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MACROECONOMIC SHOCKS AND FINANCIAL VULNERABILITY

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Resumen

Este trabajo busca identificar en la Argentina la relación existente entre shocks macroeconómicos y vulnerabilidad financiera durante el período 1977-2004 con modelos de VEC. Las caídas en la relación depósitos/circulante en poder del público (indicador de vulnerabilidad financiera) estarían asociadas con: salidas de capital, caídas en los términos de intercambio, contracciones en el PIB real, depreciaciones cambiarias reales y alzas en las tasas de interés reales externas. Las recesiones económicas causan, en sentido de Granger, a las caídas en la relación depósitos/circulante, mientras que el PIB real es una variable exógena (débil y fuerte).

Abstract

The aim of this paper is to identify the relationship between macroeconomic shocks and financial vulnerability in the Argentine case for the period 1977-2004, by using VEC models. The results show that falls in the deposit-currency ratio (indicator of crisis or financial vulnerability) would be associated with capital outflows, drops in the terms of trade, contractions in real GDP, depreciations in real exchange rates, and increases in international real interest rates. Economic recessions Granger-cause deposit-currency ratio declines; whereas real GDP would behave like a (weak and strong) exogenous variable.

Key Words: macroeconomic shocks, vulnerability or crisis in the Argentine financial system, VEC models, causality, weak and strong exogeneity.

JEL Codes: E44, G21.

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1. Introduction

The turbulences recorded in Asian markets in the 1990s and the crisis unleashed in Argentina by the end of 2001 showed how quickly and strongly can financial crises arise, and how difficult it is to forecast the evolution and ramifications of such events. In many cases during the debt crises in the beginning of the 1980s and throughout the 1990s, governments had to assume the obligations of financial institutions. These events had fiscal costs, which represented several GDP percentage points, in addition to adversely affecting economic growth.

Given the importance of the financial vulnerability issue, it is relevant to analyze the causes of financial crisis and the need to identify the behavior of certain variables, which could make this sector vulnerable, in the particular case of the Argentine economy.

Part of the recent literature has focused on verifying theories on financial crises, mainly by applying *microeconomic data* or using information on the specific fundamentals of the banking sector (Park, 1991.) In contrast, other papers lay greater emphasis on the behavior of some *macroeconomic variables* associated with crisis periods (Gorton, 1988; Demirgurc-Kunt et al., 2005.) Finally, a third group of studies has intended to isolate *contagion effects*, even though there is still no consensus on the effective incidence of such factors (Parks, 1991; Edwards and Rigobon, 2002; and Rigobon, 2002).

In several articles subsequent to the Asian crisis it is possible to find numerous early warning indicators of banking crisis which mainly rely on specific variables related to individual entities (largely based on the balance sheets of financial entities.) Nevertheless, the role of macroeconomic variables, which might affect the financial system, has not generally been much explored and, for such reason, this paper addresses this second strategy.

In particular, it should be noted that there are discrepancies as to the relationship between the real economy and the financial sector. The dilemma consists in determining whether falls in the level of economic activity are the causes of financial crises or, otherwise, crises in the financial sector are responsible for the problems in the real economy. The empirical answer to this question is very important to determine economic policy guidelines, because it would help elucidate whether first to protect the financial system from unfavorable macroeconomic shocks (of a domestic or foreign origin), or the rest of the economy from crisis or vulnerability in the financial sector.

Therefore, it is relevant to analyze the causality relationship between business cycle and financial vulnerability, in order to empirically contrast opposite theories as well as to select financial regulation policies.

Precisely, discussion in the financial regulation arena on the relationship between business cycle and financial vulnerability is at the heart of the debate on Basel II. For some critics of this proposal, it stresses procyclicality of the financial system compared with Basel I, and therefore it would be proper to aim at macro prudential regulations (Danielsson et al., 2001; Goodhart et al., 2006 and Lowe, 2006.) It should be noted that the application of prudential regulations is essential to ensure the smooth operation of financial entities and the stability of the financial system as a whole. However, macro prudential rules should gain more importance if macro economy were to affect the vulnerability of the financial sector (rather than the other way round.) In particular, for developing economies some macro prudential rules, such as those originating in Basel II, could foster systemic volatility due to its

procyclical effect. In such case, output growth in the upward phases of the business cycle would improve the portfolio of banks, increase the value of guarantees (collateral), favor the rating of entities, and reduce capital requirements, thereby generating more credit and consequently more investment and output. Thus, the procyclical behavior of the economy would be strengthened. Due to the foregoing, it is necessary to complement micro prudential regulations (those set forth at the level of firms) with macro prudential ones (those relating to the assessment of the financial system and the economy as a whole.) The importance of this proposition would be enhanced: (1) for countries where macro economy would "cause" the behavior of the financial system, (2) for very volatile economies where the occurrence of sizeable macroeconomic shocks would be highly probable. In other words, the evaluation of the causality relationship between macro economy and financial system for the Basel II discussion may be even more relevant for emerging than for developed countries for which this scheme was originally proposed. [2]

The aim of this paper is to analyze financial crises, or financial sector vulnerability, in the case of the Argentine economy, by focusing on the above-mentioned second (macroeconomic) approach. For such purpose, it intends to identify relationships between macroeconomic shocks and the financial sector on the basis of VEC models. It also examines, through Granger causality analysis and exogeneity tests, whether decline periods (or slow-downs) in real GDP determine financial crises, or vice versa. This paper uses Argentine economy quarterly data, covering the period subsequent to the 1977 Financial Reform, which dramatically liberalized transactions executed in financial markets.

The rest of this paper has been organized as follows: Section 2 analyzes the main theories, which explain financial crises. Section 3 describes macroeconomic variables, which could anticipate crisis, or vulnerability, in the financial sector, as well as empirical evidence found in literature. Section 4 describes major crisis episodes in the Argentine financial system, subsequent to the 1977 Financial Reform, and the key regulations (laws, executive orders, and Central Bank circulars), which have governed the financial sector. Section 5 analyzes the statistical properties of the time series used in this paper. Section 6 describes the econometric methods used and the results obtained through VEC models. Finally, Section 7 includes comments on the main conclusions on this paper, and some economic policy recommendations.

2. Main Theories Explaining Financial Crises.

The phenomenon of crises in the financial sector has been a topic under study in literature both theoretically and empirically. The main theories emphasize certain features of financial systems (such as the existence of asymmetric information), which make them vulnerable to shocks or changes in the individual expectations of economic agents vis-à-vis the solvency of financial entities.[3]

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[2] It should be noted that the proposal of Basel II proves to be more procyclical than that of Basel I.

2 In the specific case of the financial sector, *asymmetric information* could be defined as a situation in which one of the parties, to a financial contract, has less information than the other (Mishkin, 1997.) For example, a borrower who is granted a loan generally has better information than the lender on the potential returns and associated risks with the investment project financed by the loan. Asymmetric information generates two problems in financial systems: adverse selection and moral hazard. *Adverse selection* is an asymmetric information problem which occurs before the transaction. In this case, the party to the contract who is more likely to generate an undesirable (adverse) result is also the one more likely to be selected for the loan. *Moral hazard*, instead, is an asymmetric information problem which occurs after the transaction. In this case, the lender runs the risk that the borrower may conduct undesirable activities, from the lender's viewpoint, and that the loan failed to be fully repaid. Increased problems of adverse selection and moral hazard reduce the appeal to the granting of loans by financial entities; which could lead to an investment decline and a fall in aggregate economic activity. For such reason, for Mishkin (1997), adverse selection and moral hazard problems would be the cause, rather than the result, of financial crisis.

A first line of theoretical models on financial crises established that financial systems would be unstable, and therefore vulnerable to random shocks. The adverse effects of these shocks could determine that economic agents (depositors) lose confidence in the financial system and try to withdraw their deposits and exchange them for money. In this case there would also be liquidity problems in financial entities.

This group of papers, linked to the articles by Gibbons (1968), Kindleberger (1978), Diamond and Dybvig (1983), and Waldo (1985), provides a "bubble" explanation for bank runs. If some depositors believed that other agents could withdraw their deposits from financial entities, the former would try to anticipate in order to avoid losses deriving from the liquidation or bankruptcy of the latter. Diamond and Dybvig (1983) point out that bank runs could be self-generated, even in case of entities that are solvent but illiquid. In such case, bank runs take place when some depositors expect that others withdraw their deposits, even in absence of an initial deterioration in the position of banks. Runs on certain individual entities might threaten the financial sector as a whole if depositors believed that other banks in the system also present contagion risks. In this case, the bank run could turn into a crisis or bank panic.

The existence of an explicit deposit insurance system is useful to prevent self-generated bank crises. However, under deposit insurance, financial systems could be vulnerable to certain macroeconomic shocks if entities assumed greater risk exposure due to the existence of moral hazard.[4]

A second theoretical line incorporates asymmetric information as a key element for the occurrence of financial crises and holds that bank runs would not only be explained by the occurrence of random shocks, which induce depositors to withdraw their deposits from the financial system, but also by the fact that they would be caused by the scarce information given to depositors on risk exposure and solvency of financial entities (in this case, depositors would be unable to correctly assess the individual risk of banks.) Gorton (1988) indicates that deposit runs could arise in solvent entities, due to scarce information given to depositors on the quality of granted loans and the situation of banks. For his part, Park (1991) argues that depositors could try to withdraw their deposits from certain entities if it were difficult for them to distinguish between solvent and insolvent banks.

According to this second group of papers, deposit runs would originate in changes in the perception by depositors as to risk exposure assumed by banks. Bank runs could be triggered by contagion effects, or arise when agents find it difficult to procure information on the individual soundness of financial entities. In this case, depositors would be obliged to use aggregate information on the operation of the system.

Three versions derive from this second line of thought consistently with the aggregate information which depositors would be forced to use (Gorton, 1988), in the sense that crises would be triggered (i) by extreme cyclical fluctuations ('cyclical hypothesis'); (ii) by the unexpected failure of an important entity ('failure hypothesis'); or (iii) by a recession in the economy ('recession hypothesis'.)

The idea that problems in the financial sector originate in periods of crisis, or monetary astringency, was pointed out at an early stage by Jevons for the economy of the United

[4] For example, Demirguc-Kunt et al. (1998) find that there is a positive relationship between explicit deposit insurance schemes and financial sector crises (also see Lambregts et al., 2006.)

Kingdom. High interest rates, a decline in asset prices and the operation of some firms or financial entities could hasten these cyclical effects.

The failure hypothesis underscores that the failure of a major financial entity could arouse mistrust as to the solvency of the remaining entities and lead to a mass withdrawal of deposits in order to avoid the expected capital loss (thereby unleashing a financial crisis.) However, it is often pointed out that this scenario would preferably arise in a context of recession in the economy.

The third rationale stresses that financial crises arise from a reduction in the levels of economic activity ('recession hypothesis'.) In this case, depositors assume that economic shrinkage could seriously affect the solvency and liquidity of financial entities.

The common element to these three hypotheses is the existence of asymmetric information between banks and depositors, which generates information externalities and changes the perception of risk on bank deposits. This commonality is the main difference with the first body of theories, which explain financial crises.

It is also usual to point out that financial crises would not be alien to the level of system regulation. Some authors argue that, on an equal footing, the risk of bank insolvency and, more generally, of systemic bank crises, would be higher under liberalized financial systems. Financial liberalization processes give banks and other financial intermediaries more leeway, which could increase the exposure to risk by financial entities. If prudential regulation and supervision mechanisms were not effective, financial liberalization could end up increasing the fragility of financial entities in relation to socially desirable parameters, making them even more vulnerable (Demirguc-Kunt et al., 1998.) Arteta (2004) also suggests that the presence of dollar-denominated deposits and credits ('financial dollarization' or 'banking dollarization') could raise the probability of crisis and its costs in terms of output. In these cases, banks could have difficulties in facing a run on dollar-denominated deposits, whereas the central bank could not act as a lender of last resort due to the impossibility of issuing foreign currency. The latter argument is associated with the research papers on "original sin", "currency mismatch", and "fear of floating", that have lately emerged in literature (see, for example, Calvo, 2002; Eichengreen et al., 2003; and Bordo et al., 2005.) Banks are therefore highly vulnerable to real exchange rate fluctuations (Heymann and Kawamura, 2004.)

Another relevant issue is also the interaction between macroeconomic shocks and crisis episodes, as emphasized by Minsky (1977.) The relationship between financial and real environments becomes manifest in the existence of two prices for capital goods, which (based on expectations) represent debtor and creditor risk. The equality of both prices determines the level of investment. Within this scenario, financial crises would be complex processes where adverse expectations could lead to a reduction in expected gains and a decline in investment. This would exert pressure to decrease interest rates and increase liquidity preference, thereby inducing a fall in financial wealth. Gains would decline once again, and this process would tend to feedback on itself. Thus, causality between real and financial aspects would not be a one-way street, but instead a process of interaction.

In the theories under study, macroeconomic shocks play a major role either as a cause or a result of financial vulnerability. The aim of this paper is to investigate the importance and causality of the relationship between both spheres. For such purpose, the following Section examines the main macroeconomic shocks that relate to the financial system.

3. Relationship between Macroeconomic Shocks and Vulnerability in the Financial Sector. Empirical Evidence.

3.1. Sources of Macroeconomic Shocks and Financial Vulnerability.

Due to the nature of the activities conducted by financial entities, the latter are often exposed to risks associated with the performance of the economy. Entities assume liabilities (deposits), which are enforceable in the short term, but they hold assets (loans) with higher risk and longer terms. When the difficulties of borrowers increase, the value of the assets of financial entities decreases, whereas the value of their liabilities remains constant. An unfavorable macroeconomic shock would increase credit risk for financial entities because it reduces the value of the assets of firms (in relation to their debt.) For such reason, monitoring the variables, which affect the real economy, would be useful to identify crisis or vulnerability in the financial sector.

Literature has intended to identify macroeconomic shocks that could be associated with (or be the cause for) episodes of financial crisis. Several papers show the relationship between international financial conditions and financial vulnerability, particularly in cases of emerging economies, whereas other papers give more weight to domestic variables. Below we analyze the main shocks, which could affect the financial sector.

Falls (or low rates of growth) in domestic product (real GDP) could be associated with financial crises (Demirguc-Kunt et al., 1998.) However, there is disagreement in literature as to the direction of causality between both events. While part of these papers emphasize that falls (or low rates of growth) in the levels of economic activity unleash crises, other authors suggest otherwise, i.e. that financial crises would determine a contraction in the economy. Kaminsky et al. (1996) point out that the decline in real GDP tends to anticipate financial crises. Gorton (1988) shows that economic recession causes financial crises, rather than the other way round. Nevertheless, financial crises could generate a run on initially solvent financial systems (bank deposit exits), and cause an increase in real interest rates and a decrease in the economic activity level.[5]

Financial crises could also arise due to an *expansion in domestic bank credit*. Gavin et. al. (1998) and Demirguc-Kunt et al. (1998) underscore that some credit expansion episodes anticipated financial crises in Latin America, whereas Kindleberger (1978) states that financial crises are caused by an excessive expansion of credit during the upward trend in the business cycle. Sachs, Tornell, and Velasco (1996) also establish a link between credit expansion and financial crises, particularly in the case of emerging economies. Bank credit expansion is associated with a decline in the capacity of entities to value the quality of their loan portfolio (it increases the risk assumed by financial entities), which tends to increase the vulnerability of the financial system. Moreno (1999) stresses the relationship between credit expansion and financial crises during the Asian crisis by the end of the 1990s, while Pesola (2001) underscores that this relationship has also affected Nordic countries throughout such decade. In this regard, financial crises would coincide with a contraction in the economy, after a long boom period in economic activity, buoyancy, which could have been nurtured by excessive credit creation and higher capital inflows (Kaminsky and Reinhart, 1998.)

[5] The paper by Blejer et al. (1997), for example, would be associated with the theory which suggests that financial crises respond to random shocks.

Another relevant vulnerability indicator is the *increase in M2/international reserves ratio* (mismatch in the balance sheets of financial entities.) An increase in this ratio could generate problems within financial entities, if M2 holders wished to exchange such monetary aggregate for foreign currency, at the prevailing exchange rate, and exit from the financial system. Calvo (1996) argues that this ratio would be a good indicator of vulnerability for any country vis-á-vis balance of payment crises and financial sector problems, particularly in economies with a fixed exchange rate, which may experience sudden capital outflows. For their part, Calvo et al. (1996) point out that during the prior period to the 1994-95 Mexican crisis there was an increase in monetary aggregate M2 and a fall in international reserves. Thus, there would have been a widening of the gap between liquid bank liabilities and available foreign currency stock to meet those liabilities (Moreno, 1999.)

High *government budget deficits against GDP* could affect the financial system (Von Hagen and Ho, 2004.) Governments with budgetary constraints could postpone adopting measures that are necessary to strengthen entities, thereby making financial sector difficulties become systemic problems. In turn, fiscal deficits might originate inflationary expectations. However, Carrasquilla (1998) suggests that fiscal indicators have not been very useful to explain financial crises in Latin America.

Infation would affect the financial system by causing increases in nominal interest rates. Likewise, it could erode the value of entities' assets, specifically those that are neither dollarized nor indexed consistently with the evolution of domestic prices.[6]

Financial crisis episodes could be associated with *real exchange rate appreciations* if it affected the performance of exporting sectors or caused difficulties in the foreign sector of the economy. Hardy et al. (1998) argue that a real exchange rate appreciation affects competitiveness of the economy and earnings of firms, thus rebounding in the financial system.

Higher *volatility in some macroeconomic variables* could cause financial crises. A volatility increase would make it more difficult to distinguish good from bad investments (information in financial markets would become more asymmetric), thereby worsening the problems of adverse selection and making the financial system more fragile. Volatility could come from foreign (terms of trade, interest rates) as well as domestic sources. Higher volatility in the terms of trade could cause banking crises, specifically in cases of small economies with low diversification in their exports. Another source is associated with changes in international interest rates, which cause alterations in foreign capital flows. For its part, higher volatility associated with domestic product, or inflation rates, would make it difficult to determine credit risk and the appropriate assessment of loan portfolios by financial entities (Fanelli, 2005.)

Increases in international interest rates could alter foreign funding flows and affect emerging countries. In turn, such increases would have an impact on domestic interest rates, thereby affecting the quality of loan portfolios of financial entities. Thus, there would be an increase in the funding cost of banks and domestic firms, as well as the problems of adverse selection and moral hazard. This could affect the fragility of the financial sector and make the granting of loans less desirable (Kaminsky y Reinhart, 1998.)

Unexpected falls in the terms of trade would erode confidence in financial entities and they could unleash a financial crisis. These shocks could damage the capacity of domestic firms

[6] However, inflation could also even reduce the real value of bank deposits (liabilities of financial entities.)

to service their debts in the future and impair the quality of loan portfolios of financial entities. Such falls would therefore act as exogenous triggers of financial crisis, by reducing the earnings of debtors of financial entities.

The reduction (or reversal) in *capital flows* would also rebound adversely on the financial system. It could affect the level of international reserves (particularly, under a fixed exchange rate system) and/or the size of current account deficit, and also have major consequences for the financial system (see Calvo and Reinhart, 1999b.) While the loss of international reserves increases the country's financial vulnerability, an abrupt current account deficit contraction has serious effects on production and employment. As the current account balance is assimilated to GNP (GDP adjusted for factor payments abroad) less aggregate demand, a sudden current account deficit reduction is associated with an aggregate demand decline, unless it is offset by a GNP increase. In this regard, Calvo and Reinhart (1999a) suggest that almost every financial crisis has been associated with adverse changes, or reversals, in capital inflows.

Briefly, financial crises would be generated by several causes: (i) impairments in the terms of trade; (ii) higher interest rates; (iii) a reversal in capital flows; (iv) falls (or low rates of growth) in real GDP; (v) a deterioration in fiscal status; (vi) excessive expansion in domestic bank credit; and (vii) an increase in M2/international reserves ratio. The financial crisis scenarios could also be associated with a real exchange rate appreciation, with higher inflation rates and high volatility in some macroeconomic variables (Table 1.)

Table 1. Summary of Economic Variables Likely to Generate Crises in the Financial Sector.

* Falls, or low rates of growth, in real GDP.
* Expansion in domestic bank credit.
* Appreciation in the real exchange rate.
* Increase in M2/international reserves ratio.
* Increase in government deficit against GDP.
* Increases in domestic real interest rates.
* Higher inflation rates.
* High volatility in some macroeconomic variables.
* Impairment in foreign terms of trade.
* Increases in international interest rates.
* Reversal in capital flows.

In turn, several papers point out the effects that financial crises might cause on the economy. Goldstein et al. (1996), for example, suggest that crises might rebound on the rest of the economy, to a greater extent than disruptions generated in other sectors. Liquidity problems in financial entities would limit their capacity to channel resources from domestic saving, thereby affecting availability of credit, production, and possibilities for growth in the economy.

Thus, some macroeconomic variables could be affected by the occurrence of financial crises. For example, domestic credit could suffer a slowdown, or directly fall, thereby causing a credit crunch ((Borensztein et al., 2002), whereas interest rates could decrease owing to a monetary policy relaxation generated by the bail-out of problem entities. Dell'Ariccia et al. (2005) suggest that bank credit and output probably suffer a slowdown as a result of a banking crisis, which would affect the real economy through the lending channel.

3.2. Empirical Evidence on Financial Crises.

Several empirical papers have analyzed financial sector crises and their connection with macroeconomic variables. Kaminsky and Reinhart (1996) examine the behavior of several macroeconomic indicators during episodes of financial crisis by using panel data. For these authors, financial crises would be anticipated by falls in real GDP, impairments in the terms of trade, appreciation in the real exchange rate, expansion in domestic bank credit, and an increase in real interest rates (as well as declines in equity market prices or increases in the monetary multiplier.) The paper also scrutinizes the link between banking and currency crises, suggesting that the former generally anticipate the latter, whereas the reverse causality direction is less frequent.

On analyzing the causes of the banking crises recorded in the second half of the 20th century in more than thirty countries, Caprio and Klingebiel (1997) suggest that capital outflows, terms of trade falls, recessions, excessive credit growth, as well as terms of trade and output volatility would be the key macroeconomic factors which explain financial crises.

In a study on the Mexican banking system, Gonzalez-Hermosillo et al. (1997) analyze whether financial crises are generated by specific entity factors or macroeconomic variables. The findings obtained by these authors suggest that the variables linked to the banking sector would explain the probability of occurrence of crises, whereas macroeconomic variables would determine their length.

Demirguc-Kunt and Detragiache (1998b) identify the situations, which could weaken the financial sector and lead to systemic crises. To such effect, they use a multivariate probability model, which allows estimating the probabilities of banking crises depending on specific explanatory variables. These authors show that the slowdown or fall in real GDP, high real interest rates, and higher inflation significantly increase the probability of occurrence of systemic problems in the financial sector. They also sustain that adverse shocks in the terms of trade could influence crisis in the financial sector.

The paper by Hardy et al. (1998) advocates for the use of an econometric method similar to the one applied by Dermirguc-Kunt et al. (1998), with panel data for 38 countries (1980-97 period). These authors suggest that financial crises are associated with contemporaneous real GDP falls, higher inflation, domestic bank credit expansion, real interest rate increases, capital/output ratio and real exchange rate decreases, with deteriorating terms of trade.

Rossi (1999), using panel data for fifteen developing countries (1990-97 period) finds that growth in real GDP, real interest rates, inflation rates, changes in the terms of trade, government consumer spending against GDP, current account balance/GDP ratio, M2-reserves ratio, and private sector credit against GDP would be useful indicators to evaluate episodes of financial crises.

In a more recent study, Bordo and Meissner (2005) analyze (exchange and banking) financial crises in the periods 1880-1913 and 1972-97, with panel data, and suggest that a high exposure to foreign borrowing does not necessarily lead to a financial crisis. These authors also suggest that a strong reserve position, as well as a good exports/foreign currency debt ratio, would help diminish the probability of occurrence of this type of crisis.

For their part, Demirguc-Kunt and Detragiache (2005) intend to explain financial crises by using panel data for several economies. For these authors, real GDP rates of growth, changes in the terms of trade, inflation rates, M2/international reserves ratio, real interest

rates, exchange rate depreciation, share of bank credit to private sector/GDP, and the existence of a deposit insurance system, could help explain banking crises in these economies.

4. Financial Vulnerability and Crisis Episodes in Argentina.

4.1. Changes in the Deposit-Currency Ratio as Indicators of Scenarios of Vulnerability or Crisis in the Financial Sector.

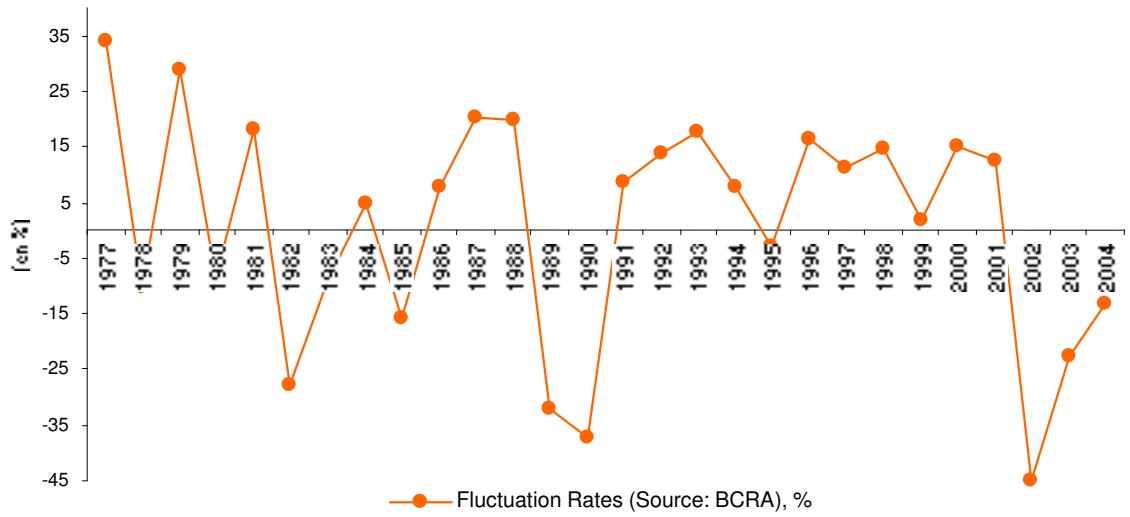
This paper considers that an indicator of scenarios of vulnerability or crisis in the Argentine financial sector consists of falls recorded in the deposit-currency ratio, against the previous period (both series taken at the end of period.) The deposit-currency ratio has frequently been used as an indicator of financial crises (Waldo, 1985, and de Gorton, 1988.) This indicator relates (peso and/or dollar denominated) current (checking) account and time deposits in the banking sector, excluding public sector deposits,[7] with money holdings or currency in public hands, stemming from data supplied by the Central Bank of Argentina. For purposes of comparing with crisis episodes arising from specialized literature, Figure 1 presents financial vulnerability episodes through the deposit-currency ratio with data collected annually.

The first element which stands out is the high volatility of this variable, which becomes manifest in the alternation between positive and negative rates, as well as in the magnitude of changes. It can be noticed that in the years 1978, 1980, 1982, 1983, 1985, 1989, 1990, 1995, 2002, 2003, and 2004 there was a decline in the deposit-currency ratio against the previous period. These falls generally coincide with periods in which there were major problems of insolvency and vulnerability in the Argentine financial sector consistently with the analysis made by Caprio and Klingebiel (1997). These authors state that major crises, occurring after the 1977 Financial Reform, would have taken place in the periods 1980-82, 1989-90, and 1995. For their part, Kaminsky (1998), as well as Calvo and Reinhart (1999b), mention that another crisis in the financial sector happened in 1985, whereas Demirguc-Kunt and Detragiache (2005) also include the financial crisis beginning in late 2001 which, according to these authors, has protracted over the following years. [8]

[7] This distinction is made due to different reasons for which public and private sectors maintain deposits or currency. In the public sector case, it may be an economic policy decision, and therefore it does not reflect the perception of a crisis.

[8] Although the deposit-currency indicator has been used in literature to point out financial crises, and it adjusts itself fairly well to vulnerability episodes in the Argentine case, there are two periods which deserve an additional comment. One of them is the year 2001, which does not appear as a crisis. This is due to the fact that currency fell more quickly than deposits (on the money's side, some economic agents reduced their holdings by choosing to be positioned in US dollars, whereas on the deposits' side, part of the depositors remained dollar-positioned within the financial system.) The other landmark is the year 2004, which is still regarded as a vulnerability period because money grew faster than the increase recorded in deposits (in both cases, data correspond to end of year.) It should be noted that this behavior will remain unchanged if we consider quarterly averages rather than year-end data.

Figure 1. Rates of Fluctuation in the Deposit-Currency Ratio. Annual Percentage Data.



The next two Sections analyze financial sector evolution and crisis episodes occurring after the 1977 Financial Reform.

4.2. Prior Period to Financial Reform.

Argentina functioned under a gold standard regime between the years 1899-1914 and 1927-29. Pursuant to this scheme the money creation mechanism operated through the Currency Board by delivering pesos against gold, and vice versa. During the periods in which this mechanism was not fully operative (for example, between the years 1914 and 1927), monetary policy was erratic and unpredictable (Gerchunoff et al., 1998). For such reason, after the final exit of the convertibility regime in 1929, some studies were conducted to reform the prevailing scheme and establish a Central Bank.

In March 1935, Argentina's National Congress finally passed the Central Bank Law, the Banking Law, and other legal rules which completed the Financial Reform. This scheme was purported to concentrate reserves, regulate the amount of credit and the means of payment, exercise control on banks, act as a financial agent of the Government, and advise on the issuance of loans and other credit transactions. The Banking Law was supplemented with the creation of an Institute for the Promotion of Bank Investments (*Instituto Movilizador de Inversiones Bancarias*) designed to restructure the financial system.

The Central Bank functions have evolved overtime and the Institution has become one of the key economic policy instruments. One of the features of the prior period to the 1977 Financial Reform was the role of banks in the allocation of credit. During the years of heavy regulation of the financial system, banks' capacity to lend did not bear much relation to the amount of funds that entities received as deposits and, instead, it depended on the allocations granted by the Central Bank. Periods of severe control were also characterized by the existence of regulated interest rates, which did not evolve to the same extent as inflation. Due to this fact, deposits had been rewarded with negative real interest rates since the post-war period until 1977, with the exception of some periods with lower inflation rates, such as the years 1953, 1968, and 1969.

4.3. Crisis Episodes Subsequent to the 1977 Financial Reform.

The 1977 Financial Reform (established by Law 21526) determined a fundamental change in the Argentine financial system. This legal rule implied a transfer from a scheme where the lending capacity of banks was based on the allocations made by the Central Bank to another system where the lending capacity was linked to the ability of banks to take deposits (Gerchunoff et al., 1998.) The reform included the deregulation of interest rates, theoretically designed to encourage savings and its channeling toward highly profitable investments. A fractional reserve system (at the beginning reserve requirements were set at 45%), entry barriers to the banking system were removed, foreign funding inflows were liberalized, and the Central Bank Charter was amended by Law 21547. In the first years of this Reform, there was a remarkable increase in the number of financial entities and banks, and a higher percentage of deposits relative to GDP. Savings, instead, increased during some periods but then declined due to, among other reasons, the expansion of credit geared to consumption. The 1977 Reform also created the so-called Monetary Regulation Account, whereby a mechanism of compensations and charges was imposed on financial institutions according to the different types of deposits. This mechanism implied a sort of undercover subsidy for entities and it adversely affected the Central Bank balance sheet, since it increased quasi-fiscal deficit.

Throughout the year 1978, output and terms of trade fell and there were capital outflows, all of which was associated with a banking crisis (see Table 2.) By the end of that year, the Government set a new economic plan in motion (the Plan dated December 20, 1978), which intended to dispel the uncertainty about the future evolution of the exchange rate, by setting its value through a Cross Rate Table.

The 1977 Financial Reform also allowed entities to compete for deposit taking, offering depositors higher interest rates (which, however, were negative in real terms over several periods), and determined a cost of funding increase for borrowers (De Pablo 2005.) The financial sector operated with a local currency-denominated deposit insurance system in the hands of the Central Bank, who ultimately responded for the insolvency of entities and the difficulty in taking charge of returning bank deposits. This system operated smoothly up until a crisis erupted as a result of the liquidation of an important domestic banking institution in March 1980. This circumstance triggered a banking crisis, despite the recovery in the terms of trade and domestic output recorded during such period. Until the exit from the Martinez de Hoz program at the beginning of 1981, the Central Bank had authorized entities to take foreign-currency denominated deposits, which were not covered under the deposit insurance system governing local-currency denominated deposits only.

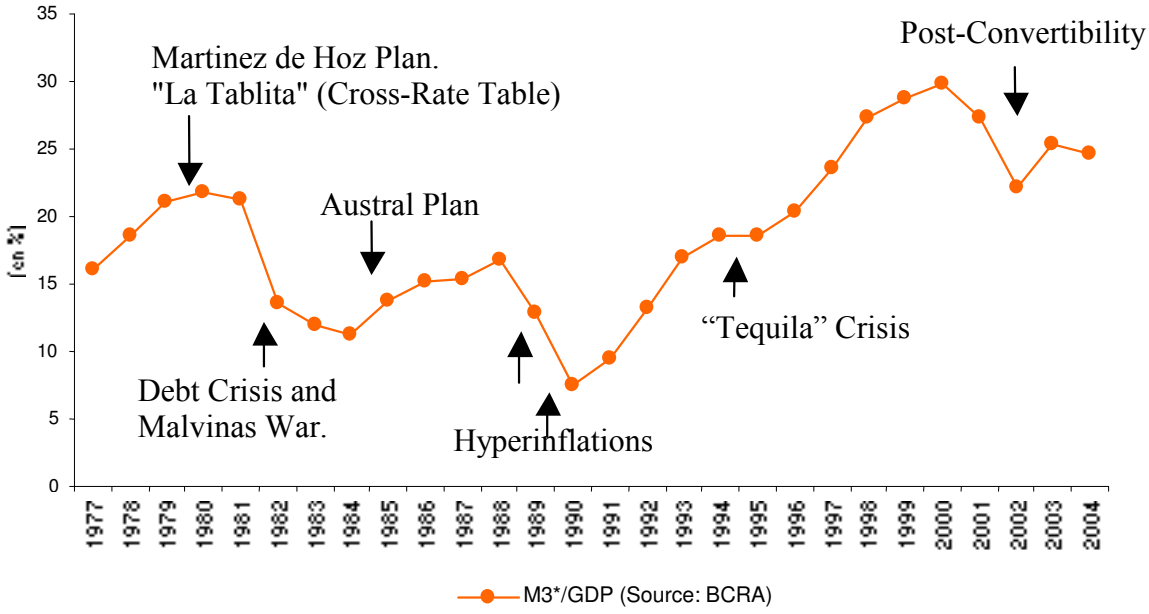
In 1982, the external debt crisis and the Malvinas conflict affected the economy and adversely rebounded on the banking system. That year, the crisis was accompanied by significant exchange rate devaluation, a decline in the terms of trade, capital outflows, and a decrease in Central Bank reserves and domestic output. Despite the improvements recorded in some of these indicators (for example, GDP at constant prices) all over 1983, deposits kept on falling relative to money in public hands, which affected the financial system.

By mid-1985, the Government put in place the so-called Austral Plan, which was designed to curb inflationary pressures on the economy, create a new currency unit, and establish de-indexation mechanisms for financial assets and liabilities. Throughout that year, there was deterioration in some macroeconomic variables (high inflation and terms of trade and GDP falls) and a crisis in the banking system.

In the 1980s, the deposit insurance system remained operative, with certain caps for guaranteed amounts, whereas in some years of this decade there loan and deposit transactions coexisted both at regulated and free interest rates. The M3*/GDP monetization coefficient at current prices[9] recorded a decreasing trend in the first half of the 1980s (see Figure 2.)

The financial system suffered another important crisis after the 1989 hyperinflation, which, by the end of that year, derived into the impossibility for banks to return deposits to savers, giving rise to the so-called BONEX Plan. This plan determined the exchange of bank deposits for dollar-denominated government bonds. Likewise, there was another crisis episode in 1990 which was associated with price disruption caused by hyperinflation (in 1989 and 1990, falls in the deposit-currency ratio reached 32% and 37%, respectively.) Both episodes were accompanied by impairments in the terms of trade (especially in the former year), major capital outflows, and GDP falls.

Figure 2. M3*/GDP Coefficient at Current Prices during Different Economic Plans. Annual Percentage Data.



As from 1991 a Currency Convertibility Plan was put in place. Under this regime, both peso and dollar-denominated loans and deposits increased dramatically, the Deposit Insurance Company was created, and constraints were set on the amounts of guaranteed deposits. In 1992 a new Central Bank Charter was passed into Law 24144 (this legal rule authorized that rediscounting be granted but only within a maximum 30-day period.)

In the first half of 1990s, there was significant growth in the economy's real GDP which was fuelled, among other factors, by a stream of capital inflows. By mid-1990s, the increases in the U.S. Federal Reserve reference rates and the contagion of the Mexican crisis by late 1994 caused a decline in capital inflows within the economy. This behavior was associated with a crisis in the financial system, which derived into the withdrawal of deposits from

[9] Monetary aggregate M3* includes money in public hands and foreign/local currency-denominated deposits, excluding public sector deposits.

financial entities, particularly from smaller institutions (between end of December 1994, and same month the following year, private sector deposits fell nearly by 5 %.) In order to stop the deposit run on some banks and overcome the crisis, the Government took several actions designed to strengthen the financial system (inter alia, dollarization and modification of minimum cash requirements, creation of a bank deposit insurance system, prohibition to pay through cashier's window checks exceeding a specified amount, creation of a bank capitalization trust fund and deepening of preventive measures established pursuant to BIS Basle rules.) Additionally, a new bank regulation and supervision system was developed and known by the Spanish acronym BASIC, which meant the following: Bonds (subordinate debt issued by financial entities), Audit (an internal/external audit program geared to financial entities), consolidated Supervision (supervision of financial conglomerates), Information (enhanced quality information disclosure), and "C" (*Calificadoras*) which stands for risk Rating Agencies (annual credit risk rating conducted through such expert agencies), wholly designed to reinforce financial system supervision.

The stylized facts observed in the financial sector as pointed out by Fanelli et al. (2002) over such decade are the following: (i) greater *bankarization* (outreach of banking services); (ii) significant dollarization of deposits and credits; (iii) sensitivity of domestic credit cost vis-à-vis external shocks; (iv) strong procyclicality between activity level and bank credit; (v) bank risk reduction in the recessive phase of the business cycle and increase in the exposure to the public sector; and greater short-term debt share in recessive phases.

Action taken by mid-1990s, which was geared to provide backing to the financial system and prevent new crises in this sector, helped support the Convertibility regime, which remained active until 2001 when, after a major capital outflow, there was a partial public sector debt default and a crisis in the foreign (devaluation) and financial sectors, as well as an exit from the pegged exchange rate system.[10] Owing to the crisis, the Government implemented banking restrictions on deposits, known as "*corralito*" (through Executive Order 1570, dated December 01, 2001), whereby limitations were set on cash withdrawals from financial entities, thereby fixing a maximum weekly amount for deposit withdrawals. Afterwards, on January 9, 2002, peso-denominated deposits were subject a rescheduling program. In turn, Executive Order 214, dated February 03, 2002, provided for the so-called "asymmetric pesification", whereby dollar-denominated obligations to deliver money amounts were converted into pesos. On the one hand, it was established that all dollar and/or other currency-denominated deposits should be converted into pesos at the rate of US$ 1 = $ 1.40, whereas dollar-denominated debts should be converted into pesos at the rate of US$ 1 = $ 1. For purposes of a subsequent re-adjustment consistently with the evolution of domestic prices, the legal rule also created the so-called CER -Spanish acronym for "Reference Stabilization Coefficient"- based on the Consumer Price Index (Table 3, Appendix I, contains a summary of some of the main rules which have affected the financial sector since the 1977 Reform.)

All over 2002 there were continuous GDP falls, capital outflows, and a dramatic decline in Central Bank reserves (that year the deposit-currency ratio was reduced by 45% against the previous period.) However, once the initial shock gradually dwindled, some real indicators started to change their trend. The Central Bank, thanks to a relatively high level of reserves

[10] As regards external debt, one should mention that in 2001 it was conducted a mega debt exchange procedure (*megacanje)*, whereby there was a voluntary exchange of investor-held government securities for other instruments issued by the National Government (approximately US$ 30 billion), as well as a voluntary conversion of domestic public debt into "guaranteed domestic bonds" (Executive Order 1387.)

for crisis periods managed to stabilize the dollar price in the exchange rate market and the expectations of economic agents.[11]

In the year 2002, the Central Bank approved Circular A3911 which regulated financial asset valuation by financial entities, and enacted a new Central Bank Charter under Law 25562 (since 1992 partial amendments had been made to the BCRA Charter by way of several Executive Orders, namely 2708 of 1993; 1373 of 1999; 439 and 1523 of 2001; and 401 of 2002).[12] This last E.O. provided that minimum reserve requirements could partially be satisfied with marked-to-market government securities. Also that year, Executive Order 494 allowed exchanging bank deposits for government securities.[13]

Table 2. Behavior of Some Macroeconomic Variables in Times of Banking Crisis or Financial Vulnerability consistently with the Deposit-Currency Ratio.

Year of Banking Crisis	Real GDP	Foreign Terms of Trade	Capital Flows/GDP	International Reserves at End of Period	Multilateral Real Exchange Rate
1978	–	–	Outflow	+	–
1980	+	+	Lower Inflow	–	–
1982	–	–	Outflow	–	+
1983	+	≈	Outflow	–	–
1985	–	–	Inflow	+	+
1989	–	–	Outflow	–	+
1990	–	≈	Outflow	+	–
1995	–	≈	Lower Inflow	–	+
2002	–	≈	Outflow	–	+
2003	+	+	Outflow	+	–
2004	+	+	Outflow	+	–

Symbols: + positive fluctuation against previous period, -- negative fluctuation, ≈ small, or zero fluctuation. International reserves exclude Central Bank gold holdings.

Despite the effects caused by devaluation and the actions that had to be taken in order to cope with the crisis,[14] as months went by deposits managed to recover and as from 2003 there has been a gradual improvement in the monetization process and a rebuilding of depositors' trust in financial entities, even though there has still been a decline in the deposit-currency ratio owing to the higher relative currency growth. However, there has been a restructuring in the non-performing loan portfolio of financial entities, which was high pursuant to international standards, and there has been a progressive increase in the medium-and long-term credit share in the economy.

From the analysis of the interaction between macroeconomic shocks and crises in the Argentine financial system one could derive that such sector suffered significant vulnerability

[11] As regards the late 2001 crisis, please see the papers by Burdisso et al. (2002), and McCandless et al. (2002.)

[12] It should be mentioned that the Financial Entities Law 21526, passed in 1977, which is still effective, has been subject to partial amendments overtime, including, among others, those introduced pursuant to Law 24627 of 1996; Law 25466 of 2001; Law 25780 of 2003 (which also amended the Central Bank Charter), and Law 25782 of 2003.

[13] Executive Order 905/2002 provided for a compensation to banks (entities received peso-denominated bonds for the difference generated by asymmetric pesification, and dollar-denominated bonds to offset the mismatch suffered by them); and rediscounting was granted to financial entities in order to overcome illiquidity situations and purchase bonds to cover position mismatch (Executive Order 905/2002.) Additionally, it set forth that entities could value government securities at technical value (Communications A 3785/2002 and A 4114/2004.)

[14] As regards net worth effects caused by the crisis, Fanelli et al. (2002) state that in December 2001 banks' consolidated shareholders' equity was US$ 16.16 billions, then falling in August 2002 to US$ 4.46 billions.

largely over the period under study. Likewise, it is difficult to establish from the historical survey the order of causality between such shocks and the financial system operation. For such reason, it is necessary to make an econometric analysis based on methods, which may explore time series properties, a topic that will be addressed in the next Section.

5. Analysis of the Statistical Properties of Relevant Time Series.

5.1. Macroeconomic Variables Used in Econometric Estimations.

For purposes of making econometric estimations, it is necessary to determine the statistical properties of time series. To such effect, we have used quarterly data covering the period 1977:1-2004:4.

The *deposit-currency* indicator was deseasonalized through the X12-ARIMA method due to the presence of seasonality in such ratio.

The remainder of the series used in the estimates presents the following characteristics and sources. The *real GDP* series represents Gross Domestic Product at 1993 prices. The years prior to such date are obtained by joining backwards the piece of data on the first quarter of 1993 with the series at 1986 prices and 1970 prices, respectively, through the corresponding variations. This series was also deseasonalized by means of the X12-ARIMA method. The *multilateral real exchange rate* corresponds to the rate of exchange relative to a currency basket, expressed in real terms, consistently with BCRA estimates. The *terms of trade* show the relationship between unit export and import prices, and they have been estimated by the INDEC National Bureau of Census Statistics and the ECLAC U.N. Commission. The *M3/international reserves* coefficient indicates the relationship between monetary aggregate M3* (including currency in public hands and total deposits, excluding public sector deposits) pursuant to Central Bank data, and reserve stock at year-end, excluding gold (reserves in US dollars were converted into pesos through the nominal exchange rate) corresponding to the IMF base. The *capital flows* series represents the balance of payments financial account, according to IMF (the financial account is used because of the absence of data on the capital account over several years in the period under study), scaled by a physical volume index (GDP in constant currency.) *Domestic borrowing real interest rates* represents the spread between deposit rates deriving from a Central Bank sample and consumer price index fluctuations, whereas *U.S. real interest rates* shows the spread between the rates of Federal Funds (IMF data base) and consumer prices in that country. *Private sector credit/GDP at current prices* represents the ratio between private sector bank credit (Central Bank source) and GDP at current prices. A detail on the applied series is shown in Appendix II to this paper.

The series under study generally have recorded significant fluctuations over the last three decades (see Appendix III.) Most of them also show a (stochastic) trend in the series, thereby suggesting that they might not be stationary in levels, and therefore need to be differentiated in order to achieve stationarity.

5.2. Unit Root Tests.

In order to determine whether series are stationary, unit root tests are performed through Augmented Dickey-Fuller (ADF) statistics. The series are expressed in natural log, except for capital flows/GDP, real interest rates, and inflation rates (see Table 4.)

The ADF test results generally determine the impossibility of rejecting the unit root null hypothesis, in levels (at 1% of significance), even though it is possible to reject such hypothesis for the first differences in variables, except for cases of domestic real interest rates, private sector credit/current GDP, and inflation rates, which prove to be I(0) at 1%.

Table 4. Unit Root Tests. Augmented Dickey-Fuller (ADF) Statistics. Quarterly Periodical Series. Period 1977:1-2004:4.

Series	No. of Lags (1)	Levels Constant Significance	Levels Trend Significance	ADF (2)	First Different. (3)	Integ. Order
Terms of Trade Log.	5	No	No	0.30	-4.31	1
Capital Flows/GDP.	5	No	No	-2.02	-3.87	1
Real GDP Log.	5	No	No	1.37	-3.37	1
Multilateral Real Exchange Rate Log.	5	No	No	-0.08	-4.55	1
Domestic Borrowing Real Interest Rates.	5	No	No	**-2.77**		0
M3*/International Reserves Log.	5	Yes	No	-2.46	-5.96	1
U.S. Real Interest Rates.	5	No	No	-1.54	-4.61	1
Private Sector Credit/Current GDP Log.	5	Yes	No	**-6.29**		0
Inflation Rates.	5	No	No	-2.66		0
Deposit-Currency Log.	5	No	No	-0.93	-3.45	1

(1) A number of lags were considered as equal to periodicity plus one (five lags.) (2) The unit root existence null hypothesis is not rejected in levels at 1%. (3) The null hypothesis is rejected at 1% of statistical significance. Critical value at 1% is –2.59 (without constant and without trend, and with five lags.)

However, it is possible that structural changes in the series may bias Augmented Dickey-Fuller test results. Some authors suggest that such tests are low power, and therefore could confuse structural breakups in the series with the existence of a unit root (for an analysis of this issue see Carrera et al., 2003.) In other words, ADF tests could accept the null hypothesis of the existence of a unit root when the process indeed proves to be stationary at both sides of the point where the structural change is observed. This would generate a Type II error, that is to say, the probability of accepting the null hypothesis when this is false.

In order to confirm whether series are I(1), additional tests are performed starting from recursive and rolling Dickey-Fuller statistics. Such tests have the peculiar trait of considering potential structural changes in the series, being therefore more powerful than ADF tests. While the recursive test is repeatedly estimated by using a greater subset of sample data each time, the rolling test operates as if the sample period were run (mobile window.) The results of these tests are shown in Table 5.

Table 5. Unit Root Tests considering Potential Structural Changes in Series. Recursive and Rolling Dickey-Fuller Tests (Tests with Constant and Trend). Period 1977:1-2004:4.

Series	Statistics	
	Recursive (1)	Rolling (1)
Foreign Terms of Trade Log.	-2.75	-2.96
Deposit-Currency Log.	-2.20	-2.03
Real GDP Log.	-2.34	-2.61
Multilateral Real Exchange Rate Log.	-2.24	-2.19
M3*/International Reserves Log.	**-3.94**	**-4.11**
U.S. Real Interest Rates.	**-4.16**	-2.21
Capital Flows/GDP.	-3.13	-1.95

(1) The unit root existence null hypothesis is not rejected in levels at 1%. In U.S. real interest rates the recursive test rejects the unit root null hypothesis, whereas in M3*/international reserves both tests reject the unit root null hypothesis. Critical value at 1% is 3.53 (with constant and trend.)

Additionally, both recursive and rolling tests do not manage to reject the existence of a unit root in the levels of the series where previously-performed standard ADF tests indicated that they were I(1) series, except for the case of the recursive test for U.S. real interest rates, which exceeds critical value at 1%. However, in this series both rolling and ADF tests suggest the existence of a unit root, and therefore this series was considered as I(1). For their part, in M3*/international reserves, both (recursive and rolling) tests allow rejecting the unit root null hypothesis, and therefore this series was considered as I(0).

The latter include both a constant and a variable trend in the estimation, which do not generally prove to be significant in standard ADF tests, except for the constant in M3*/GDP and credit/GDP. Therefore, recursive and rolling Dickey-Fuller tests were not performed in series that are I(0) according to ADF tests because they include constant and trend.

Briefly, consistently with the different unit root tests performed (ADF, recursive and rolling), foreign terms of trade, capital flows/GDP, real GDP, multilateral real exchange rate, U.S. real interest rates, and deposit-currency ratio are considered to be I(1) variables, whereas domestic real interest rates, private sector credit/current GDP, M3*/international reserves coefficient, and inflation are considered to be I(0) variables.

6. Econometric Estimations through VEC Models.

6.1. Johansen's VEC Model.

The econometric estimations made in this paper, designed to explain the relationship between macroeconomic shocks and crisis or vulnerability in the financial sector, are based on VEC (Vector Equilibrium Correction) Models, according to the proposal by Johansen (1991 and 1995.) This strategy represents a methodological advance in relation to the unrestrained standard VAR version, since they allow estimating short-term dynamic adjustments and long-term relationships (cointegration) between variables. In this case, estimates include variables that are integrated in the same order.

Pursuant to Engle and Granger (1987) the linear combination of two or more non-stationary time series could be stationary. If such linear combination existed, one could infer that such series might be co-integrated. The stationary linear combination is known as equilibrium correction term (cointegration equation) and it is interpreted as the long-term equilibrium relationship between variables.

Assuming n endogenous variables, with a unit root each, there could exist up to n-1 linearly independent cointegration relationships.

A p-order VAR Model would be:

$$Z_t = A_1 \ Z_{t-1} + \ldots\ldots\ldots\ldots + A_p \ Z_{t-p} \ + B \ x_t + \ \varepsilon_t \qquad (1)$$

Where Z_t is a vector of n non-stationary endogenous variables I(1), x_t is a vector of deterministic variables, $A_1 \ldots A_p$ and B are coefficient matrices to be estimated, and ε_t indicates a vector of innovations (which could contemporaneously be correlated, but should not be correlated with their own past values, as well as with all the independent variables.) The expression (1) reflects that each endogenous variable is a function of the lagged values of the remaining endogenous variables of the system.

Thus, the VAR could be symbolized as:

$$dZ_t = \Pi Z_{t-1} + \sum_{i=1}^{p-1} \Gamma_i dZ_{t-i} + B x_t + \varepsilon_t \quad (2)$$

Where:

$$\Pi = \sum_{i=1}^{p} A_i - I = -(I - A_1 \ldots - A_p) \quad y \quad (3)$$

$$\Gamma_i = -\sum_{j=i+1}^{p} A_j \quad (4)$$

In (3) I represents the identity matrix. The Granger representation theorem establishes that if the Π coefficient matrix presented a reduced range $r < n$ there could exist (n x r) matrices α and β, each one with a range r, so that $\Pi = \alpha \beta'$ and $\beta' Z_t$ be I(0).

In this representation, r indicates the number of cointegration relationships (cointegration rank) and each column β indicates the cointegration vector (long-term parameters.) On its side, α represents the adjustment parameter, or the velocity of adjustment of the i-thousandth endogenous variable towards equilibrium, in the VEC Model.

Johansen's method (1991 and 1995) consists in estimating matrix Π, starting from an unrestrained VAR Model, and testing if it is possible to reject the constraints imposed by the reduced range of matrix Π. In VEC Models, deviations from long-term equilibrium are gradually corrected through a series of short-term partial adjustments. In this regard, endogenous variables converge into their cointegration relationship(s), while short-term dynamic adjustments occur in the variables.

In order to perform cointegration tests, it should be made some sort of prior assumption regarding the underlying trend in data. The estimations made in this paper use the following deterministic linear trend case, considered by Johansen (1995), for data in levels of Z_t and the cointegration equation:

$$\Pi Z_{t-1} + B x_t = \alpha (\beta' Z_{t-1} + \rho_0 + \rho_1 t) + \alpha_\perp \gamma_0 \quad (5)$$

Where $\alpha_\perp$ indicates the deterministic term outside the cointegration relationship.

6.2. Estimated VEC Models.

In this paper five VEC Models are estimated for the period 1977:1-2004:4. The variables included in each of the models and the results of the respective LM joint serial autocorrelation tests are shown in Table 6.

Table 6. Estimated VEC Models. Variables included in the Models and Results of LM Joint Serial Autocorrelation Tests, with Five Tiered Lags.

Model	Variables	LM Statistics	Probability
One	Deposit/Currency, Real GDP	9.2	0.056
Two	Deposit/Currency, Real GDP, FTT	11.6	0.234
Three	Deposit/Currency, Real GDP, FTT, RER	11.9	0.740
Four	Deposit/Currency, Real GDP, FTT, KF/GDP	20.6	0.196
Five	Deposit/Currency, Real GDP, FTT, real USIR	23.1	0.111

Note: The order in which variables appear on this Table does not necessarily reflect the order of VEC models. FTT: Foreign Terms of Trade; RER: multilateral Real Exchange Rate; KF/GDP: Capital Flows relative to GDP; real USIR: U.S. Interest Rates in real terms. In the five models it is impossible to reject the absence of (joint) serial correlation Ho, at 5%.

In the estimations, one proceeds sequentially from the more parsimonious model (with two variables) to another model with three endogenous variables, and subsequently to models with four variables. To such effect, in each of the models, one maintains the two main

variables to be related (real GDP and deposit/currency), and incorporates the remaining key macroeconomic variables that are I(1) in order to select the models where one verifies the cointegration of series. A similar method is followed by Ahumada et. al. (2001.)

The use of five lags in the variables at levels (periodicity plus one) determines that residue estimates be white noise. In fact, the residue from estimated models shows an absence of order-five joint serial correlation, consistently with LM test, at 5% of significance.

6.3. Cointegration Relationships between Variables.

Trace statistics tests the null hypothesis of r cointegration relationships against the alternative hypothesis of n cointegration relationships, where n indicates the number of endogenous variables, for r = 0, 1,..., n-1. The alternative of n cointegration relationships represents the case in which none of the series has a unit root and where a stationary VAR model might be specified in terms of levels of series.

For the null hypothesis of r cointegration relationships, this statistics is specified as follows:

$$LR_{tr}\,(r / n) = - T \sum_{i=r+1}^{n} \log\,(1 - \lambda_i) \qquad (6)$$

Where λ_i indicates the highest i-thousandth eigenvalue of matrix Π.

For its part, the maximum eigenvalue statistics tests the null hypothesis of r cointegration relationships against the alternative hypothesis of r+1 cointegration relationships. This statistical test is specified as follows:

$$LR_{max}\,(r / r+1) = - T \log\,(1 - \lambda_{r+1})$$

$$= LR_{tr}\,(r / n) - LR_{tr}\,(r+1 / n) \qquad (7)$$

For r = 0, 1,…., n –1.

The LR (Likelihood Ratio) test is distributed as a square Chi statistics with (q – n) degrees of freedom, where q indicates the number of constraints.

In order to determine the number of cointegration relationships r, conditionally upon the assumptions made on the deterministic trend of the model in (5), one proceeds from r = 0 to r = n – 1 and up to the point where it is impossible to reject the null hypothesis.

Table 7 shows the results of the tests performed in order to determine the existence of cointegration between variables in each of the models, as well as the number of cointegration relationships between them. To such effect, two tests are included stemming from trace statistics and maximum eigenvalue statistics. The first column of this Table indicates the number of cointegration relationships under the null hypothesis, while the next three ones correspond to trace statistics, critical values at 5%, and the respective probability (the same applies to the case of maximum eigenvalue statistics.)

Table 7. Cointegration Tests. Maximum EigenValue and Trace Statistics.

Cointegration Relationships	Trace Statistics	Critical Value at 5%	Prob.	Cointegration Relationships	Maximum EigenValue Statistics	Critical Value at 5%	Prob.
			Model One				
None *	30.4	25.9	0.013	None *	19.8	19.4	0.043
At Most One	10.6	12.5	0.102	At Most One	10.6	12.5	0.102
			Model Two				
None *	57.1	42.9	0.001	None *	33.8	25.8	0.004
At Most One	23.3	25.9	0.101	At Most One	17.5	19.4	0.092
At Most Two	5.8	12.5	0.485	At Most Two	5.8	12.5	0.485
			Model Three				
None *	78.6	63.9	0.002	None *	45.9	32.1	0.001
At Most One	32.8	42.9	0.348	At Most One	19.4	25.8	0.282
At Most Two	13.4	25.9	0.706	At Most Two	7.8	19.4	0.837
At Most Three	5.6	12.5	0.515	At Most Three	5.6	12.5	0.515
			Model Four				
None *	83.5	63.9	0.001	None *	40.0	32.1	0.004
At Most One *	43.4	42.9	0.044	At Most One	24.9	25.8	0.067
At Most Two	18.6	25.9	0.307	At Most Two	14.7	19.4	0.208
At Most Three	3.8	12.5	0.768	At Most Three	3.8	12.5	0.768
			Model Five				
None *	76.7	63.9	0.002	None *	34.3	32.1	0.027
At Most One *	44.4	42.9	0.035	At Most One	20.9	25.8	0.197
At Most Two	23.5	25.9	0.095	At Most Two	15.1	19.4	0.188
At Most Three	8.4	12.5	0.218	At Most Three	8.4	12.5	0.218

In Models 1, 2, and 3, both tests show a cointegration relationship at 5% of significance; whereas in Models 4 and 5 the trace test shows two cointegration relationships, and the maximum eigenvalue test, one at 5%. *It shows that the null hypothesis is rejected at 5%.

6.4. Causality between Real GDP and the Deposit-Currency Ratio.

This part of the paper analyzes the Granger-driven causality relationships between real GDP and the deposit-currency ratio, stemming from VEC model estimations. To such effect, variables are expressed in logs (except for U.S. real interest rates and capital flows/GDP) and with five lags in levels.

Table 8. Granger Causality Tests based on VEC Models (Five Lags.)

Model	Null Hypothesis.	Square Chi Statistics.	Probab.
One	GDP does not cause Deposit/Currency	15.03	0.005 *
	Deposit-Currency does not cause real GDP	5.93	0.205
Two	GDP does not cause Deposit/Currency	16.39	0.003 *
	Deposit-Currency does not cause real GDP	8.16	0.086
Three	GDP does not cause Deposit/Currency	9.77	0.044 *
	Deposit-Currency does not cause real GDP	7.93	0.094
Four	GDP does not cause Deposit/Currency	14.03	0.007 *
	Deposit-Currency does not cause real GDP	9.28	0.055
Five	GDP does not cause Deposit/Currency	16.54	0.002 *
	Deposit-Currency does not cause real GDP	9.03	0.060

*: Null hypothesis is rejected at 5% of significance.

A variable is said to Granger-cause another variable if the lagged values of the former help explain the subsequent movements of the latter, when estimating a model which also includes lagged values of the variable subject to explanation. In the different models, bivariate ("pairwise") Granger causality tests are performed for real GDP and the deposit-currency ratio (Table 8.)

Causality tests suggest that it is possible to reject the null hypothesis that real GDP does not Granger-cause the deposit-currency ratio (at 5%), whereas it is not possible to reject the reverse hypothesis (that the deposit-currency ratio does not Granger-cause real GDP.)

The results of causality tests are maintained when estimating a bivariate model (Model One), as well as models with three variables (Models Two and Three), and with four variables (Models Four and Five.) This suggests that selected models are robust relative to the results of Granger causality tests.

Estimates also show that changes in real GDP are positively and significantly correlated with future changes in the deposit-currency ratio. Thus, periods of decline in real GDP are associated with crisis or vulnerability in the financial sector, whereas periods of economic expansion would be related to improvements in the deposit-currency ratio. In this regard, the findings are similar to the results obtained by Gorton (1988) when he studied the case of the U.S. economy.

6.5. Weak Exogeneity Tests.

VEC models also allow testing the weak exogeneity condition between real GDP and the deposit-currency ratio. In this representation, the existence of weak exogeneity between variables requires that the parameter measuring the weight of the cointegration relationship of the estimated equation (velocity of adjustment) be equal to zero. The test results are shown in Table 9.

In other words, weak exogeneity implies that, on estimating Y_t with X_t, if variable X_t were weakly exogenous for the parameters of interest, it would not be necessary to estimate the model for X_t jointly with Y_t to find the parameters being sought.

The weak exogeneity tests performed in this paper suggest that it is not possible to reject the null hypothesis that real GDP is a variable which is weakly exogenous (at 5%), whereas it is possible to reject the reverse hypothesis (that the deposit-currency ratio is weakly exogenous.) According to LR (Likelihood Ratio) tests, when it is tested that real GDP is a weak exogenous variable, parameter $\alpha = 0$ (for a cointegration relationship or two cointegration relationships, where appropriate); whereas this equality is not verified when it is tested the hypothesis that the deposit-currency ratio is a weak exogenous variable. Thus, in the former case (real GDP) the null hypothesis Ho: $\alpha_{ij} = 0$ is verified for j =1 or 2.

Table 9. Weak Exogeneity Tests in VEC Models.

Model	Null Hypothesis: X_t is a weak exogenous variable, $X_t$being:	Number of Cointegration Relationships.	Log-Restricted Likelihood	Statistics (Likelihood Ratio)	Prob.
One	Real GDP	One	375.3	1.52	0.217
	Deposit/Currency	One	371.9	8.34	0.004*
Two	Real GDP	One	559.7	0.29	0.587
	Deposit/Currency	One	552.7	14.4	0.000*
Three	Real GDP	One	637.8	0.24	0.625
	Deposit/Currency	One	629.6	16.8	0.000*
Four	Real GDP	Two/One	452.7	4.76	0.092
	Deposit/Currency	Two/One	447.3	15.5	0.000*
Five	Real GDP	Two/One	381.9	1.57	0.456
	Deposit/Currency	Two/One	373.7	18.1	0.000*

*It rejects the null hypothesis at 5%. In models four and five, the trace test indicates two cointegration relationships and the maximum eigenvalue test, one.

6.6. Strong Exogeneity between Variables.

The results of the Granger causality and weak exogeneity tests between variables allow making inferences regarding the strong exogeneity condition between one another. The time-series theory establishes that if a variable X_t were exogenously weak (relative to another Y_t), and in turn variable Y_t did not Granger-cause X_t, therefore X_t would be an exogenously strong variable. This characteristic of time-series is useful from the viewpoint of forecasting variables.

Table 10 summarizes the link between real GDP and the deposit-currency ratio, according to causality and exogeneity tests.

Table 10. Link between Real GDP and the Deposit-Currency Ratio, according to Causality and Exogeneity Tests, based on VEC Models.

Granger's Causality.	Weak Exogenous Variable.	Strong Exogenous Variable.
Real GDP causes Deposit/Currency	Real GDP	Real GDP

Thus, real GDP Granger-causes the deposit-currency ratio, and it may also be considered as a weak exogenous variable. Due to this, it may be inferred that real GDP proves to be a strong exogenous variable.

The results of causality and exogeneity tests show that situations of weakness or crisis in the financial sector would not be the cause for the decline in the levels of economic activity. Periods of GDP falls would rather answer to other factors that are exogenous to the financial system.

Pursuant to Demirguc-Kunt and Detragiache (2005), in the extreme case of non-causality, if recession periods were the result of financial system exogenous shocks (rather than being caused by financial crises), more consideration should be given to fiscal costs and adverse effects associated with the bailout of entities in difficulties.[15] Instead, if financial crisis

[15] Nevertheless, it is acknowledged that financial crises might alter the operation of the payment system and, through the credit channel (*credit crunch*) adversely affect the levels of economic activity (even though this would be an indirect effect on the real sector of the economy.)

episodes directly affected real GDP and employment (if they directly impacted on the real sector of the economy), the operations of bailing out problem entities would have greater justification in terms of the fiscal costs and expenses that they represent for the Government or the Central Bank.

6.7. Impulse-Response Functions in VEC Models.

In VEC models a shock to the i-thousandth variable does not only directly affect such variable but it is also transmitted to all the other endogenous variables through the model's dynamic structure.

Impulse-response functions simulate the effect of a shock in one of the variables (corresponding to a specified period) on the current and future values of all the endogenous variables. Thus, it is possible to analyze the dynamic impact of random disturbances on the system of variables.

Since generally innovations ε_t are contemporaneously correlated, they are frequently applied to a transformation P in order to correct such correlation. In symbols, we have:

$$\nu_t = P\,\varepsilon_t \sim (0, \quad D) \qquad (8)$$

Where ν_t indicates the transformed innovation and D represents the diagonal covariance matrix.

In practice, there are several options to choose transformation P. The most frequent one is Cholesky's transformation, which uses the residue covariance matrix to orthogonalize impulses. This option imposes a specific order on variables in the VEC model and attributes all the effects of any common component to the variable that ranks first in the system. For such purpose, the results of impulse-response functions could change dramatically if the order of variables were altered in the estimated model.

An alternative option is the Generalized Impulse analysis proposed by Pesaran and Shin (1988.) This option establishes an orthogonal set of innovations, which do not depend on the order of variables in the VEC model. With this option, which is the one chosen for this paper, the results of impulse-response functions should be invariate relative to the order imposed on the variables in the different models. Below one can see the impulse-response functions of the deposit-currency ratio against a standard deviation of generalized impulses stemming from the different VEC models. Thus, a shock in a specified variable (at "t" moment) generates a response from the deposit-currency ratio overtime.

Figure 3. Deposit-Currency Impulse-Response to a Standard Deviation Shock. Model One.

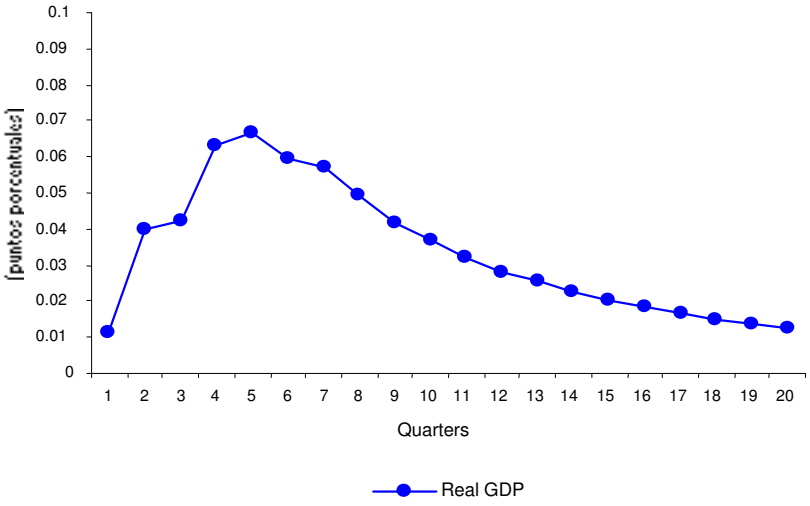
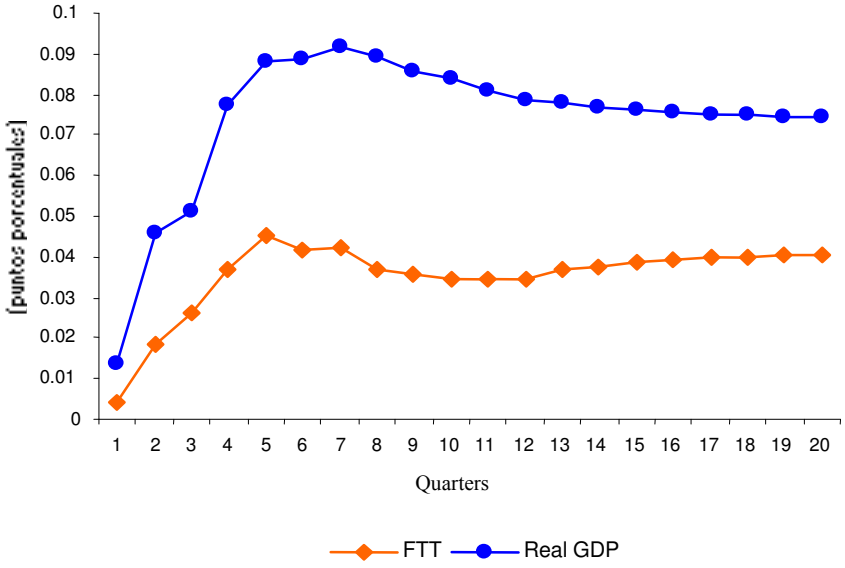


Figure 3 shows that innovations corresponding to levels of economic activity (real GDP) generate a positive response in the deposit-currency ratio, which reaches a peak in Q5. Thus, real GDP falls would be associated with reduction in the deposit-currency ratio.

Figure 4. Deposit-Currency Impulse-Response to a Standard Deviation Shock. Model Two.



Innovations in terms of trade generate a positive and permanent response in the deposit-currency ratio, the same also holding true for innovations in real GDP. (Figure 4.)

Figure 5. Deposit-Currency Impulse-Response to a Standard Deviation Shock. Model Three.

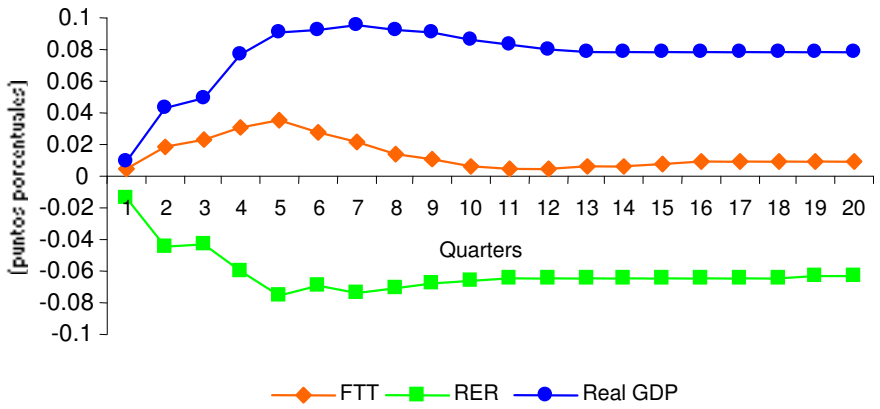
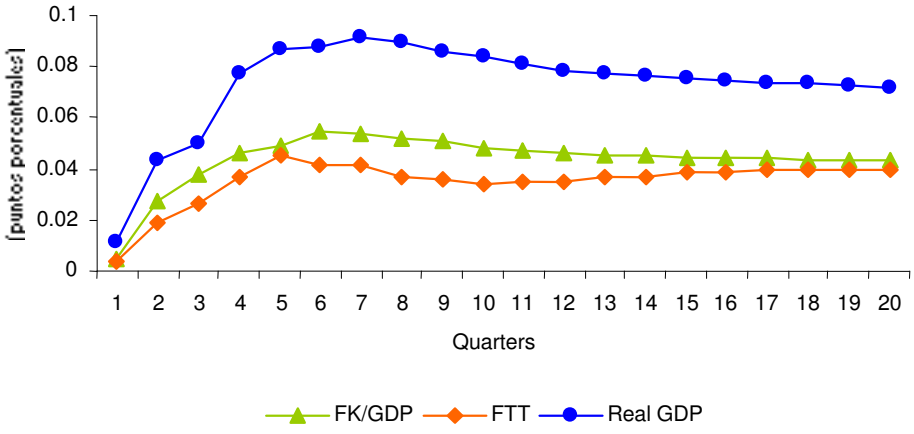


Figure 5 shows that innovations in the multilateral real exchange rate (a depreciation in domestic currency) would be associated with the deposit-currency ratio falls and, therefore, with greater probabilities of crisis or vulnerability in the financial sector. Empirical evidence found for the Argentine economy suggests that periods of deposit-currency ratio improvement are related to appreciations in the real exchange rate, as it occurred in the Convertibility years. On their side, innovations in foreign terms of trade and real GDP generate a positive response in the deposit-currency ratio on a permanent basis (even though the deposit-currency response to shocks in the terms of trade diminishes in the medium and long term) when incorporating the real exchange rate.

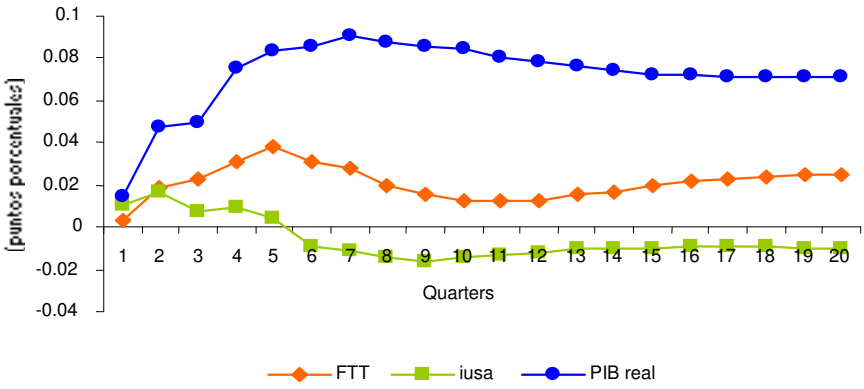
Figure 6. Deposit-Currency Impulse-Response to a Standard Deviation Shock. Model Four.



It is observed that innovations in capital flows generate positive increases in the deposit-currency ratio, both in the short and long term. Thus, capital flows reversals would be

associated with falls in the deposit-currency ratio and also with greater possibilities of occurrence of crisis or vulnerability in the financial sector. Innovations in real GDP and foreign terms of trade continue to generate a positive response in the deposit-currency ratio (Figure 6.)

Figure 7. Deposit-Currency Impulse-Response to a Standard Deviation Shock. Model Five.



Innovations in U.S. real interest rates generate in the first periods a positive response in the deposit-currency ratio, and then become slightly negative in the medium and long term. On their side, innovations in real GDP and foreign terms of trade induce a positive response in the deposit-currency ratio similarly to what happens with Models Two to Four (Figure 7.)

6.8. Variance Decomposition Analysis.

While impulse-response functions measure the effect of a shock on a variable, the analysis of variance decomposition allows distributing the variance of the forecast error in each variable consistently with their own shocks and the innovations in the remaining variables of the system. In other words, this analysis shows the relative importance of each random innovation in each of the VEC models.

In this case, factoring is performed through the Cholesky method, and therefore the results of variance analysis could be affected by the order of the variables imposed on the model. Due to this circumstance, variables are orderly arranged from the most exogenous (known as external variables to the economy) to the least exogenous ones; and the deposit-currency ratio –which is the variable under study- is placed in last order.

Each of the estimated models indicates the percentage of variance in the deposit-currency ratio due to each innovation, so that the addition of such percentages may reach one hundred. The outcomes are shown in Table 11.

It is observed that in the different models the innovations attributable to their own shocks and real GDP in the long term (after twenty periods) explain most of the forecast error variance in the deposit-currency ratio.

The exception to this result can be seen in Model Three which, in addition to real GDP and deposit-currency ratio, includes terms of trade and real exchange rate. After twenty periods, the latter accounts for a percentage slightly higher than real GDP.

Table 11. Variance Decomposition Analysis. Percentages of Deposit-Currency Ratio Variance as Explained by the Following Factors:

Model One.			Model Two.			
	GDP	Dep/Currency.	S Periods	FTT	GDP	Dep/Currency
1	1.7	98.3	1	0.2	2.5	97.3
4	15.4	84.6	4	4.8	18.5	76.7
8	24.3	75.7	8	8.6	33.9	57.5
12	25.3	74.7	12	9.1	38.9	52.0
16	25.2	74.8	16	10.1	40.7	49.2
20	24.8	75.2	20	11.3	41.9	46.9

	Model Three.				Model Four			
	FTT	TCR	GDP	Dep/Currency	Periods	FK/GDP	FTT	GDP	Dep/Currency
1	0.3	2.3	0.2	97.1	1	0.3	0.1	1.5	98.1
4	3.8	13.5	9.6	73.1	4	8.3	3.2	13.6	74.9
8	4.2	23.0	21.4	51.4	8	13.5	5.7	25.6	55.2
12	2.9	25.3	24.6	47.2	12	14.8	5.9	29.2	50.1
16	2.2	26.3	24.7	46.7	16	15.5	6.6	30.4	47.6
20	1.9	26.9	25.1	46.1	20	16.0	7.3	31.1	45.6

Model Five.				
	FTT	Real USIR	GDP	Dep/Currency
1	0.1	1.4	2.7	95.8
4	3.6	1.0	18.5	76.9
8	4.9	0.9	34.2	59.9
12	3.8	1.1	39.8	55.3
16	3.7	1.1	41.4	53.8
20	4.0	1.1	42.5	52.4

GDP: Real GDP, FTT: Foreign Terms of Trade, RER: multilateral Real Exchange Rate, Dep/Currency: Deposit-Currency ratio, real USIR: real U.S. Interest Rates, KF/GDP: Capital Flows/GDP.

Model Four shows that after twenty periods capital flows account for about 16% of the forecast error variance in the deposit-currency ratio, whereas the terms of trade account for a percentage close to 7%. On their side, Model Five underscores the low explanatory capacity of the U.S. interest rates.

6.9. Long-Term Relationships.

Table 12 shows the cointegration equations corresponding to the estimated five models. These expressions represent long-term relationships (which arise once the steady state has been reached and there are no short-term imbalances in the variables); whereas coefficients would reflect the long-term elasticities of the variables relative to the deposit-currency ratio (numbers in brackets indicate standard errors.) In every case, the velocity of adjustment relevant to the deposit-currency ratio (the term α shown in the last column of the Table) proves to be statistically significant, negative, and lower than the unit, thereby underscoring that such relationship would not be a weakly exogenous variable and that there would not be an explosive process.

Table 12. Cointegration Equations.

Model		Cointegration Coefficients				α
One	Dep/Curr =	3.900*GDP (0.807)	– 0.019*Trend (0.004)			-0.149 (0.036)
Two	Dep/Curr =	10.429*GDP (1.750)	– 5.025*FTT (1.167)	– 0.046*Trend (0.008)		-0.073 (0.014)
Three	Dep/Curr =	11.771*GDP (2.069)	– 6.689*FTT (1.229)	+ 0.012*RER (0.437)	– 0.054*Trend (0.008)	-0.056 (0.012)
Four	Dep/Curr =	24.487*GDP (4.317)	– 12.315*FTT (2.252)	– 0.666*KFGDP (0.287)	– 0.101*Trend (0.018)	-0.035 (0.008)
Five	Dep/Curr =	9.862*GDP (1.632)	– 4.280*FTT (1.162)	+ 0.061*USIR (0.046)	– 0.043*Trend (0.007)	-0.082 (0.015)

Dep/Curr: Deposit-Currency ratio, GDP: real GDP, FTT: Foreign Terms of Trade, RER: multilateral Real Exchange Rate, KFGDP: Capital Flows/GDP, USIR: U.S. real Interest Rates, Trend: Deterministic Trend. Standard Error in Brackets. Velocity of Adjustment α corresponds to the equation of Deposit-Currency ratio. Models Four and Five present the first of the two cointegration equations only.

Likewise, unit root tests were performed through Augmented Dickey-Fuller statistics in order to determine residue stationarity in cointegration equations. The results of these tests show that the null hypothesis of unit root existence is rejected in residues at 5% of significance (except in Model One where it is rejected marginally.)

Table 13. Residue Stationarity Tests in Cointegration Equations.

Model	ADF (1)
1	-2.58
2	-3.24
3	-3.30
4	-3.64
5	-2.92
Estimates were made with a constant (without trend) and five lags.	

7. Conclusions and Some Economic Policy Recommendations.

7.1. Conclusions.

Like other emerging economies, Argentina has suffered major crisis or vulnerability in the financial sector ever since the liberalization of such market by the end of the 1970s. The main crisis episodes in the financial sector occurred in the years 1978, 1980, 1982-1983, 1985, 1989-1990, 1995, and 2001-2004.

This paper has focused on identifying the existing relationship between macroeconomic shocks and situations of financial vulnerability in the Argentine case. To such effect, different econometric estimations were made through VEC models, using quarterly periodical time series, which cover the 1977-2004 period (after the 1977 Financial Reform.) In such models the variables under study are integrated of order one.

In this paper crisis or vulnerability in the financial sector is considered to be assimilated to a decline in the deposit-currency ratio against the previous year. This indicator has been used as a measure for financial crisis by Waldo (1985) and Gorton (1988), among other authors.

On analyzing the behavior of such quotient, it is observed that the main falls occurred over the last twenty-five years generally coincide with the financial crisis periods mentioned in the papers by Caprio and Klingebiel, 1997; Kaminsky, 1998; Calvo and Reinhart, 1999b, and Demirguc-Kunt and Detragiache (2005). Therefore, this ratio could be regarded as a good measure for the vulnerability episodes recorded in the Argentine case.

The results of the causality tests performed on the basis of VEC models suggest that real GDP Granger-causes the deposit-currency ratio with a positive sign, whereas no relationship is observed inversely (that is to say, from the deposit-currency ratio to real GDP.) Thus, economic expansion periods would anticipate deposit increases in the financial system, whereas economic activity recession periods would anticipate deposit-currency ratio falls and, therefore, greater possibilities of occurrence of crisis or vulnerability situations in the financial sector. The findings in the Argentine case coincide with those obtained by Gorton (1988) for the U.S. economy.

The weak exogeneity tests performed through VEC models indicate that real GDP could be regarded as a weak exogenous variable on considering a long-term horizon, whereas the null hypothesis is rejected in the sense that the deposit-currency ratio is a weak exogenous variable relative to real GDP.

Thus, consistently with Granger causality and weak exogeneity tests, real GDP would behave as a strong exogenous variable. These tests suggest that declines in the levels of economic activity would not be caused by financial crisis, but they would respond to other factors that are exogenous to the financial system. This is no obstacle for the financial sector to enhance the initial effects of macroeconomic shocks by behaving in a procyclical manner.

The impulse-response functions deriving from VEC models show that (positive) shocks in the terms of trade, capital inflows, and real GDP, generate a positive response in the deposit-currency ratio, whereas (positive) shocks in the multilateral real exchange rate and international real interest rates are associated negatively with such ratio in the long term (thereby indicating higher vulnerability in the financial sector.) On its side, the variance decomposition analysis establishes that a significant part of the forecast error variance in the deposit-currency ratio is generally explained in the long term, by its own shocks and real GDP innovations, and also in the multilateral real exchange rate and, to a lesser extent, in the terms of trade, capital flows, and U.S. real interest rates.

The findings arising from econometric estimations suggest that the financial sector proves to be more vulnerable to unfavorable (domestic and/or foreign) macroeconomic shocks than the rest of the economy vis-á-vis crises originating in the financial sector. Due to this, a priority should be set on the effort to neutralize the effects of the business cycle on the financial system. However, it is acknowledged that financial crises could end up altering the operation of the payment system and, through the credit channel, adversely affect the levels of economic activity.

7.2. Some Economic Policy Recommendations.

Argentina has suffered many banking crisis episodes after the 1977 Financial Reform. As pointed out in literature, and also shown by the empirical evidence included in this paper, certain adverse macroeconomic shocks of a foreign origin (terms of trade decline, real interest rates increase, capital flight) and/or a domestic nature (economic activity reduction, multilateral real exchange rate depreciation) could have an impact on the financial system and deteriorate the condition of banking institutions.

Nevertheless, from the financial system perspective, the process of adjustment for unfavorable external shocks may be different for this sector if the prevailing exchange rate regime is fixed or flexible.

While under a flexible exchange rate regime the external adjustment would generally lead to a domestic currency depreciation and a domestic price increase, thereby facilitating the recovery of granted loans and the decline in the real value of bank liabilities (deposits),[16] under a fixed exchange rate regime unfavorable external shocks might cause a money supply decrease and a domestic interest rate increase. The interest rate surge would increase the difficulties of debtors to settle their obligations with the financial system, thus impairing the quality of bank loan portfolios as well as the liquidity and solvency of banking institutions (Gavin y Hausmann, 1998.)

This suggests that, as a consequence of the occurrence of adverse external shocks, the adjustment process would be less traumatic for the financial system under a flexible exchange rate regime,[17] since the cost of such adjustment would, in this case, largely be borne by depositors, who would witness depreciation in he real value of their deposits.[18]

Therefore, the more probable the occurrence of these shocks, particularly either under fixed exchange rate or highly systemic dollar-based regimes, the higher the requirements for capitalization and liquidity imposed on banks, so that these entities may cope with the adverse effects of such shocks. In this regard, it is convenient to reinforce the regulation and supervision mechanisms designed to strengthen financial institutions.

From the financial sector stability viewpoint it would be advisable that the economy operate under a sustainable condition in domestic and foreign accounts, because macroeconomic instability might generate financial crises and involve high costs, in terms of output and employment. As mentioned before, since many of the banking crises-related variables are associated with macroeconomic-type shocks, it is advisable that *the economy may develop within a context* of low volatility (instability could generate asymmetric information problems, and also worsen adverse selection problems, thereby making the financial system more fragile.).[19]

In turn, and as acknowledged by Ffrench-Davis (2004), the Chilean experience demonstrates the convenience of having policy instruments, which may reduce the most volatile components of capital inflows. For this author, direct foreign investment would be much less volatile than the other types of capital flows (portfolio flows and short-term leverage). Therefore, it would be more valuable to focus macroeconomic regulation prudential policies, such as reserve requirements, on the case of short-term flows so as to avoid generating bubble scenarios as a result of more speculative capital inflows (Ostry et al., 2005.)

[16] However, it should also be computed the effect that might be generated in the value of bank assets.

[17] Except that the domestic financial system were highly dollarized or indexed for domestic inflation.

[18] It should be added that fixed exchange rate regimes, such as Currency Convertibility, exhibit severe problems to materialize the operation of the automatic adjustment mechanism vis-á-vis significantly adverse shocks. And even if such mechanism operated indeed, it is still unclear whether the financial system could preserve its capacity to absorb such adjustments if the latter extended overtime (Carrera, 2002.)

[19] Fanelli (2006) stresses that high volatility could contribute to maintaining liquidity constraints, weakening arbitrage transactions, strengthening financial accelerator effects, causing a partial dollarization, and discouraging the market for long-term instruments.

The strengthening of some macroeconomic indicators could also prevent the occurrence of financial (banking and exchange-rate) crisis. Bordo and Meissner (2005) argue that a strong reserves position, as well as a high ratio between exports and foreign currency-denominated debt could help avoid this type of crisis.

Supervisory authorities should improve *reporting systems* (through appropriate practices related to accounting, auditing, disclosure of banks' financial statements, and better knowledge of borrowing sectors) in order to reduce asymmetric information problems between depositors and banking entities.

Findings show that it is not an endogenous deposit-currency increase that pushes economic activity, but definitely the other way round.

For such reason, and as pointed out in literature, credit expansions should also be considered as potential triggers of financial crises. Evidence in several economies which have suffered these crises over the last years suggests that in periods of output growth (frequently as a result of higher capital inflows) and ensuing credit expansion, the quality of loan portfolios deteriorates and the financial vulnerability of banks increases. In such cases, prudential regulations, based on capital requirements, would not be effective to prevent credit expansion, since credit expansion would also be associated with a higher risk for financial entities to collect non-performing loans.[20] Central banks should monitor the bank credit growth rate and avoid its concentration in specified entities or certain aggregate demand sectors. Likewise, the excessive dollarization of bank credits should be avoided, even at the expense of having a smaller-sized financial system, particularly in the business cycle phases characterized by domestic currency appreciation (dollarization costs could be more strongly felt during a phase of recession in the economy.)

In this regard, it is suggested that credit expansion phases be regulated on the basis of growth indicators for this variable (the rate of credit growth should be compatible with the rate of GDP growth) and a credit valuation system taking into account the long-term volatility of income received by loan-demanding sectors and the concentration thereof (in particular, it is suggested that project vulnerability be monitored vis-á-vis external shocks.) This suggestion aims to prevent that financial entities fail to foresee future changes that may occur in borrowers' repayment capacity, in the face of a specific contraction in the activity of beneficiary sectors or a decline in their relative prices.[21]

Finally, one should note the need to strike a balance in the policy design between macroprudential and microprudential regulations. In this regard, Danielsson et al. (2001) argue that Basle II standards (of a microprudential type) generally improve the transparency of financial entities, but at the expense of increasing the economy's systemic volatility due to their procyclical effect compared with Basle I.[22] In the rising cycle phases, output growth would favorably rebound on corporate balance sheets, and therefore on the quality of bank

[20] Credit growth could be associated with project vulnerability faced with economy slowdowns in the declining cycle phases.

[21] Thus, it is advisable to establish policy measures including cycle buffer components. One of the most effective elements would be to internalize, within the financial system itself, its vulnerability to macroeconomic shocks, as well as to reduce its capacity to amplify them.

[22] Nier (2006) underscores that Basel II could exacerbate the procyclical effect of the credit supply (banks tend to lend in years of growth and discontinue credit in times of recession, whereas capital requirements are high in periods of output decline but low in boom spells.) This could end up affecting macroeconomic and financial stability.

portfolios, which would improve the rating of financial entities and reduce capital requirements,[23] a, thereby positively affecting credit, investment and consequently increasing output; whereas the opposite would occur in the declining cycle phases. For such reason, macro prudential regulations should be strengthened, especially if macroeconomics caused vulnerability in the financial system. The concern about the ratio between business cycle and prudential regulation increases in highly volatile economies. Very strong recessions or expansions would imply great changes in available credit, and therefore a strong feedback.

In order to achieve the goal of reaching financial stability (good supervision and low inflation help but do not guarantee fulfillment thereof), supervisory authorities should try to offset the cyclical effects that are observed in the financial system, broaden the horizon for decision making, and develop risk indicators, as those measuring credit growth, asset price increase, and investment surge (Lowe, 2006.)[24]

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[23] Capital requirements are determined on the basis of these ratings. However, it should be noted that ratings tend to improve in boom periods and deteriorate in times of recession.

[24] Nier (2006) suggests that, in order to counteract the pro-cyclical effects of credit and mitigate its risks one could apply monetary policy measures, stress testing, counter-cyclical indices, and rating measures implemented throughout the cycle.

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APPENDIX I

Table 3. Some of the Key Financial System-Related Measures in the Last Decades

Measure	Year	Concept
	Financial Reforms.	
Law 21,526. Amending Laws: 24,627, 25,466, 25,780 and 25,782.	1977, 1996, 2001, 2003.	Financial Entities and Amending Laws.
Law 21,572	1977	Monetary Regulation Account (MRA).
C. BCRA RF27	1977	MRA offsetting rates and charges.
C. BCRA A72	1981	MRA offsetting rates according to deposit terms.
Executive Order 36	1990	Deposit return with BONEX.
Law 23.928	1991	Convertibility.
Executive Order 959	1991	Financial transactions.
Executive Order 2006	1992	Impossibility to attach Central Bank reserves.
	Currency Unit, Conversion Scale.	
C. BCRA RF1050	1980	Financial adjustment index.
Law 22.707	1983	Argentine Peso.
Executive Order 1096	1985	Austral and conversion scale .
Executive Order 2128	1991	Peso.
C. BCRA A1910	1991	Rules on currency unit change.
C. BCRA A2330	1995	Deferred payment check operational regime.
	Local Currency-Denominated Deposits.	
Law 21.495	1977	Decentralizing deposits.
C. BCRA A613	1985	Deposits and credits at non-regulated rates.
C. BCRA A1096	1987	Rules on deposits at regulated rates and minimum cash requirements.
C. BCRA A1388	1989	Adjustable time deposits.
C. BCRA A2188	1994	Time deposits at minimum 120 days.
C. BCRA A2402	1995	Rules for checks in excess of $50,000.
	Foreign Currency- Denominated Deposits.	
C. BCRA RF1165	1980	Foreign currency-denominated deposits.
C. BCRA A725	1985	Foreign currency-denominated deposit taking.
C. BCRA A1632	1990	Foreign currency deposit taking and application.
C. BCRA A1820	1991	Foreign currency deposits and loans.
C. BCRA A2026	1992	Dollar-denominated checking accounts.
C. BCRA A2058	1993	Dollar-denominated checking accounts.
	Minimum Cash Requirements.	
C. BCRA RF26	1977	Minimum cash single rate.
C. BCRA A443 and A1604	1984 &1990.	Minimum cash requirements.
C. BCRA A2298	1995	Minimum cash requirements.
C. BCRA A2350	1995	Changing minimum cash requirements into minimum liquidity requirements.
	Deposit Guarantee.	
Law 22.051	1979	Optional and pecuniary deposit guarantee.
C. BCRA RF860, A123, A133	1979 & 1982.	Deposit guarantee.
Law 24.485	1995	Deposit guarantee.
Executive Order 540	1995	Guarantee Fund and Deposit Insurance Corporation.
	Interest Rates and Indexation.	
C. BCRA RF8 y RF10	1977	Lending and borrowing rates.
C. BCRA A185	1982	Indexed loans as per update index.
C. BCRA A221	1982	Daily adjustment index for time deposits.
C. BCRA A372	1983	Regulated maximum interest rate.
C. BCRA A617	1985	Non-adjustable transactions at regulated rate.
C. BCRA A1599	1990	Financial transactions indexation.
Executive Order 376	1994	Interest rate subsidy for SMEs.
Law 24.467	1995	Interest rate bonus and labor laws for SMES.

	Credit Policy.	
C. BCRA A2046	1993	Credit to SMEs.
C. BCRA A2180	1994	Debtor Rating and Credit Default Risk.
C. BCRA A2233	1994	Computable equity responsibility.
C. BCRA A2274	1994	Debtor rating within financial entities.
C. BCRA A2357	1995	Provision for bad debts.
C. BCRA A2364	1995	Financial entities ratings according to computable equity responsibility.
	Rediscounting. Public Sector Loans.	
C. BCRA RF1284	1980	Rediscounting for illiquidity situations.
C. BCRA A1241	1988	Escrow account.
C. BCRA A1443	1989	Rediscounting for illiquidity.
C. BCRA A1697	1990	Special financial asset.
C BCRA A1864	1991	Lending transactions with interest capitalization clause.
C. BCRA A1946	1992	Credit settlement on behalf of financial entities under liquidation.
C. BCRA A2061	1993	Borrowing transactions within financial entities.
C. BCRA A2380	1995	Repos.
	Central Bank.	
Laws: 21,547, 22,467, 24,144, 25,562 and 25,780. Dec: 2708, 1373, 439, 1523, and 401.	Laws: 1977, 81, 92, 02, 03. Dec.: 1993, 99, 01, 02.	Amendments to the Central Bank Charter.
Executive Order 731	1990	Asset Promotion Institute.
	Financial Entities.	
C. BCRA RF23	1977	Opening affiliates of financial entities.
C. BCRA RF80	1977	Rules on opening affiliates of foreign financial entities.
C. BCRA RF1246	1980	Merger and acquisition of entities.
C. BCRA B186	1981	Financial entities and forward exchange cover.
C. BCRA A1858, A2118, A2417	1991, 1993, 1996	Minimum capital requirements.
Executive Order 1849	1990	Supervisory committee on money laundering-related transactions.
C. BCRA A1880	1991	Issuance of corporate bonds (ONs).
Executive Order 1456	1993	Liquidation and winding-up of financial entities.
Executive Order 146	1994	Financial entities.
C. BCRA A2241	1994	Creation, operation, and expansion of financial entities.
C. BCRA A2280	1994	Province-owned banks, mergers and acquisitions.
Executive Order 445	1995	Bank Capitalization Trust Fund.
C. BCRA A2433	1996	Money laundering disclosure regime.
C. BCRA A2451	1996	Recommendations to discover money launderers.
Executive Order 1570	2001	Restrictions on deposit withdrawals ("*corralito*").
Resolution ME n° 6	2002	Bank deposit rescheduling.
Executive Order 214	2002	Asymmetric pesification and CER creation.
Circular BCRA A3911	2002	Valuation of financial assets.
Executive Order 494	2002	Exchange of deposits for government bonds.

APPENDIX II.

Quarterly Series Applied in Estimations. Characteristics and Sources.

Deposit/Currency. It indicates the quotient between total deposits (excluding public sector deposits), both in pesos and dollars, as well as currency in public hands. Both deposits and currency relate to year-end data and Central Bank estimates. Since this coefficient presents seasonality, it was deseasonalized through the X12-ARIMA program.

Real GDP. It represents Gross Domestic Product expressed in 1993, estimated by the National Directorate of National Accounts of the Economy Ministry for the period 1993-2004. Before 1993, the real GDP series was obtained by joining backward the 1993 data piece, through the corresponding variations, with the GDP data at 1986 prices and 1970 prices, respectively. Since the resulting series presents seasonality, it was deseasonalized through the X12-ARIMA program.

Foreign Terms of Trade. It indicates the relationship between unit prices of exports and imports. For the period 1986-2004, the terms of trade correspond to INDEC estimates. Before 1986, the terms of trade series were obtained by joining backward 1986 data from the INDEC, through the corresponding variations, with data estimated by the ECLAC.

Multilateral Real Exchange Rate. It measures the peso real value against the currencies of its main trade partners and it has been estimated by the Central Bank. The weighting of each partner within the index reflects its share in the total trade (exports plus imports) of Argentina. An increase in the MRER is interpreted as a real depreciation in the peso and vice versa. Although the index is adjusted monthly, weightings are variable and they are modified each year. In this case, the weight of the MRER index (1995=100) includes trade in commodities (such as crude oil, soy, and corn.)

Capital Flows/GDP. It corresponds to the financial account of the balance of payments, consistently with the IMF data, scaled by a physical volume index (GDP at constant currency.) The financial account was used instead of the capital account of the balance of payments due to the absence of available data on the capital account for the period prior to 1992.

Domestic Real Interest Rates. It represents the spread between borrowing interest rates at 30 days, according to the Central Bank survey, and rates of fluctuation in INDEC-based consumer prices

M3*/International Reserves. This coefficient relates monetary aggregate M3* at year end (including currency held by the public and deposits, both in pesos and dollars, excluding public sector deposits) consistently with Central Bank data and Central Bank international reserves at year end according to IMF data (reserves exclude gold holdings.) Since M3* data are expressed in pesos, data on reserves in dollars are converted into pesos through the nominal exchange rate.

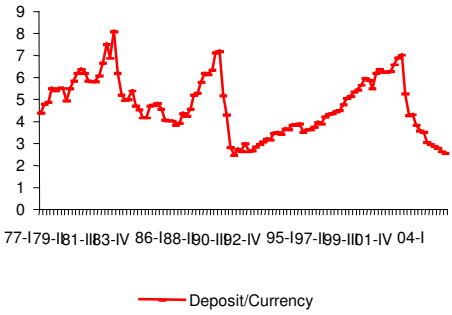
U.S. Real Interest Rates. It indicates the spread between the Fed Funds rates of the United States, according to IMF data, and the rates of fluctuation in U.S. consumer prices.

Private Sector Credit/GDP at Current Prices. It reflects the quotient between the balances of private sector bank credit, according to Central Bank data, and GDP at current prices. Quarterly data on current GDP prior to 1993 were estimated by using the fluctuations in quarterly GDP at constant prices and a combination of consumer and wholesale prices.

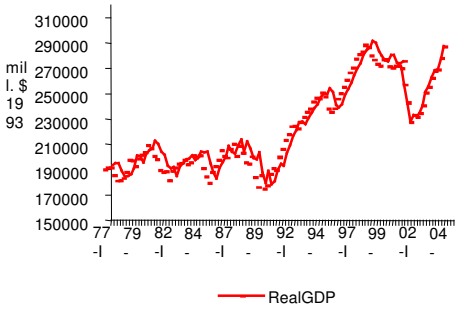
Inflation Rates. It corresponds to rates of fluctuation in the CPI prepared by the INDEC.

APPENDIX III. Series Applied in Empirical Estimations.

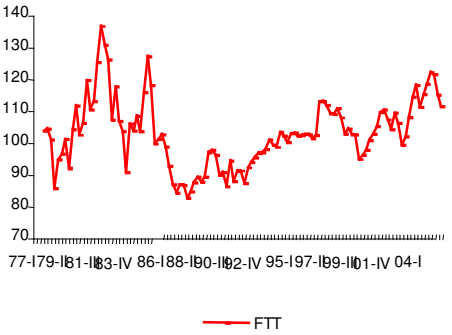
Deposit/Currency Ratio. Deseasonalized Quarterly Data.



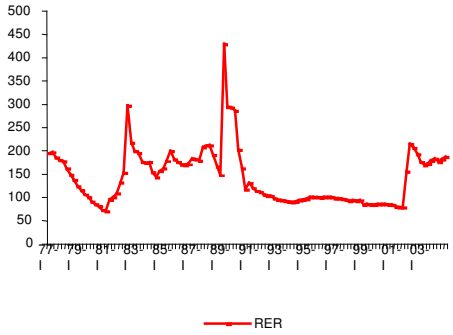
Deseasonalized Real GDP. In Million $ as of 1993



Foreign Terms of Trade.

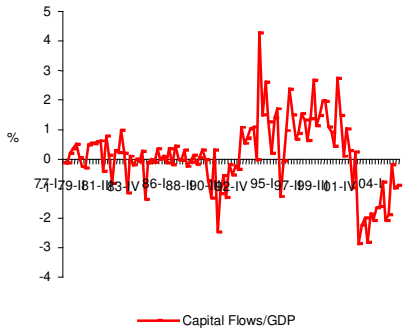


Multilateral Real Exchange Rate.

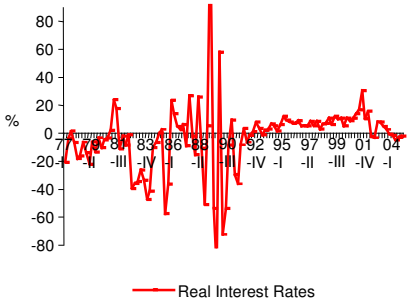


APPENDIX III. Series Applied in Estimations.

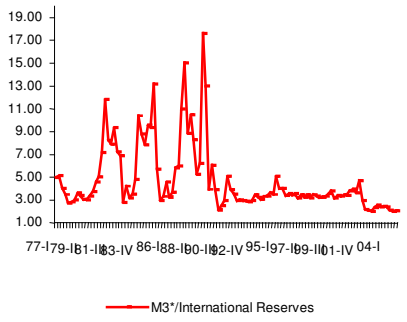
Capital Flows/GDP. In Percentages.



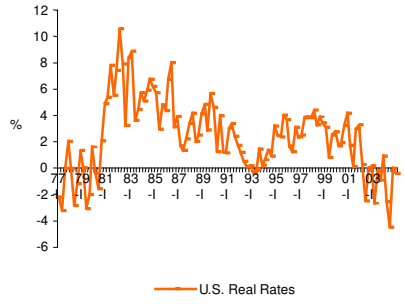
Domestic Real Interest Rates. In Percentages



M3*/international Reserves.



U.S. Federal Funds Rates in Real Terms In Percentages.



Private Sector Bank Credit/GDP at Current Prices. In Percentages.