt/GDP; Public Sector Deficit/GDP
Trade	Imports variation, Exports variation, Exports/GDP, Exports/Imports, Trade Balance / GDP, Total Trade/GDP,
Exchange Rates	Real Exchange Rate (CPI calculated), Real Exchange Rate Variation

We have chosen two different ways to calculate the Kaminsky-Reinhardt EMP index. On the first one we have simply given the same weight to reserves and real exchange rate variations. On the second one we have established the weights as the inverse of the dispersion coefficient. We have also set the crisis threshold in two standard deviations above mean in order to maximize the accuracy of the crisis signals.

Figure 5: Exchange Market Pressure index with equal weights for each variable



As can be seen on Figure 5 the EMP index sends an isolated signal of crisis on November 2000 before sending another one on April 2001. If we would have set the threshold in three standard

deviations (as is suggested in some literature) the indicator sends the first signal in April 2001. So, the EMP index shows the climax of the currency crisis the period July 2001-June 2002.

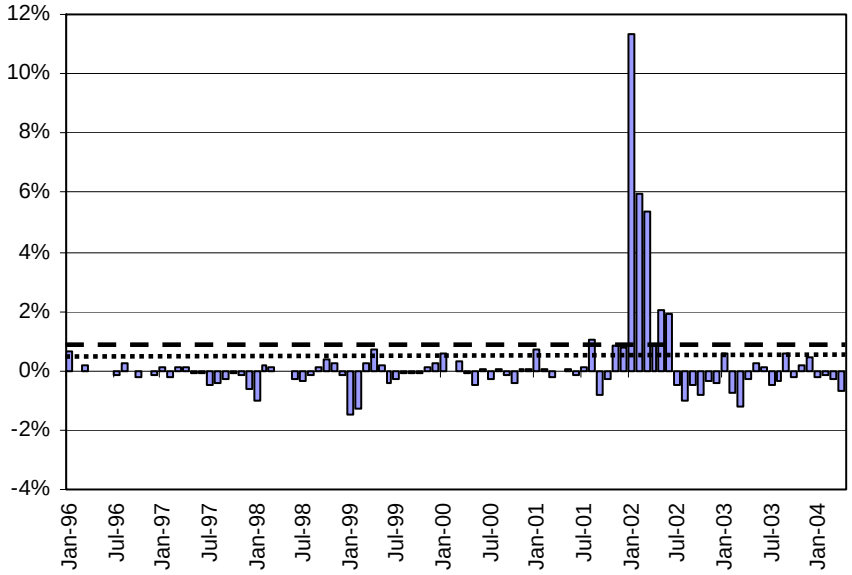
An important feature is that the threshold changes depending on which is the data that is used. We have used two thresholds: one is established using data from 1996-1998 and the other one is established using 1996-2000. Both experiments are in-sample since both used data that was available well before the crisis climax. Using 1996-1998 the indicator sends isolated signals on January 1996, April 1999, Jan 2000, November 2000 before starting sending the more evident signals from April 2001 to June 2002. When using 1996-2000 data the indicator sends the first crisis signal in November 2000. Both approaches can be considered useful to determine the moment of the crisis, since the first one has signaled very lightly a crisis in the first moments of Argentina´s stagnation (the April 1999 signal) and the second one has signaled clearly the climax of the currency crisis. In Figure 5 the thresholds can be seen as a dashed line (using 1996-2000 data) and a dotted line (using 1996-1998 data). Also, in table 6 can be seen the differences in the thresholds of the EMP indexes.

Table 6: EMP Index thresholds using different data reference

EMP Index	**Thresholds**			
	Using 1996-1998 mean and std. deviation		Using 1996-1998 mean and std. deviation	
EMP 1: Using equal weights	2 standard deviations	3 standard deviations	2 standard deviations	3 standard deviations
	2.7	4.0	2.9	4.4
EMP 2: weighted by the inverse of std. deviation.	2 standard deviations	3 standard deviations	2 standard deviations	3 standard deviations
	0.6	0.9	0.8	1.1

As literature suggests we can build the EMP index using weights that are the inverse of the standard deviation for each variable. The form of this index can be seen in Figure 6:

Figure 6: Exchange Market Pressure index with weights as the inverse of the standard deviation



This indicator sends almost the same signals as the one that we used before. The only difference is that in the first half of 2001 the indicator in Figure 6 sends signals in January 2001 and then stops sending them until August 2001. This leads us to say that the first indicator, despite being more rudimentary signals better the climax of the crisis.

As we said before some authors use an indicator of exchange market pressure that includes the domestic interest rate. We will test this indicator for Argentina in section 5 but instead of using just an arbitrary exchange rate we will use another indicator of our own that includes the spread between short term and long term interest rates. This has the advantage of anticipating some of the crises because this spread increases in the proximity of them.

We have evaluated the behavior of the variables chosen as leading indicators and Table 7 shows the main findings:

Table 7: Argentina - Indicators sending signals prior to the crisis

Period	Number of indicators sending signals	% over total indicators
January-June 1998	5	17.2%
July-December 1998	2	6.9%
January-June 1999	7	24.1%
July-December 1999	3	10.3%
January-June 2000	7	24.1%

July-December 2000	7	24.1%
January-June 2001	11	37.9%
July-December 2001	12	41.4%
January-June 2002	13	44.8%
July-December 2002	13	44.8%
Average 1998-2000	5	17.8%

As we can see, even in the worst period of the crisis there is less of 45% of indicators sending the appropriate signals. The average of signals in the two years before the crisis is of 17.8% of the indicators sending the correct signals. The noise to signal ratios are high, especially because the indicators have not send warning signals when the EMP indexes show the existence of problems.

As we said before, one of the main drawbacks of the leading indicators approach to Argentina´s currency crisis is that the calculation of the mean is strongly influenced by the period that the researcher is considering. We have chosen to use as mean a period considered of normality, for example calculating the mean of the period 1996-2000. But the thresholds change dramatically if another sample is taken (this can be fully observed in Annex I where we have taken two thresholds, one calculated with 1996-2000 mean and another one calculated with 1996-1998 means). Thresholds, means and variances using different datasets can be found in Annex I and II. In Annex III the evolution of some leading indicators considered through some graphical analysis can be seen.

5- A proposal for new indicators for Argentina

Some proposals for new indicators can be done in two levels: first of all on the EMP index where it can be suggested to include some fundamental variables. On second level we can propose some new indicators that can anticipate a little bit better the climax of the crisis.

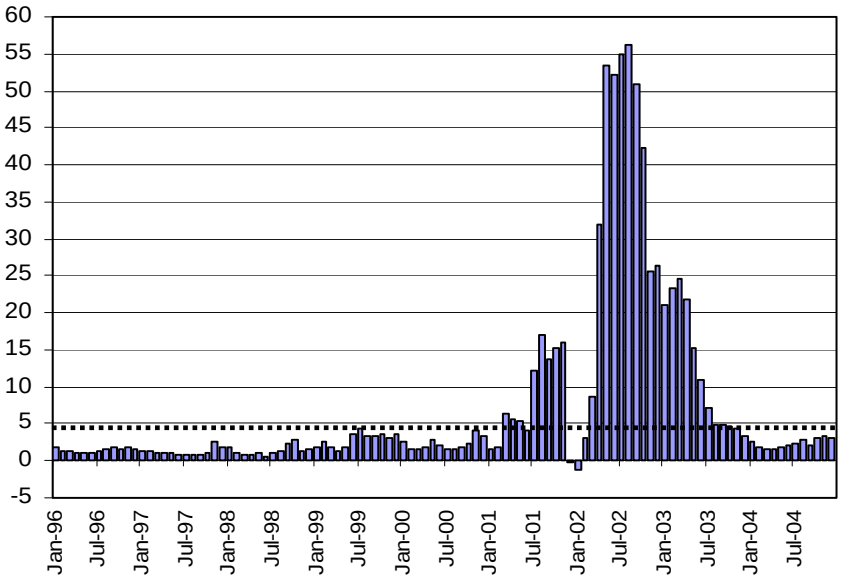
Proposals for the EMP index

Indicators of Exchange Market Pressure

In previous section we analyzed the EMP indexes proposed by Kaminsky-Reinhart with an application to Argentina. Now we can add some interesting variables to the analysis in order to see if they signal the existence of an incubating crisis in a better way. One way to do this could be adding to the EMP index an exchange rate. The choice of with which exchange rate to work is somewhat arbitrary, so we have chosen instead to use a spread between same term credit nominated in domestic and foreign currency.

A good way to see if this will have a better result is to analyze separately the new variable as if it were an EMP index by itself. As can be seen in Figure 7 the interest rate spread between mid term deposits nominated in pesos and equal term deposits nominated in dollars in the Argentinean financial system starts sending some warning signals in March 2001 (if we choose the threshold of three standard deviations above mean). The threshold is represented in the graphic as the dotted line. If we had chosen the threshold of two standard deviations this indicator would have sent one warning signal in November 2000.

Figure 7 – Argentina – Spread between Argentinean Peso and U.S. Dollar nominated deposits in the banking system



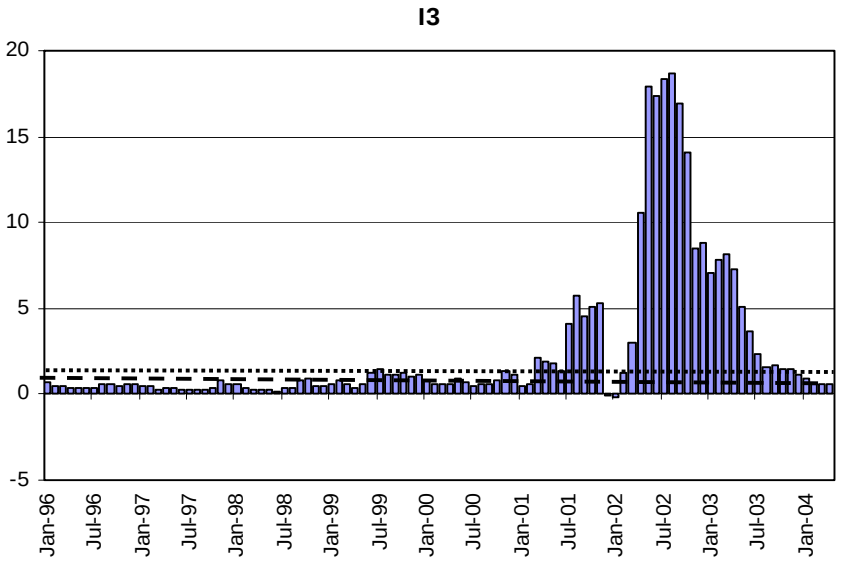
We can elaborate an indicator of EMP containing this spread. The use of this new variable in the EMP index is suggested because in countries like Argentina, interest rates in domestic currency are considerably higher than in dollars, because for the financial system it is more difficult to attract this type of deposits due to previous experiences of devaluation and depreciation of the domestic currency.

$$I_{3,t} = w_1 \Delta RER_t + w_2 Spread_t - w_3 \Delta \mathrm{Re}\, s \qquad (5.1)$$

We have chosen to use equal weights for each variable by following the experience obtained with the Kaminsky-Reinhart indexes in the previous section. In equation (5.1) the weights w_1, w_2 and w_3 are set equal to 0.333 each.

As can be seen in Figure 8 this index sends a crisis signal in November 2000 and starts sending signals again in March 2001. This is quite similar to the results obtained with the original Kaminsky-Reinhart EMP index with equal weight.

Figure 8 – EMP Index containing deposits interest rate spread



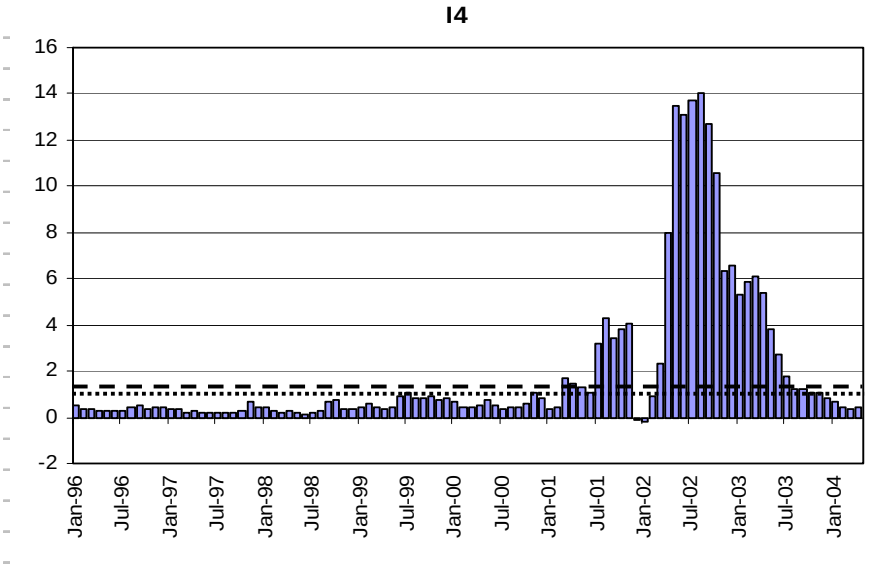
Then we can set another indicator of EMP containing at the same time the interest rate (as suggested by Eichengreen et al.) and the spread.

$$I_{4,t} = w_1 \Delta RER_t + w_2 Spread_t + w_3 \Delta i_t - w_4 \,\mathrm{Re}\, s \qquad (5.2)$$

Again we have chosen to set the weights equal for each variable. So, in (5.2) $w_1, w_2,$ w_3 and w_4 are set equal to 0.25 each.

With a threshold of two standard deviations we obtain here the same results than with the previous indicator, with the I_4 sending one signal on November 2000 and more evident ones from March 2001.

Figure 9 – EMP Index containing deposits interest rate spreads and interest rates



If we experiment in constructing the index using the weights as the inverse of the standard deviation, as is suggested in some literature, we obtain the following indexes:

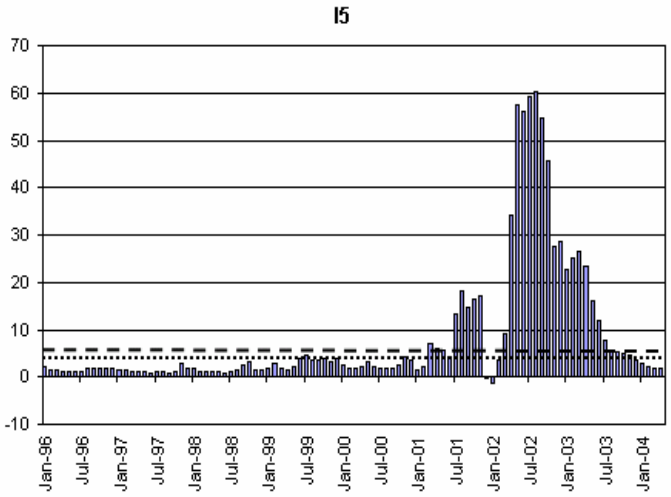
$$I_{5,t} = \frac{1}{\sigma_{RER}} .\Delta RER_t + \frac{1}{\sigma_{Spread}} .Spread_t - \frac{1}{\sigma_{\mathrm{Res}}} .\Delta \mathrm{Res} \qquad (5.3)$$

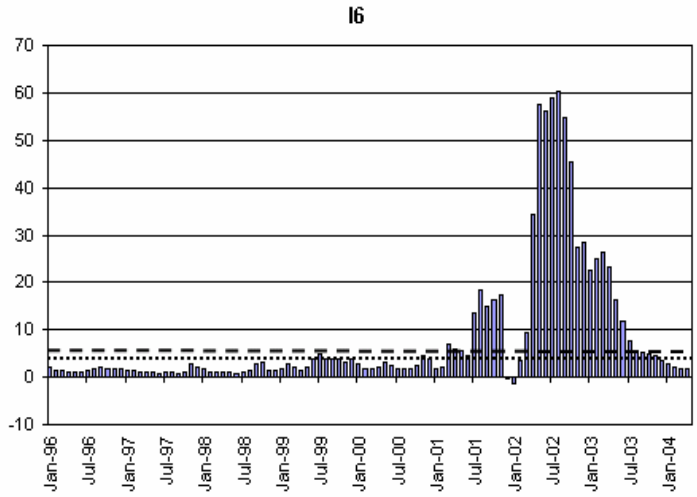
$$I_{6,t} = \frac{1}{\sigma_{RER}} \Delta RER_t + \frac{1}{\sigma_{Spread}} Spread_t + \frac{1}{\sigma_i} \Delta i_t - \frac{1}{\sigma_{\mathrm{Res}}} \mathrm{Res} \qquad (5.4)$$

we have used the standard deviations of period 1996-2000, that is a period of relative normality before the crisis climax.

The evolution of these two indexes can be seen in Figure 10.

Figure 10 – EMP Indexes weighted by the inverse of the standard deviation





Index 5 (I5) gives a signal in July 1999, then an isolated one in November 2000 and then starts sending signals from March 2001 up to November 2003 (except for the three months of the crisis climax , December 2001- February 2002).

Index 6 (I6) sends the first signal in July 1999 and also gives the same signals than I5, being its evolution extremely similar to the one of that index.

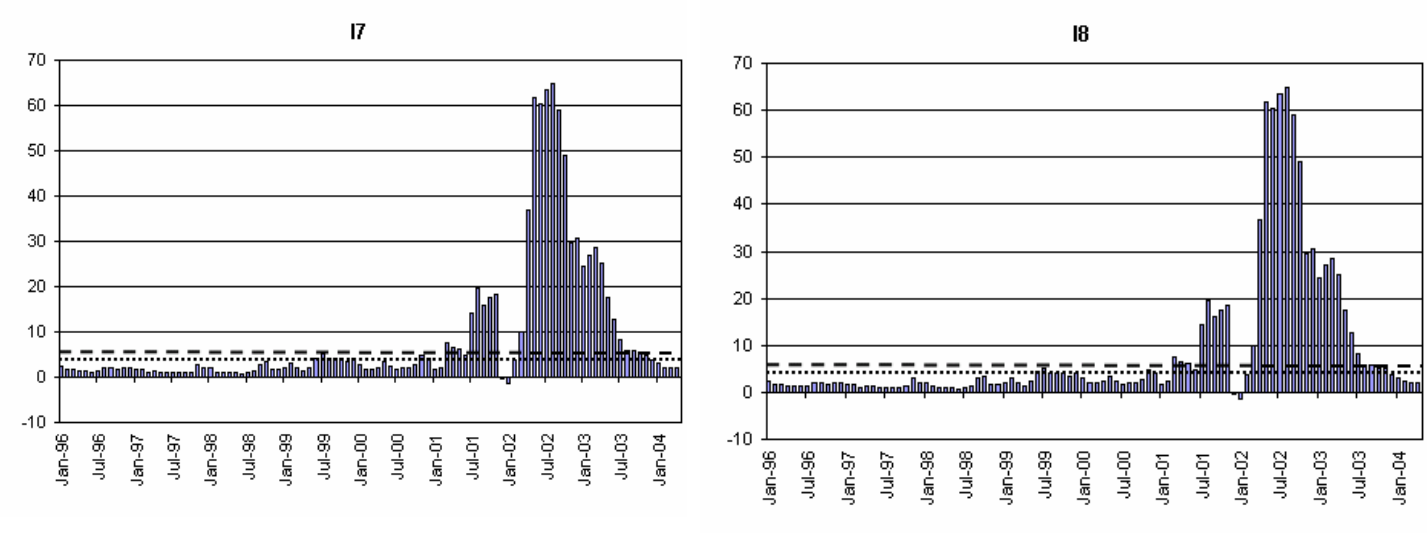
We have also used as a weight for the EMP index the inverse of the variances as is suggested by Bussiere-Fratzscher (2002). We obtained these two indexes:

$$I_{5,t} = \frac{1}{\sigma^2_{RER}}.\Delta RER_t + \frac{1}{\sigma^2_{Spread}}.Spread_t - \frac{1}{\sigma^2_{\mathrm{Res}}}.\Delta \mathrm{Res} \qquad (5.5)$$

$$I_{6,t} = \frac{1}{\sigma^2_{RER}}.\Delta RER_t + \frac{1}{\sigma^2_{Spread}}.Spread_t + \frac{1}{\sigma^2_{i}}.\Delta i_t - \frac{1}{\sigma^2_{\mathrm{Res}}}\mathrm{Res} \qquad (5.6)$$

As can be seen on Figure 11, Index 7 (I7) sends the first signal on June 1999 and then all the signals that have been sent by indexes I5 and I6. Index 8 (I8) has the same pattern.

Figure 11 – EMP Indexes weighted by the inverse of the variance



Results change using mean, standard deviations and variances from the period 1996-1998, giving more often signals of crisis.

A conclusion that can be obtained from the analysis of this EMP indexes is that most of the time the 2 standard deviations threshold is somewhat high making the EMP not send enough signals of crisis in the moments when it should have done so. An option to solve this is to reduce the threshold to 1.75 standard deviations. This gives more sensibility to the indexes making them signal the crisis some months before. Other option could be to use mean and standard deviation of periods of normality (understanding "normality" as the value that these parameters take in a period of growth). These thresholds should be calibrated in order to reflect the particularities of each economy in developing countries.

Some useful indicators

Since some of the commonly used indicators failed in sending warning signals when Argentina´s crisis was unleashed we want to propose some indicators that can represent certain particularities of the Argentinean economy.

Table 8: Argentina - Chosen leading indicators

Type of Indicator	**Indicators**
Fiscal Indicators	Interest Payments/Tax Revenues, Current Expenditures/Tax Revenues, Current Expenditures/Lagged Tax Revenues
Financial Indicators	Credits/Deposits, Variation of Private Capitals in Balance of Payments
Exchange Rate indicators	Departure of Real Exchange Rate from Trend

On table 8 can be seen the indicators that we have chosen. Some of them reflect certain intrinsic characteristics of Argettina´s situation before the crisis. The Interest Payments over Tax Revenues indicator was selected because it reflected if the authorities were able to pay all the interests with the revenue of each specific month. In a similar way, the Current Expenditures over Tax Revenues indicator shows if the public sector is capable of financing this type of expenditures with the revenues of the same month. Current Expenditures over Lagged Tax Revenues shows if the public sector can finance its current expenditure with the revenue of the previous month (we have lagged only one month). The credits / deposits indicator shows if the banking system is in a healthy situation or if it is suffering from low deposits or excessive credit creation. The Variation of Private Capitals in Balance of Payments can show if there is a huge outflow of capitals, as happened to Argentina during the Mexican crisis or after the Russian and Brazilian ones. The departure of Real Exchange Rate from Trend indicator shows if there is volatility on the exchange market that could lead to collapse. Annex IV shows the mean and thresholds for the new set of leading indicators both using 1996-1998 and 1996-2000 data. Annex V is the graphical analysis of this indicators where can be seen the results in a more explicit way.

In Table 9 we show the number of signals that is issuing each indicator using thresholds at 1.75 and 2 standard deviations, with 1996-1998 and 1996-2000 data:

Table 9: Number of signals sent by each proposed indicator

Indicator		1996	1997	1998	1999	2000	2001	2002	2003
Credits/Deposits	A*	3	0	0	0	12	12	10	12
	B*	1	0	0	0	12	10	10	12
	C*	1	0	0	0	5	7	10	11
	D*	0	0	0	0	1	5	10	11
Tax Revenues / GDP	A*	1	1	0	1	1	2	1	8
	B*	1	0	0	0	1	2	1	8
	C*	1	0	0	0	1	2	1	8
	D*	1	0	0	0	1	2	1	8
Interest Payments / Tax Revenues	A*	0	1	2	2	3	7	3	1
	B*	0	0	1	2	3	6	3	1
	C*	0	0	0	2	2	3	0	0
	D*	0	0	0	1	2	3	0	0
Current Expenditures / Tax Revenues	A*	0	1	0	4	4	5	2	0
	B*	0	0	0	4	2	5	2	0

	C*	0	0	0	2	2	2	1	0
	D*	0	0	0	1	2	1	1	0
Current Expenditures/ Tax Revenues in t-1	A*	1	0	0	1	2	3	3	0
	B*	0	0	0	1	1	3	3	0
	C*	0	0	0	1	1	3	3	0
	D*	0	0	0	0	0	1	3	0
Interest Payments / Current Expenditures	A*	0	1	2	2	3	6	3	2
	B*	0	0	0	2	3	4	3	1
	C*	0	0	0	1	2	2	3	1
	D*	0	0	0	0	1	2	1	0
Private Capital Flows Variation (quarterly variable)	A*	0	0	0	0	2	2	4	4
	B*	0	0	0	0	2	2	4	2
	C*	0	0	0	0	1	2	4	1
	D*	0	0	0	0	1	2	4	0
Departure of Real Exchange Rate from Trend	A*	2	0	0	1	7	12	12	8
	B*	0	0	0	0	6	12	12	7
	C*	0	0	0	0	4	12	12	4
	D*	0	0	0	0	3	12	12	3
Interest Rates Spread	A*	1	1	2	8	5	9	11	12
	B*	1	1	2	8	4	9	11	12
	C*	0	0	0	3	1	9	10	11
	D*	0	0	0	0	1	9	10	11

* A = using 1996-1998 mean and std. dev. – Threshold set at 1.75 std.deviation.

B = using 1996-1998 mean and std. dev. – Threshold set at 2 std.deviation.

C = using 1996-2000 mean and std. dev. – Threshold set at 1.75 std.deviation.

D = using 1996-2000 mean and std. dev. – Threshold set at 2 std.deviation.

The Credits/Deposits anticipates fairly well the crisis giving 12 signals in 2000 and 2001 when 1996-1998 data is used. It also keeps sending signals when the worst of the crisis is over. This later feature is due to the "asymmetric pesification" system implemented in the first months of 2002 and the "corralito bancario" that was desarticulated only in 2003. If 1996-2000 data is used

with the 1.75 standard deviation the indicator works in a similar way sending 5 signals in 2000, 7 in 2001, 10 in 2002 and 11 in 2003.

The Tax Revenues over GDP indicator does not perform so well, sending only few signals in the moment of the crisis climax. This could be explained by the seasonality characteristics of tax collection where some taxes are collected in certain months and not in others.

The Interest Payments over Tax Revenues performs well, specially using 1996-1998 mean and standard deviation. As can be seen on Table 9 the indicator sends 3 signals in 2000, 7 in 2001, 3 in 2002 and 1 in 2003. The diminishing of signals in 2002 and 2003 can be explained by the default of public debt at the end of 2001.

The Current Expenditures over Tax Revenues also performs better with 1996-1998 mean and deviations. It starts sending signals in 1999 and 2000. In 2001 the number of signals increases and in 2002 diminishes, disappearing in 2003. This is mostly explained by the increase in revenues in 2002 due to inflation and the implementation of the export taxes that had also effect in the tax revenues of 2003. A similar analysis can be done for the Current Expenditures over Tax Revenues in t-1. Both indicators do not perform as well if 1996-2000 data is used.

Interest Payments over Current Expenditures performs better with 1996-1998 data where in 1999 are issued 2 signals, in 2000 are issued 3 signals and in 2001 are issued 6. In 2002 three signals are issued and this can be explained by the default of the public debt at the end of December 2001.

Private Capital Flows Variation has the drawback of being a quarterly variable but the outflow of capital had an important role in the Argentinean crisis. This indicator can send a maximum of 4 signals per year and beginning in 2000 sends 2 signals per year until the economy collapses, sending 4 signals in 2002, a year when the retirement of capitals increased.

Departure of Real Exchange Rate from Trend also performs well, giving good signals in 2000 and even more in 2001 and 2002.

Finally, the Interest Rates Spread has a good performance, increasing deeply as the crisis approaches. Two of the three months of 2001 where the indicator did not send signals can be explained as the first two months of the restriction to withdrawal of deposits (November and December 2001)

The noise-to-signal ratios of most of this indicator are lower than for the ones analyzed in the previous section.

This indicators feature certain particularities of Argentinean economies that can also appear in certain developing countries, specially the ones in Latin America. So, this indicators proposed can be a starting point for a wider Early Warning System to predict this type of crises.

6- Conclusions and Extensions

The possibility of forecasting a currency crisis with enough anticipation is extremely relevant for developing countries longing to achieve a development path. The leading indicators approach is an interesting and relative new approach that deserves still a lot of research. The availability of all the data used to elaborate these indicators can be very useful for policy makers that are willing to forecast the existence of currency crises. It is really necessary for developing countries to have a tool that allows them to forecast the probability of occurrence of a crisis within a time window wide enough to let them react in order to avoid this problematic situation. Indicators should not be exhaustive and should show particularities of the economy that is being studied

Also, a good path to explore is which year or period to take as a basis for analysis. That is, which period must be the mean and deviations referred too. As was seen in the previous section this could take to different results.

There is still a lot of work to develop on leading indicators of currency crisis. Some of our proposals for further exploration is to work with seasonally adjusted indicators in order to discriminate the variations due to the crisis of those that are derived merely from seasonal variations. Also another proposal could be to analyze the departure of indicators its trend. One way to explore this could be using a Hodrick-Prescott filter to determine the trend and then to analyze the departures from it for each variable.

Another extension could be the use of multi-country models where contagion is taken on account and where fundamentals from the main trading partners can be analyzed in a similar way.

There are multiple crisis with particular features, such as the one suffered by Argentina in 2001-2002. these types of crisis need a deep analysis and a permanent following of multiple key variables. This consideration of multiple factors (macroeconomic, political, financial) is essential to construct an effective Early Warning System because indicators that could be good in predicting some currencies could not be as good in explaining others.

A drawback of the leading approach indicators is that it only matters if the indicator is above or below the critical threshold, but it does not matter how far have this threshold been surpassed. It is just the same for this type of models to surpass the critical value in 1% than in 10%. A further work can be done in order to give more weight to values that surpass the threshold in a bigger magnitude.

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ANNEX I - Mean and Variance of selected leading indicators

Indicator	1996-2001		1996-1998		1999-2000		2001-2002		2003-2004	
	Mean	Var	Mean	Var	Mean	Var	Mean	Var	Mean	Var
Int. Reserves/GDP (in %)	10.3	2.51	9.4	1.53	11.7	0.16	10.4	2.42	10.2	2.34
Imports Variation (in %)	-0.3	97.5	1.14	82.66	0.2	73.1	-2.8	247.5	5.1	104.1
Int. Reserves/Imports	13.7	7.18	11.5	1.41	15.8	1.47	15.5	10.7	9.9	1.44
Int. Reserves Variation in pesos (in %)	0.1	19.3	1.5	4.37	0	4.4	0.9	102	2.1	30.5
Int. Reserves in dollars – variation (in %)	0.1	19	1.5	4.45	0	4.4	-4	104.4	2.8	34.6
Exports variation (in%)	0.9	108.4	1.3	106.6	1.4	116.6	-0.5	70.4	2.2	60.5
Exports/GDP (in%)	0.7	0.0064	0.74	0.0053	0.7	0.0060	1.5	0.548	1.9	0.024
Exports/Imports	1.01	0.0511	0.91	0.012	0.98	0.014	2.12	0.7	1.89	0.177
Total Credits / GDP (in %)	27.1	7.97	24.9	4.09	29.7	1.41	29	54.57	15.8	6.51
Monetary Base/GDP (in %)	4.9	0.12	4.8	0.09	5.1	0.11	6	1.48	10.2	1.35
Credits Variation (in %)	0.3	2.84	1	1.58	-0.1	2.23	0	165.32	-0.5	4.34
Trade Balance/GDP (in %)	-0.01	0.019	-0.1	0.009	0	0.007	0.3	0.025	0.3	0.006
Real Exchange Rate (CPI)	81.8	52.8	88.4	15.8	75.7	2.5	126.5	3077.1	175.9	21.0
Real Exchange Rate (CPI) Variation (in %)	-0.2	2.97	-0.2	1.27	-0.5	4.87	4.4	148.08	0.1	3.81
M1 (in pesos)	24977	5520291	24646	6237074	26365	650760	27016	19047302	52266	102697346

M1 Variation (in %)	0.3	29.9	1	16.4	-0.1	18.6	1.3	69.0	2.9	5.7
Debt Interests Payments (in pesos)	619	97428	471	50617	728	79812	708	176722	534	109305
Debt Interests/GDP (in %)	0.2	0.0123	0.2%	0.0057	0.3	0.01	0.2	0.0199	0.1	0.0084
Consumer Prices Index Variation (in %)	0	0.11	0	0.08	-0.1	0.12	1.4	5.84	0.4	0.13
Wholesale Prices Index Variation (in %)	-0.1	0.46	-0.2	0.39	0.2	0.55	3.2	34.07	0.4	0.87
M2/Int. reserves	1.3	0.017	1.3	0.007	1.2	0.001	1.4	0.058	1.6	0.016
Fed. Rate	5.2	0.8	5.4	0	5.6	0.5	2.8	2.1	1.2	0
Int. Reserves/Monetary Base	2.1	0.07	2.0	0.04	2.3	0.01	1.8	0.12	1	0.01
Total Trade / GDP (in %)	1.5	0.02	1.6	0.02	1.5	0.01	2.2	0.70	3.0	0.09
Deposits Variation (in %)	0.3	4.90	1.2	2.79	0	0.65	-0.8	12.39	2.1	2.60
Credits/Deposits	1	0.00133	1	0.000256	1	0.000893	1.1	0.05752	0.7	0.0184

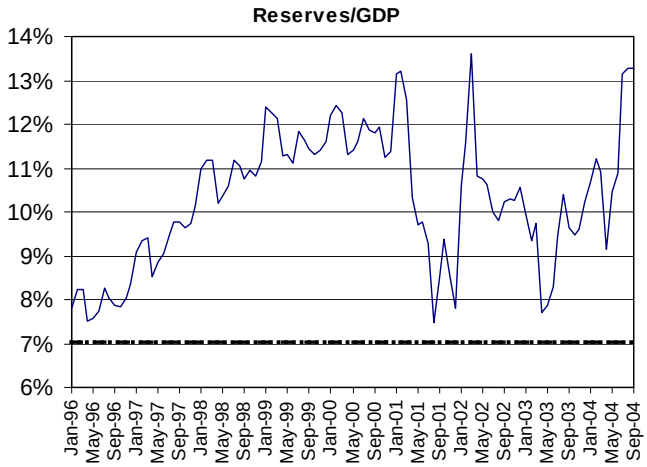
ANNEX II - Threshold values for selected leading indicators

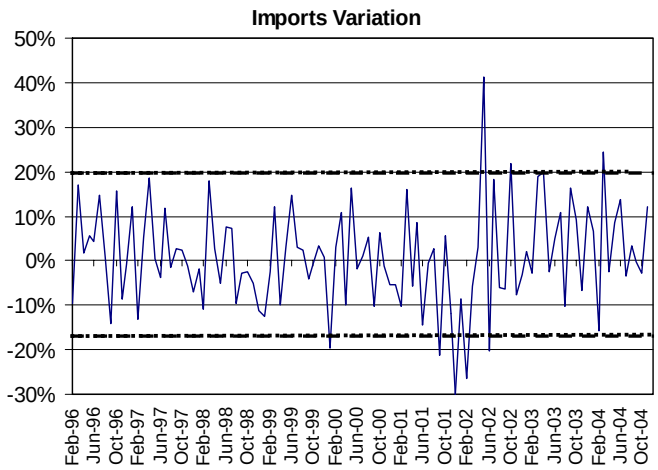
Indicator	Mean 1996-1998	Mean 1996-2000	Thresholds Using 1996-1998 data*			Thresholds Using 1996-2000 data*		
			1.75 std. dev.	2 std. dev.	3 std. dev.	1.75 std. dev.	2 std. dev.	3 std. dev.
Int. Reserves/GDP (in %)	9.4	10.33	I: 7.21	I:6.9	I: 5.6	I: 7.7	I:7.3	I: 5.8
Imports Variation (in %)	1.14	0.74	S: 17.3 I: -14.9	S:19.6 I:-17.3	S: 28.8 I: -26.5	S: 17.3 I: -15.	S: 19.6 I:-17.3	S: 28.8 I: -26.5
Int. Reserves/Imports	11.5	13.21	S: 13.59 I: 9.37	S: 13.89 I: 9.06	S: 15.09 I: 7.86	S: 15.32 I: 11.1	S: 15.62 I: 10.8	S: 16.83 I: 9.59
Int. Reserves Variation in pesos (in %)	1.5	0.89	I: -2.2	I: -2.7	I: -4.8	I: -2.2	I: -3.6	I: -5.8
Int. Reserves in dollars – variation (in %)	1.5	1.0	I: -2.3	I: -2.84	I:-4.98	I: -3.06	I: -3.62	I: -5.86
Exports variation (in %)	1.3	1.38	I: -17	I: 19.62	I: -30.1	I:-17.19	I:-19.84	I: -30.46
Exports/GDP (in %)	0.74	0.73	I: 0.61	I: 0.59	I: 0.51	I: 0.6	I: 0.58	I: 0.51
Exports/Imports	0.91	0.94	S: 1.1 I: 0.71	S: 1.13 I: 0.68	S: 1.25 I: 0.57	S: 1.15 I: 0.72	S: 1.18 I: 0.69	S: 1.3 I: 0.57
Total Credits / GDP (in %)	24.9	26.8	S: 28.5 I: 21.3	S: 29 I: 20.8	S:31.1 I: 18.7	S: 32 I: 21.6	S: 32.7 I: 20.9	S:32.99 I: 17.9
Monetary Base/GDP (in %)	4.8	4.9	S: 5.32 I: 4.26	S: 5.39 I: 4.19	S:5.69 I: 3.88	S: 5.52 I: 4.3	S: 5.61 I: 4.22	S:5.95 I: 3.87
Credits Variation (in %)	1	0.6	S: 3.23 I: -1.24	S: 3.55 I: -1.56	S:4.83 I: -2.83	S: 3.14 I: -2.01	S: 3.5 I: -2.37	S:4.97 I: -3.84
Trade Balance/GDP (in %)	-0.1	-0.1	S: 0.08 I: -0.25	S: 0.11 I: -0.28	S:0.20 I: -0.37	S: 0.11 I: -0.23	S: 0.14 I: -0.25	S:0.24 I: -0.35
Real Exchange Rate (CPI) (index	88.4	83.3	S: 95.4	S: 96.4	S:100.4	S: 95.6	S: 97.4	S:104.4

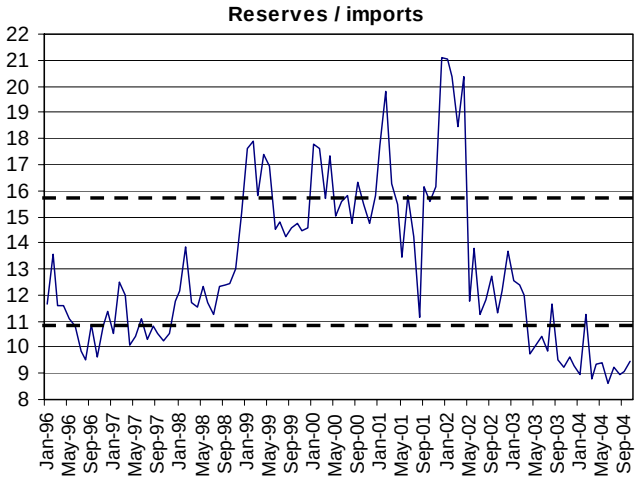
1991=100)			I: 81.3	I: 80.3	I: 76.3	I: 71	I: 69.2	I: 62.2
Real Exchange Rate (CPI) Variation (in %)	-0.2	-0.3	S: 1.82 I: -2.18	S: 2.11 I: -2.46	S:3.25 I: -3.61	S: 2.63 I: -3.23	S: 3.04 I: -3.65	S:4.72 I: -5.32
M1 (in pesos)	24646	25334	S:28477 I:20815	S:29024 I:20268	S:31213 I:18079	S: 29164 I: 21503	S:29712 I:20956	S:31901 I:18767
M1 Variation (in %)	1	0.6	S: 8.2 I: -6.18	S: 9.23 I: -7.21	S:13.34 I:-11.32	S: 7.97 I: -6.82	S: 9.03 I: -7.87	S:13.25 I: -12.1
Debt Interests Payments (in pesos)	471	574	S: 869	S: 927	S:1155	S: 1067	S: 1138	S: 1420
Debt Interests/GDP (in %)	0.16	0.2	S: 0.3	S: 0.32	S:0.39	S: 0.37	S: 0.40	S:0.50
Consumer Prices Index Variation (in %)	0	0	S: 0.53 I: -0.49	S: 0.60 I: -0.56	S:0.90 I:-0.85	S: 0.53 I: -0.59	S: 0.61 I: -0.67	S:0.93 I: -0.99
Wholesale Prices Index Variation (in %)	-0.2	0	S: 0.96 I: -1.27	S: 1.11 I: -1.43	S:1.75 I:-2.07	S: 1.19 I: -1.25	S: 1.36 I: -1.43	S:2.06 I: -2.13
M2/Int. reserves	1.35	1.29	S: 1.50 I: 1.19	S: 1.52 I: 1.17	S:1.61 I:1.08	S: 1.47 I: 1.11	S: 1.49 I: 1.09	S:1.59 I: 0.99
Fed. Rate	5.4	5.47	S: 5.65 I: 5.08	S: 5.7 I: 5.00	S:5.86 I:4.88	S: 6.28 I: 4.65	S: 6.4 I: 4.53	S:6.86 I: 4.07
Int. Reserves/Monetary Base	2.0	2.1	I: 1.6	I: 1.57	I:1.37	I: 1.68	I: 1.62	I: 1.39
Total Trade / GDP (in %)	1.6	1.53	S: 1.81 I: 1.31	S: 1.84 I: 1.28	S:1.98 I:1.14	S: 1.76 I: 1.29	S: 1.79 I: 1.26	S:1.92 I: 1.13
Deposits Variation (in %)	1.2	0.75	I: -1.73	I: -2.16	I:-3.85	I: -1.91	I: -2.29	I: -3.81

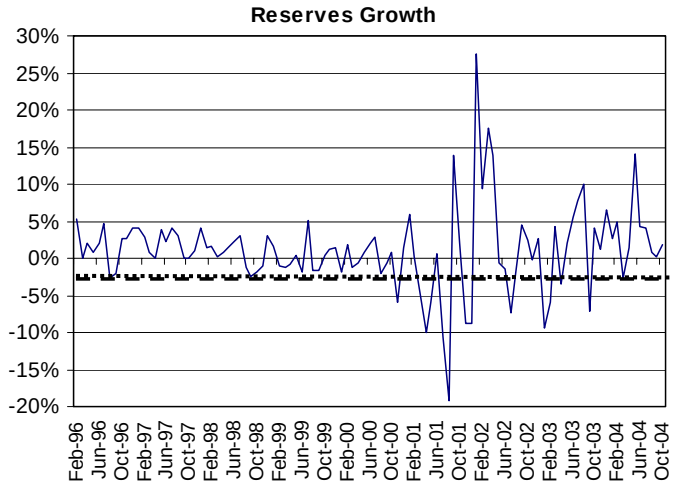
* S = upper threshold, I= lower threshold

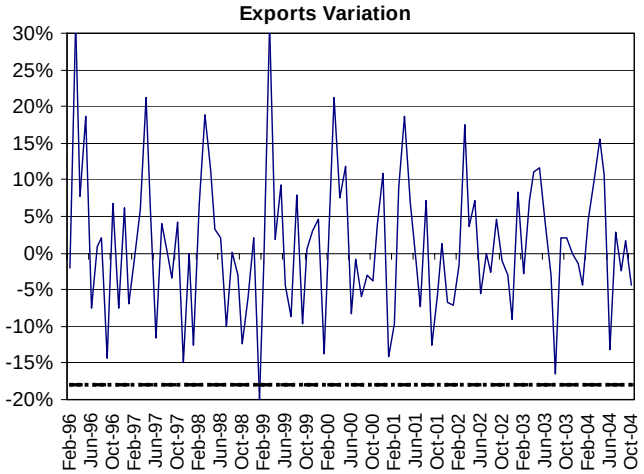
ANNEX III – Graphical Analysis of leading indicators

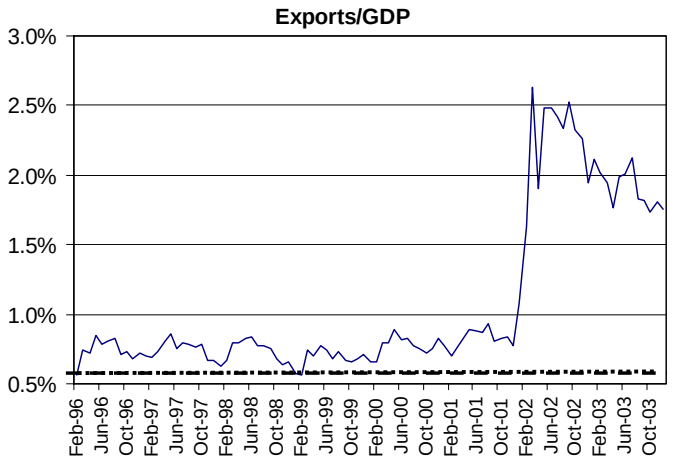












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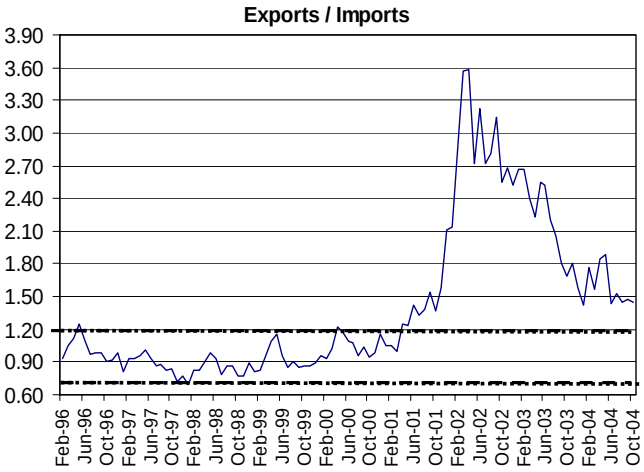

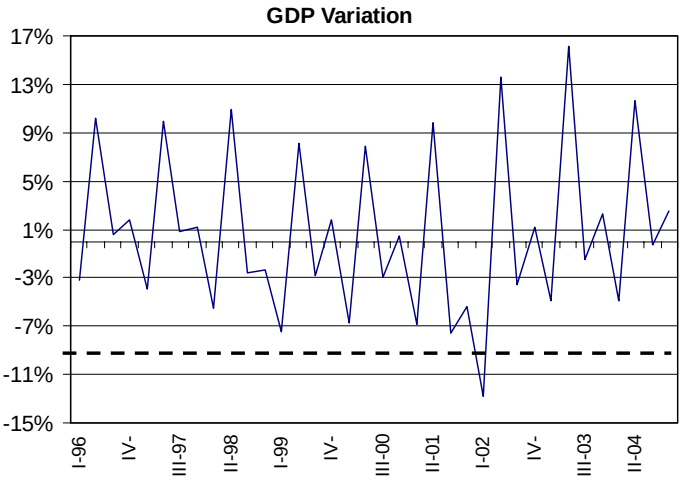

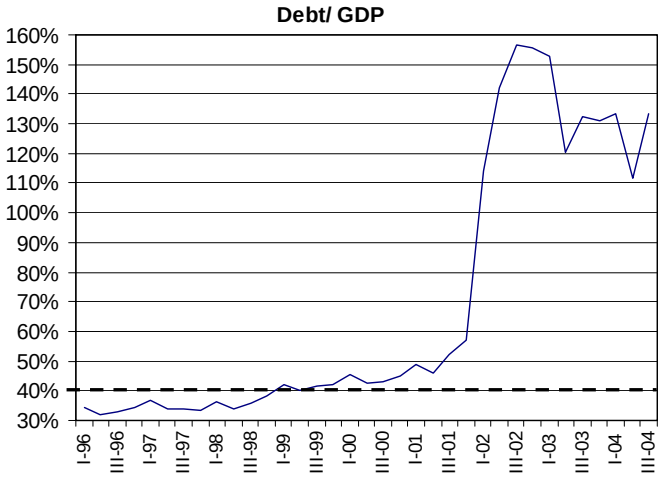

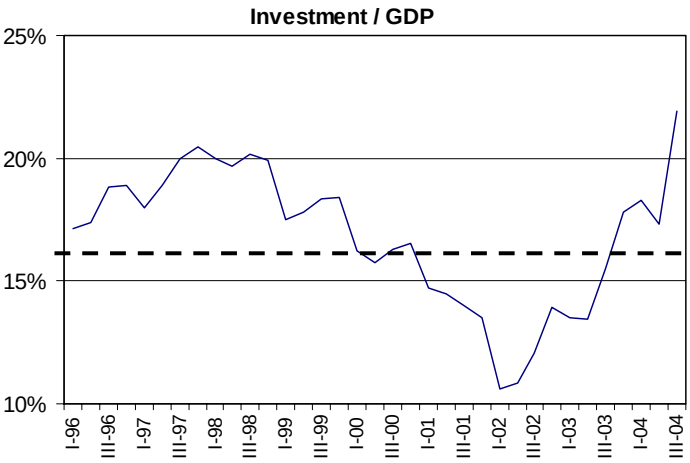

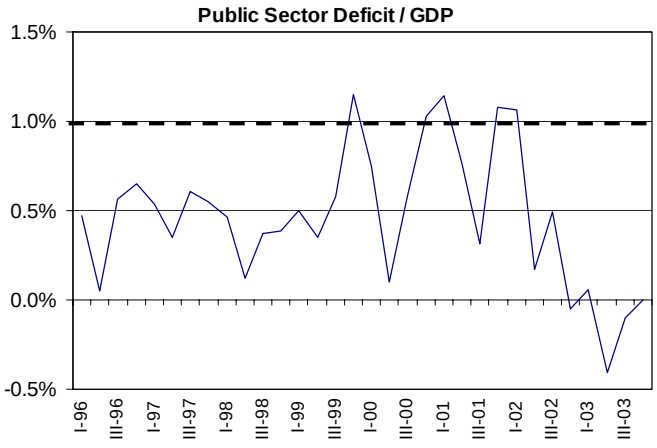

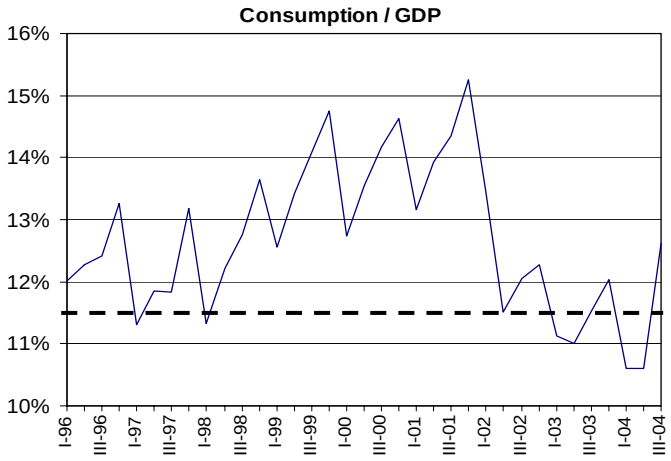

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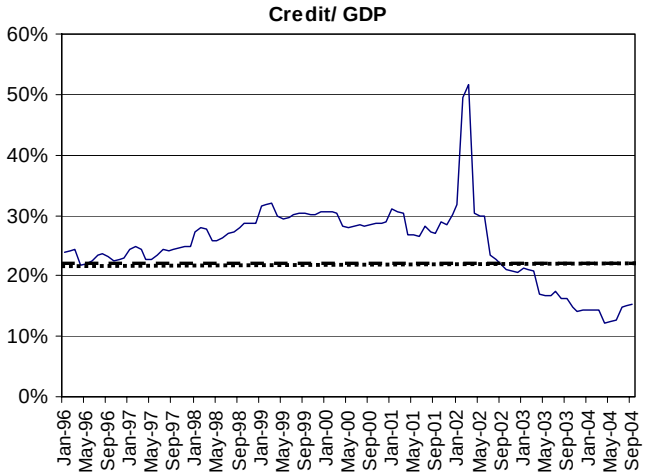

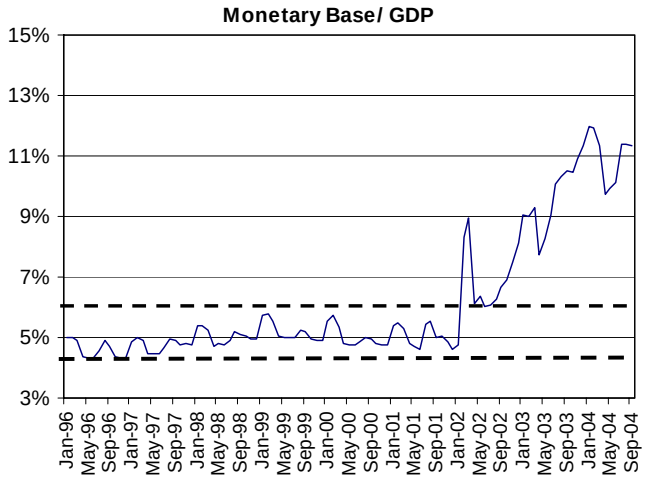

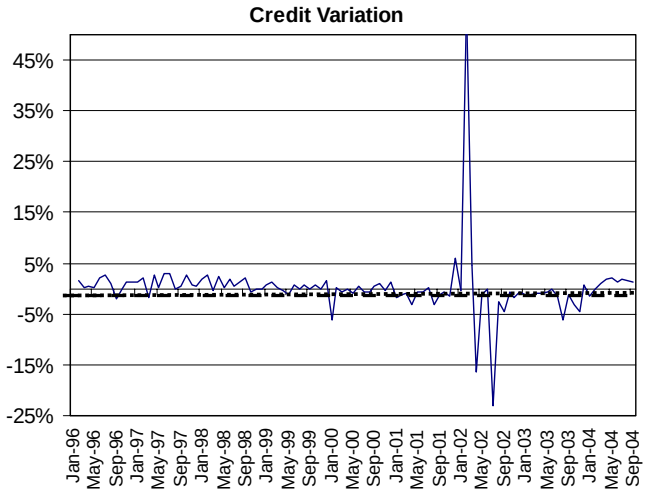

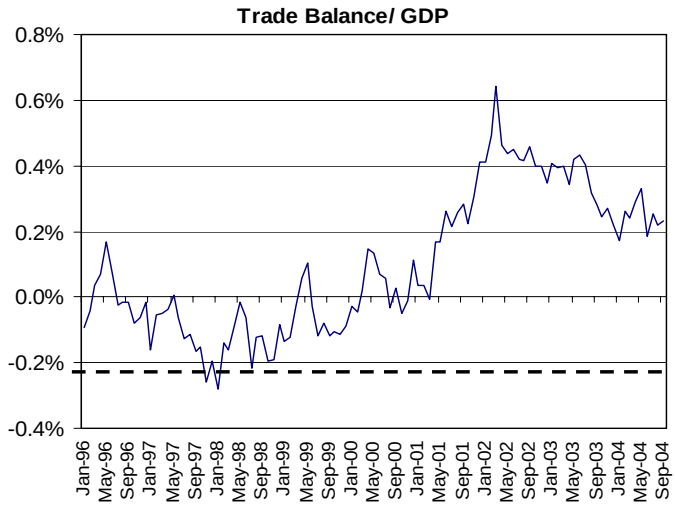

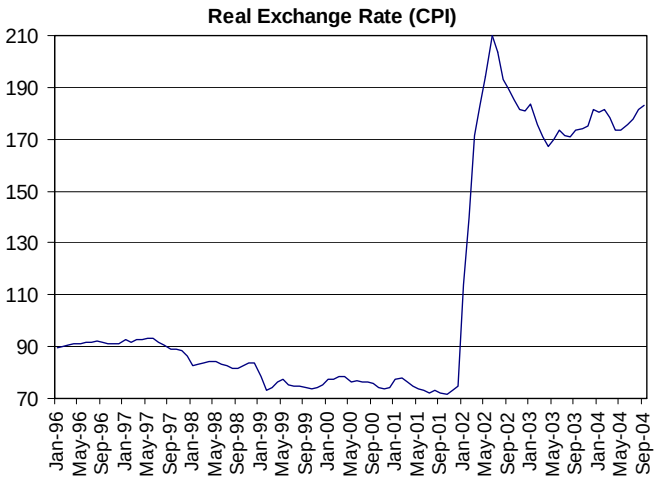

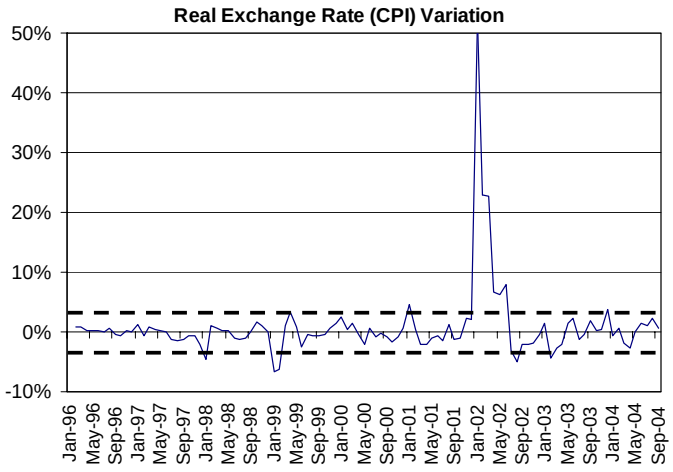

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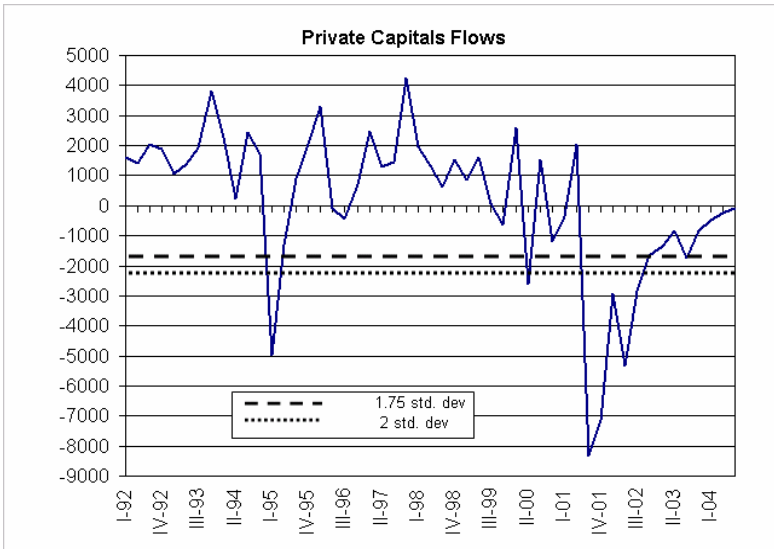
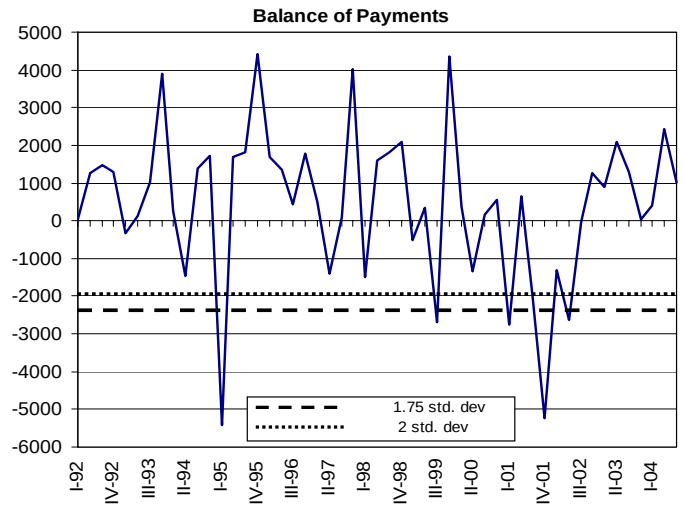
ANNEX IV - Means and thresholds of proposed leading indicators

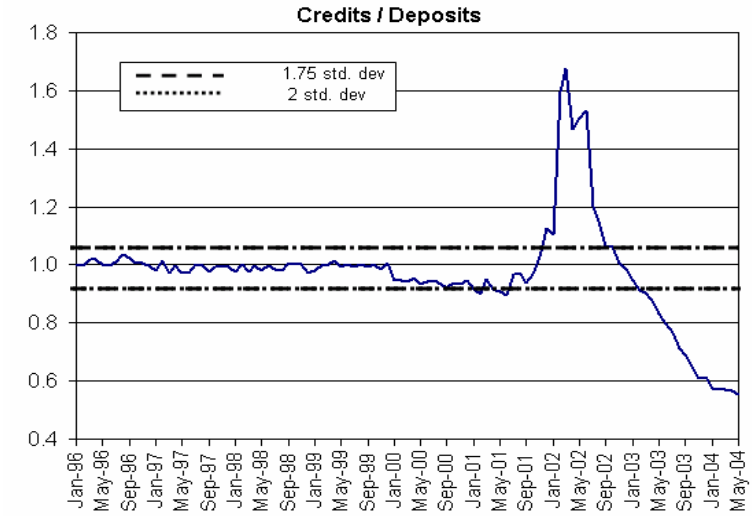
Indicators	With 1996-1998 data*				With 1996-2000 data*			
	Mean	Thresholds			Mean	Thresholds		
		1.75 std.dev	2 std. dev	3 std. dev		1.75 std.dev	2 std. dev	3 std. dev
Credits/ Deposits	1.00	S: 1.02 I: 0.97	S: 1.03 I: 0.96	S: 1.04 I: 0.95	0.99	S: 1.03 I: 0.94	S: 1.04 I: 0.93	S: 1.06 I: 0.91
Tax Revenues / GDP (in %)	1.37	S: 1.53 I: 1.21	S: 1.55 I:1.18	S: 1.64 I: 1.09	1.39	S: 1.55 I: 1.23	S: 1.57 I:1.2	S: 1.66 I:1.11
Interests Payments/ Tax Revenues (in %)	11.92	S: 21.76	S: 23.17	S: 28.79	14.43	S: 26.77	S: 28.53	S: 35.58
Current Expenditures / Tax Revenues	1.13	S: 1.26	S: 1.27	S: 1.34	1.17	S: 1.34	S: 1.37	S: 1.47
Current Expenditures / Tax Revenues in t-1	1.14	S: 1.36	S: 1.39	S: 1.51	1.17	S: 1.39	S: 1.42	S: 1.55
Interest Payments / Current Expenditures (in %)	10.5	S: 18.6	S: 19.8	S: 24.4	12.2	S: 21.4	S: 22.7	S: 28
Private Capital Flows Variation (in millions of USD)	1535	I: -809	I: -1144	I: -2485	1033	I: -1740	I: -2136	I: -3721
Balance of Payments (in millions of USD)	1042	I:-1644	I:-2027	I:-3563	688	I:-1998	I:-2381	I:-3917
Departure of Real Exchange Rate from Trend	2.7	S: 8.2 I: -2.9	S: 9 I: -3.7	S: 12.1 I: -6.8	0.3	S: 9.1 I: - 8.4	S: 10.3 I: -9.6	S: 15.3 I: - 14.6
Interest Rates Spread	1.36	S: 2.26	S: 2.39	S: 2.90	1.85	S: 3.48	S: 3.71	S: 4.64

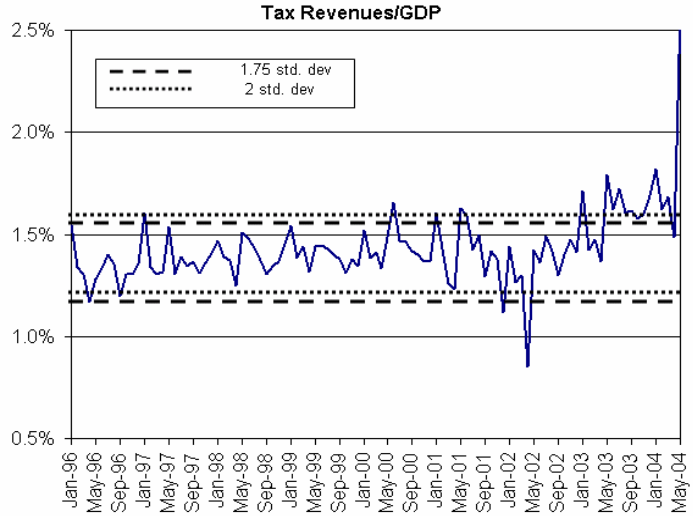
* S = upper threshold, I= lower threshold

Annex V - Graphical analysis of proposed indicators









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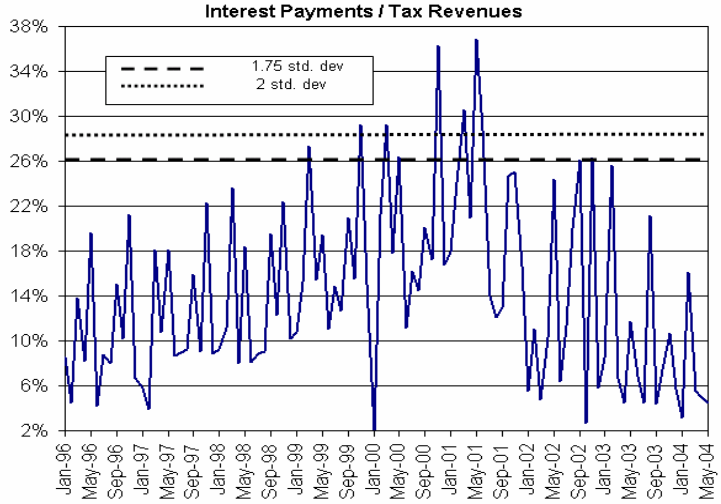

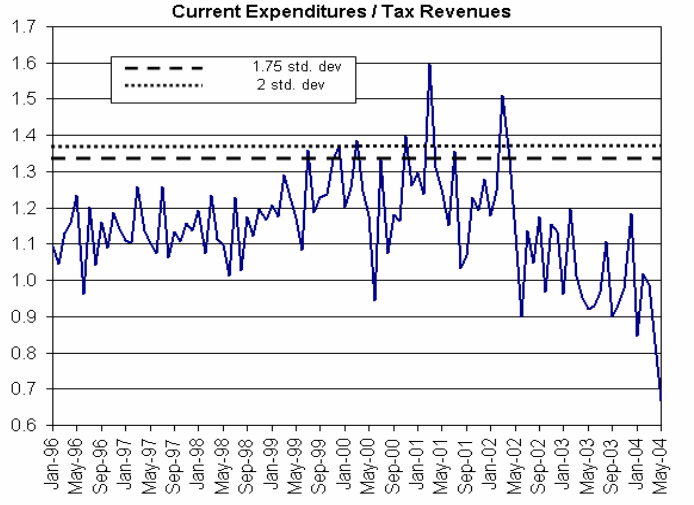

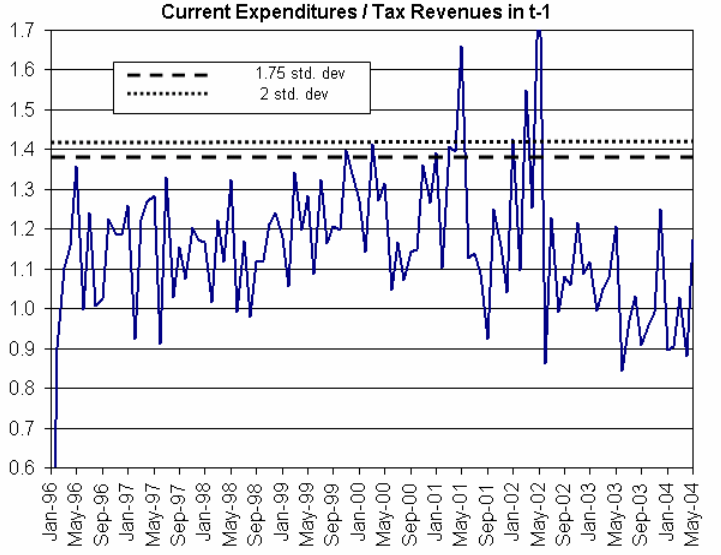

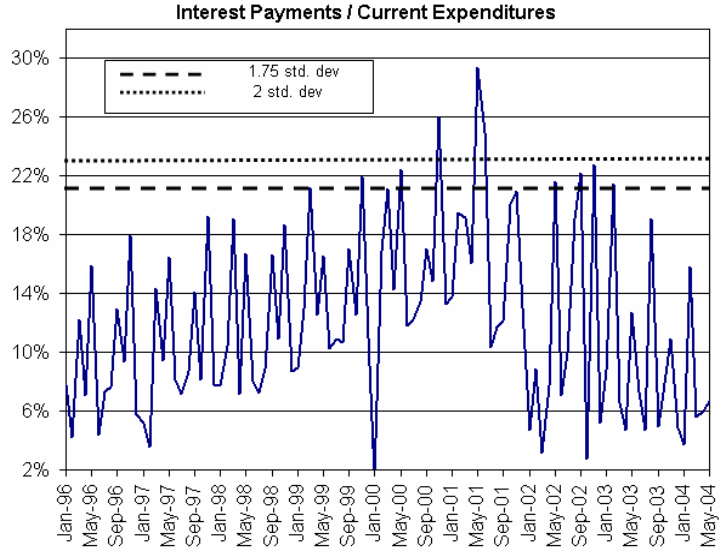

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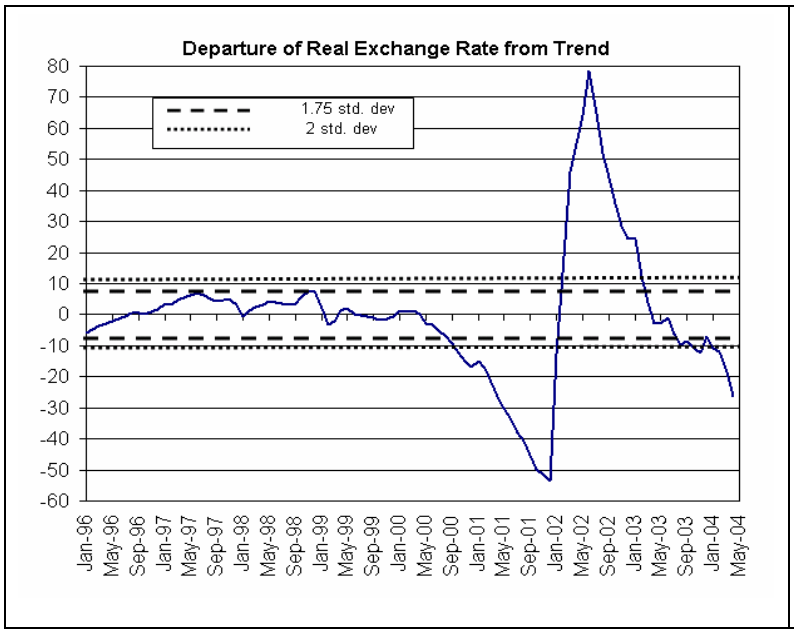

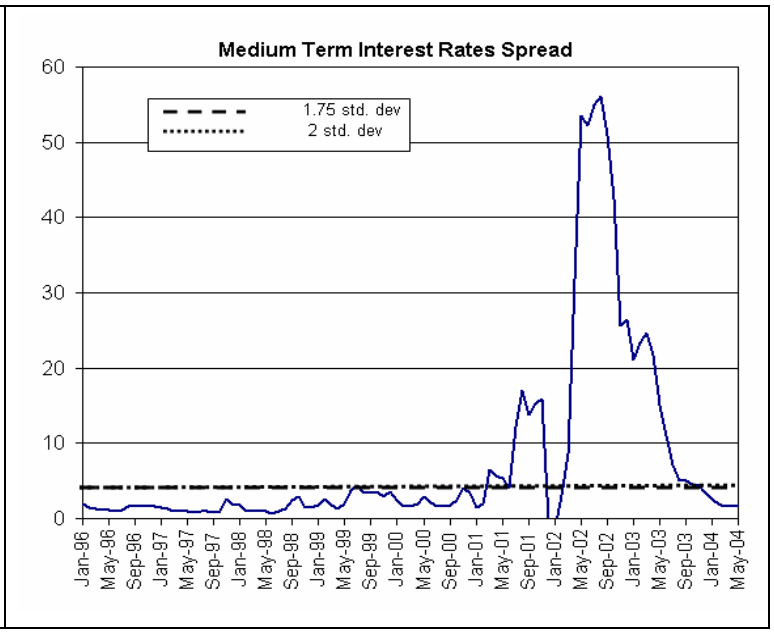

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