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**Has the Nature of Crises Changed?  
A Quarter Century of Currency Crises in Argentina**

Prepared by Nada Choueiri and Graciela Kaminsky<sup>1</sup>

Authorized for distribution by Donald J. Mathieson

November 1999

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**Abstract**

The recent turmoil in currency markets in Asia, Europe, and Latin America has given a new impetus to the literature on currency crises. The literature originally linked currency crises to deteriorating economic fundamentals, but has more recently focused on self-fulfilling expectations and contagion. To assess the changing roles of domestic and external market fundamentals and contagion, this paper examines seven major currency crises in Argentina. It finds that while crises in the 1970s and 1980s were driven mainly by monetary and fiscal policies at home and abroad, contagion played an important role in the 1990s.

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## I. INTRODUCTION

The violent upsurge in currency crises in the 1990s has whetted once again the appetite of economists for learning about the forces behind these turmoils. As always, opinions diverge. Many argue that deteriorating fundamentals lie at the core of these crises. Others defend the opposite view that rumors unrelated to market fundamentals are what triggered the recent vicious speculative attacks. While the differences in opinion are, most of the times, irreconcilable, basically all agree that crises are of a contagious nature, with spillovers not limited just to neighboring countries but reaching countries as far apart as South Africa, Argentina, the Czech Republic, and Indonesia.

While theories have multiplied rapidly, the empirical evidence on the nature of currency crises is still in many ways scarce. The earlier empirical literature, which is also the most abundant, uses specific historical episodes to test models of the Krugman (1979) type and to derive one-period ahead probabilities of crises. For example, Blanco and Garber (1986) examine the role of monetary policy in precipitating the 1976 and 1982 Mexican crises. Cumby and van Wijnbergen (1989) undertake a similar study of the 1981 Argentine crisis. Goldberg (1994) follows a similar approach in examining the Mexican experience of the early 1980s but allows for price and external credit shocks in addition to domestic fiscal and monetary policies as possible sources of the currency crash.

Until recently, most of these empirical applications have just been limited to one particular event and country, making it difficult to learn about the possibly changing nature of the crises and about how general the international linkages are. A recent wave of empirical papers has tried to overcome the limitations of the earlier work by examining a large number of crises in several countries and by designing a methodology that allows to easily assess the changing role of different economic fundamentals over time. For example, Kaminsky and Reinhart (1996) examine 76 currency crises in 20 different countries during the 1970-1995 period. They use the leading-indicator methodology to examine the changing role of financial liberalization and external and domestic factors in explaining these currency crises. Interestingly, they find that while current account problems seem to be at the root of currency crises in the earlier part of the sample, the profile of the crises changes in the 1980s and 1990s with capital account developments taking the leading explanatory role.<sup>2</sup>

In the beginning, the multicountry studies did not address the issue of contagion. As the scope of the crises proved not to be confined to national borders, several authors started to examine the channels of contagion. Initially, these studies were focused on trade links (See, for example, Eichengreen, Rose, and Wyplosz (1996)). However, trade links are basically negligible in some of the most famous crisis episodes, such as the Tequila crisis following the collapse of the Mexican peso in December 1994 or the collapse of the Indonesian rupiah following the Thai crisis in July 1997. Moreover, while trade links have not increased substantially over the last decade, financial connections have surged, with capital flows in the 1990s averaging about 10 percent of GDP for many countries in East Asia and Latin America. Thus, the focus of attention has shifted

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<sup>2</sup> See also Eichengreen, Rose, and Wyplosz (1994), (1995) for other multi-country studies of currency crises.

to examine the role of common bank creditors or cross-market hedging in propagating currency turmoils (See, for example, Kaminsky and Reinhart (1999)).

However, the multi-country studies do not try to explain the severity of the different currency crises<sup>3</sup> nor do they try to isolate the role of policy or other exogenous (domestic or foreign) shocks during the onset of crises. They concentrate instead on the fluctuations of endogenous variables such as the real exchange rate or the current account. In contrast, this paper will focus on explaining the degree of severity of the crises and linking it to the state of vulnerability of the economy as captured by policy or world shocks that threaten the survival of the fixed exchange rate regime. To track the buildup of frailty of the fixed exchange rate system, we mostly look at the behavior of foreign exchange reserves of the central bank. Since in some episodes central banks restrict the access to foreign exchange reserves for capital account transactions in the mostly vain attempt to avoid a currency crisis, we also look at the dual market premium. To quantify the effects of various shocks on the severity of the speculative attacks against the domestic currency, we use structural VAR techniques. While this methodology has been used extensively to examine the role of policy shocks in business cycles, it has not been used to analyze the triggers of crises. Most importantly, Argentina will be our case study. This country has been at the center stage in every single episode of international financial turmoil, such as the Debt crisis in 1982, the Tequila crisis in 1994, and the Brazilian crisis in 1999. Moreover, it has had several crises of its own. In total, during the last quarter of the century, Argentina has suffered eight major currency crises. It is this frequency of the speculative attacks against the Argentine peso that makes this country a key case study for learning about the evolution of exchange rate collapses. Informal explanations about the nature of Argentina's crises do abound and range from expansionary monetary policy to terms-of-trade shocks, to the "Tequila Effect." Our results indicate that the nature of crises has changed. In particular, while crises in the earlier sample period are mainly driven by monetary and fiscal policies at home and abroad, contagion effects seem to play a major role in the Tequila crisis.

The rest of the paper is structured as follows. Section 2 presents a chronology of the Argentine currency crises since 1970. Section 3 presents the model that provides the guidelines for the VAR specification. Section 4 discusses the estimation. Section 5 presents the key empirical results. Section 6 concludes.

## II. CHRONOLOGY OF THE CURRENCY CRISES

During most of the postwar period, Argentina experienced chronic inflation. Many stabilization programs with the exchange rate as an anchor were launched, in the belief that with fixed exchange rates domestic inflation would converge quickly to world levels. All these programs (but the last one) ended with currency crises. In addition to failed stabilization attempts, global external factors also contributed to the general instability of the domestic currency. Large declines in interest rates in the industrialized world fueled capital flows to developing countries in the late 1970s and early 1990s, but although this flow of funds was generally positively

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<sup>3</sup> In fact, their goal is just to explain whether a crisis occurs or not, that is, the variable to be explained is a dummy variable with two values: zero if there is no crisis and one if there is a crisis.

perceived, it was also associated with the unfavorable side effects that usually mark currency crises, such as real exchange rate appreciations and current account deficits. Besides, these flows were subject to quick reversals whenever monetary policy in the center economies switched to a contractionary stance. Also, fragilities in the domestic financial system were a third potential cause of runs against the Argentine peso (see, for example, Kaminsky and Reinhart (1996)). Thus, our chronology of crises will highlight the evolution of the different stabilization programs implemented in this period as well as the role of world shocks and financial vulnerabilities.<sup>4</sup>

Argentina's average inflation rate was already above 30 percent in the 1960s. In the next 25 years, Argentina implemented 8 major stabilization programs. Table 1 reports the dates of the implementation of these plans as well as the dates of the crises. It also reports for each stabilization episode, two measures of the severity of the crises: the loss of reserves incurred by the central bank as well as the peak value reached by the dual-market foreign-exchange premium preceding the currency collapse.<sup>5</sup> The last column reports the devaluation in the month of the abandonment of the program. All the programs but the last one ended with a devaluation of the peso. Most of these plans were centered on a fixed exchange rate (or a pre-announced exchange rate depreciation) and included plans of fiscal and monetary austerity. They also often made use of income policies and price and wage controls. While in most cases inflation initially declined, it rarely converged to world levels, which inevitably led to a real appreciation of the domestic currency and a current account deterioration. Strong expectations of devaluation soon emerged, along with losses of reserves by the central bank. The loss of fiscal and monetary discipline often fueled inflation and external imbalances further, precipitating the currency crashes.

**Table 1. Stabilization Programs and the Severity of the Crises**

Program Name	Starting Date	Crisis Date	Crisis Severity: Reserve Losses (in percent)	Crisis Severity: Dual Market Premium (in percent)	Devaluation at Crisis Date (in percent)
Vasena	1967:3	1970:6	n.a.	n.a.	14
Gelbard	1973:5	1975:3	56	369	100
Tablita	1978:12	1981:4	45	n.a.	34
Alemann	1981:12	1982:7	17	n.a.	148
Austral	1985:6	1987:9	75	n.a.	16
Primavera	1988:8	1989:4	62	206	387
BB	1989:7	1990:2	58	105	220
Convertibility	1991:4	1995:3	41	n.a.	0

To help in our discussion of the crises, Figures 1 and 2 show the behavior of the most

<sup>4</sup> This chronology is partly based on Di Tella and Dornbusch (1989), Dornbusch and de Pablo (1989), Giorgio and Sagari (1996), Montanaro (1990), and Rodriguez (1994).

<sup>5</sup> Reserve losses are computed from the month the stock of these reserves held by the central bank peaks until the crisis date. The dual market premium reaches its peak in the month preceding the crisis date in all cases except for the BB crisis. The symbol "n.a." indicates nonavailability because of lack of data for the first crisis in 1970 and because the dual market premium does not apply for periods of unified exchange rates.

relevant domestic and international indicators since 1970.<sup>6</sup> The dates of the currency crises are indicated by the vertical lines. The top two panels in Figure 1 show the behavior of foreign exchange reserves of the central bank and the black market premium so as to gauge the severity of the currency crises. The bottom panels provide measures of domestic policy shocks and real appreciation of the currency. Domestic credit (in dollars), shown in the third panel, provides a measure of possible inconsistency between exchange rate and monetary policies. The fourth panel indicates that many crises were preceded by a substantial loss of competitiveness. Figure 2 provides information on external factors. The first panel shows the behavior of the “world” real interest rate, captured using the U.S. real interest rate. The second panel tries to provide a measure of contagion by looking at the co-movement of foreign exchange reserves of the five largest Latin American countries (with the exception of Argentina).<sup>7</sup> Investor’s good feelings about Latin American markets translates into increases in foreign exchange reserves held by central banks, while worries about cascading currency crises lead to speculative attacks and losses of foreign exchange reserves across Latin American countries.<sup>8</sup>

The program implemented in March 1967 collapsed in June 1970, with a devaluation of 14 percent.<sup>9</sup> The next program, initiated in May 1973 by the finance minister José Gelbard, collapsed in March 1975 after various speculative attacks that resulted in a 56 percent loss of foreign exchange reserves since the start of the currency turmoils, even in the presence of many restrictions to free convertibility.<sup>10</sup> At that time, the domestic currency in the commercial and the financial markets were devalued by 100 and 50 percent, respectively. More than a dozen additional devaluations followed over the course of the year. By 1976 inflation exceeded 300 percent per annum and the fiscal deficit was over 10 percent of GDP.<sup>11</sup>

Following the military coup in March 1976, the new government moved to dismantle controls over various sectors of the economy. Trade barriers were reduced, and a sweeping financial liberalization led to the gradual removal of capital account restrictions. Full convertibility was introduced in December 1978, with the initiation of the *Tablita Plan*. At the onset of the

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<sup>6</sup> See Appendix I for data sources and definitions.

<sup>7</sup> This panel shows the first principal component of the foreign exchange reserves series of Brazil, Chile, Colombia, Mexico, and Venezuela.

<sup>8</sup> Naturally, common market fundamentals may also lead to comovements of foreign exchange reserves in all these countries. For example, contractionary monetary policies in the center countries will generate capital outflows from emerging markets. In our estimations in Section 4 we control for the effect of common factors.

<sup>9</sup> We will not be able to examine this crisis because our data set starts in January 1970.

<sup>10</sup> Part of the exchange rate pressures led to a sharp increase in the financial market premium, which peaked at 369 percent right before the abandonment of the program.

<sup>11</sup> See Dornbusch and de Pablo (1989) for various estimates of Argentina’s public sector deficit.

program, the fiscal accounts improved sharply. Fiscal contraction was followed by a sharp deceleration of the rate of expansion of central bank credit to the government. However, while credit to the government declined at the beginning of the plan, total credit surged. It is in these years that Argentina re-entered the world capital market, in the midst of the capital inflows episode of the 1970s put in motion by the growth of the Eurodollar market and the OPEC price shocks of 1973-1974. The massive capital inflows to developing countries at that time<sup>12</sup> were mostly channeled through the banking system, resulting in rapid monetary expansions.<sup>13</sup>

At the beginning of the 1980s, however, the government accounts worsened substantially. A banking crisis also exploded in March 1980, raising doubts about the sustainability of the peg. Interest rate differentials widened and large reserve losses occurred. The scenario was worsened by the shift towards an anti-inflationary monetary policy in developed countries. The *Tablita Plan* began to fall apart in February 1981 when a 10 percent devaluation was announced. Two devaluations followed: 34 percent in April and 38 percent in June. Dual exchange rates were adopted; the financial exchange rate was floated and it immediately depreciated by more than 70 percent. The adverse impact on firms that had contracted foreign debt prompted the government to provide these institutions with an exchange rate guarantee program.

Following the collapse of the *Tablita*, inflation continued to accelerate despite continuous changes in economic policy and it was fueled further by the 1981 bailout program of the banking sector. In December 1981, the new finance minister Dr. Alemann announced a new stabilization program. The exchange rate system was unified, the guarantee program was suspended and domestic credit was tightened. However, this new plan was doomed. In April 1982, the Malvinas war started and the massive military expenditures had to be financed by the central bank. The scenario was further complicated by a plethora of adverse external shocks: the decrease in international commodity prices, the increase in foreign interest rates, the world-wide recession, and the full explosion of the world debt crisis. After an almost 20 percent loss of foreign exchange reserves and a skyrocketing foreign exchange premium in the financial market, the crisis culminated in July 1982 with a devaluation of 148 percent and the reintroduction of dual exchange rates and drastic capital account controls.

Inflation kept on increasing afterwards, reaching 6000 percent in 1985. In June of that year the Alfonsín government announced the *Austral Plan*. The program helped to avoid economic collapse. However, by mid-1986, the annual rate of inflation was still about 100 percent, with the government being forced to abandon the peg. The government tried to save the program with repeated rounds of enforcement and then relaxation of price controls and other restrictions, but these attempts were in vain. In the first nine months of 1987, reserves at the central bank declined by 1.5 billion dollars (60 percent). The collapse of the *Austral Plan* was irrevocable by September 1987: the commercial rate was devalued by 16 percent then and by another 33 percent in the following month.

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<sup>12</sup> About \$26 billions of foreign capital flowed annually to Latin American countries during 1975-1981.

<sup>13</sup> See Calvo, Leiderman, and Reinhart (1992).

In August 1988, the *Primavera Plan* was announced. Its aim was to limit monthly inflation to 4 percent and maintain the official exchange rate within 25 percent of the free market rate. The plan succeeded initially, as the devaluation rate averaged 4.5 percent per month for the rest of the year, while inflation hovered around an average of 8.4 percent but was decreasing. However, fiscal and monetary restraint was soon abandoned. Moreover, the upcoming elections of May 1989 further weakened investors' confidence in the domestic currency and led to a complete dollarization of the economy.<sup>14</sup> The inflation explosion of February 1989, followed by the 387 percent devaluation in April, marked the irremediable failure of the *Primavera Plan*, as the central bank stopped its exchange rate interventions after having suffered sudden reserve losses.

In July 1989, the new administration (with Menem as newly elected president) took over a few months ahead of schedule and announced yet another inflation stabilization plan, the *BB Plan*. The program did not even last a year. Another run on the peso was registered in December 1989 and two maxi devaluations took place in December 1989 and February 1990 respectively. After a devaluation of 220 percent in February, the exchange rate was floated and all price controls were removed.

In April 1991 the *Convertibility Plan* was initiated and is still holding in place. Its main feature was the creation of a currency board to enforce the 1-to-1 peg of the peso to the dollar. A series of privatization and deregulation measures were implemented and the fiscal reforms undertaken have exceeded the ones attempted earlier. Also in the early 1990s Argentina, along with other emerging markets, witnessed another round of capital inflows triggered by the decline in interest rates in the United States together with the Brady Plan agreement for Mexico signed in March 1989.<sup>15</sup> As in the late 1970s, capital inflows led to a domestic credit explosion, consumption, real estate and stock market booms, and lack of diversification of bank portfolios. The real exchange rate appreciated, and the current account deteriorated. The shift back to a tight monetary policy in the United States in 1994, however, led to interest rate increases worldwide, contributing to banking fragilities and a credit crunch amid a severe recession in Argentina. In the first quarter of 1995, the banking system suffered from large withdrawals of deposits and substantial capital outflows exerted balance of payments pressures. As investors converted pesos into dollars, the central bank's reserves decreased sharply (41 percent in the first quarter of the year), marking the last currency crisis in our sample. For the first time in the postwar history of Argentina, however, the convertibility program did not end up with a devaluation of the domestic currency.

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<sup>14</sup> Interestingly, while dollarization in the past had mainly been a phenomenon driven by changes in the opportunity cost of holding money—with investors replacing peso assets with dollar assets in their portfolios, in the 1980s, dollars started to be used for settling current transactions and as a unit of account.

<sup>15</sup> Inflows to Latin American countries averaged 60 billion dollars a year during that episode (Calvo et al., 1996).

### III. THE MODEL

As described in the previous section, the monetary authority in Argentina alternated between the adoption of two exchange rate systems. In some periods, it fixed the exchange rate and introduced full convertibility for both current and capital account transactions —such as during the *Tablita Plan*. At other times, it implemented a dual exchange rate regime, with a fixed exchange rate for current account transactions and a floating rate for capital account transactions. Our model should reflect these two regimes; therefore this section discusses two versions of the model that respectively capture the stylized features of each system.

#### A. The Unified Exchange Rate Regime

The model is a discrete-time model of an open economy with a fixed and unique exchange rate. The government has a predefined goal for domestic credit, not necessarily consistent with the goal of a fixed exchange rate. Fixing the exchange rate is a secondary goal that can be abandoned if it hinders discretionary monetary policy. This assumption seems to capture quite well monetary and exchange rate policies in Argentina in the post-war period. Investors realize that these two goals might conflict and expect that the central bank will abandon the peg when it runs out of reserves, as in Krugman (1979). Naturally, losses of reserves may be the result of different shocks. As mentioned in the previous section, money demand shocks seem to have been quite important in Argentina, especially in the late 1980s with the widespread dollarization of the economy —dollars were even being used to settle transactions and as a unit of account. Moreover, crises in other countries may also change investors' beliefs about the commitment of the domestic monetary authority to maintaining the peg; this is the so-called contagion effect. Last but not least, worldwide interest rate increases will make the task of fixing the exchange rate almost impossible if they lead to sharp declines in demand for the domestic currency. To account for the effects of these different shocks on the ability of the domestic monetary authority to maintain the peg and thus to allow for the possibility of a changing nature of currency crises, we extend the one-factor Blanco and Garber (1986) model as explained below.

The money market, as is usually the case in models explaining currency crises, is the central component of our model. Equilibrium in that market is given by the following equation,

$$m_t - p_t = -\alpha i_t + \delta c_t + \mu_t^d, \quad (1)$$

where  $m_t$  and  $p_t$  are respectively the logarithms of the money stock and the price level,  $i_t$  is the domestic interest rate,  $c_t$  captures the common fluctuations of reserves of other Latin American countries, and  $\mu_t^d$  represents money demand shocks. Note that in (1) it is assumed that a currency crisis elsewhere that leads to widespread losses of reserves in other Latin American countries (a decline in  $c_t$ ) will lead to a decline in the demand for money in Argentina, with this shift in demand making it more difficult for the central bank in Argentina to maintain its commitment to a fixed exchange rate.<sup>16</sup>

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<sup>16</sup> We only examine contagion effects across Latin America because contagion in currency crises has been mostly of a regional nature (see Kaminsky and Reinhart (1999)).

We further assume that the price level and the interest rate are determined by

$$i_t = i_t^* + Ee_{t+1} - e_t \quad (2)$$

$$p_t = (1 - \beta)e_t + \beta m_t, \quad (3)$$

where  $i_t^*$  is the world interest rate and  $e_t$  is the logarithm of the nominal exchange rate. The operator  $E$  represents expectations conditional on information through time  $t$ , and, for simplicity, the log of the foreign price level in (3) is normalized to zero. Equation (3) allows for deviations from purchasing power parity, with these deviations increasing with money supply. This formulation allows to capture in a simple way the real appreciation observed in the pre-collapse periods in Argentina, as described in the chronology. The money supply in the fixed exchange rate system can be written as follows:

$$m_t = d_t + r_t, \quad (4)$$

where  $r_t$  is the ratio of foreign exchange reserves of the central bank to domestic credit in foreign currency and  $d_t$  is the logarithm of the domestic credit component of the money base.

In this simple model, changes in domestic monetary policy, changes in the world interest rate, shocks to money demand and “contagion” effects will determine the evolution of reserves of the central bank. When reserves are depleted, the central bank will not be able to intervene in the foreign exchange market any longer and will have to let the exchange rate float. Using the money-market clearing condition, we can determine the equilibrium flexible exchange rate  $\tilde{e}_t$ .<sup>17</sup> Hence

$$(1 - \beta)d_t + \alpha i_t^* - \delta c_t - \mu_t^d = (1 - \beta + \alpha)\tilde{e}_t - \alpha E\tilde{e}_{t+1}. \quad (5)$$

To obtain the time path of the permanently floating exchange rate  $\tilde{e}_t$  we need to specify the stochastic processes that govern domestic credit, foreign interest rates, and the common factor in the movements of reserves of other Latin American countries:

$$d_t = d_{t-1} + \mu_t^s \quad (6)$$

$$i_t^* = i_{t-1}^* + \mu_t^* \quad (7)$$

$$c_t = c_{t-1} - \omega i_t^* + \mu_t^c \quad (8)$$

The shocks  $\mu^j$  in (1), (6)-(8) are normally-distributed white noise shocks with zero mean

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<sup>17</sup> In a pure flexible exchange rate regime, by assumption, the stock of reserves of the central bank drops to zero.

and standard deviation  $\sigma_j$ , for  $j \in \{c, d, s, *\}$ . Note that in (8) the common factor in foreign exchange reserves of other Latin American countries responds to interest-rate changes in industrial countries, with losses of reserves in Latin America following world monetary policy tightenings. But foreign exchange reserve movements do not only respond to changes in world monetary conditions. As explained in the introduction, devaluations in one country may trigger exchange market jitters in another as investors expect the central bank of a country to devalue to regain competitiveness after an initial devaluation in one of the countries with which it shares important trade links.<sup>18</sup> Still, foreign exchange market turbulences in one country may also reach other countries in the region as investors rebalance their portfolio, selling assets not only in the country that has already devalued but in other countries in the region.<sup>19</sup> This was the case in 1982 when U.S. banks, confronted with marked rise in non-performing loans in Mexico after the moratorium and devaluation in August, started to pull out of other high risk projects in other Latin American countries to reduce the overall risk of their assets.<sup>20</sup> Again, a liquidity crunch went underway in 1995 in some Latin American countries after the Mexican crisis in December 1994. This time, it was the mutual fund industry who played a major role in propagating the crisis as it rebalanced its portfolios, selling equity in Mexico, Brazil, and Argentina.<sup>21</sup> Equation (8) summarizes all these possible intra-regional shocks in  $\mu_t^c$ .

Using equations (5)-(8), we obtain the equilibrium flexible exchange rate  $\tilde{e}_t$  :

$$\tilde{e}_t = d_t + \frac{(1 - \beta + \omega\delta)}{(1 - \beta)^2} \alpha i_t^* - \frac{\delta}{1 - \beta} c_t - \frac{1}{1 - \beta + \alpha} \mu_t^d. \quad (9)$$

The flexible exchange rate depreciates in response to expansionary domestic monetary policy, positive shocks to world interest rates, and foreign currency crises; it appreciates in response to positive money demand disturbances.

Naturally, the peg will collapse at time  $t + 1$  if  $\tilde{e}_{t+1} > \bar{e}$ . Thus, the time  $t$  probability of a currency collapse in the next period can be written as follows:

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<sup>18</sup> Particularly, Argentina shares important trade relations with the Mercosur countries, making it more likely to lose its competitive edge after, for example, a devaluation in Brazil (see Kaminsky and Reinhart (1999) for an analysis of Mercosur trade links and the odds of crisis in one country in Mercosur when other countries in this free-trade area arrangement suffer foreign exchange market turmoils).

<sup>19</sup> See, Calvo (1998), Choueiri (1999), and Kodres and Pritsker (1998) for theoretical models of contagion through financial links.

<sup>20</sup> See, Kaminsky and Reinhart (1999) for a detailed analysis of the role of international bank lending in the propagation of crises.

<sup>21</sup> See, Kaminsky, Lyons, and Schukler (1999) for an analysis of the investment strategies of mutual funds in Latin America.

$$1 - F(k_t) = \Pr \left[ \mu_{t+1}^s + \frac{1}{1 - \beta} \left[ \left( \frac{\alpha(1 - \beta + \omega\delta)}{1 - \beta} + \delta\omega \right) \mu_{t+1}^* - \delta\mu_{t+1}^c \right] - \frac{1}{1 - \beta + \alpha} \mu_{t+1}^d > k_t \right] \quad (10)$$

where  $k_t = \bar{e} - d_t - ([\alpha(1 - \beta + \omega\delta)/(1 - \beta) + \omega\delta] i_t^* - \delta c_t) / (1 - \beta)$  and  $F'(k_t) > 0$ .

Knowing the distribution function of the shocks  $F(\cdot)$ , agents can form expectations of future exchange rates based on the average of the current fixed exchange rate and the rate expected to materialize conditional on a devaluation, both weighted by the respective probabilities of occurrence:

$$Ee_{t+1} = F(k_t)\bar{e} + [1 - F(k_t)]E(\tilde{e}_{t+1}|v_{t+1} > k_t), \quad (11)$$

where

$$v_{t+1} = \mu_{t+1}^s + \frac{1}{(1 - \beta)} \left( \left[ \frac{\alpha(1 - \beta + \omega\delta)}{(1 - \beta)} + \delta\omega \right] \mu_{t+1}^* - \delta\mu_{t+1}^c \right) - \frac{1}{(1 - \beta + \alpha)} \mu_{t+1}^d$$

$$E(v|v > k) = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} \int_x^{\infty} v \varphi f^s(\mu^s) f^*(\mu^*) f^d(\mu^d) f^c(\mu^c) d\mu^s d\mu^* d\mu^d d\mu^c,$$

with  $x = k - ([\alpha(1 - \beta + \omega\delta)/(1 - \beta) + \omega\delta] \mu_{t+1}^* - \delta\mu_{t+1}^c) / (1 - \beta) + 1 / (1 - \beta + \alpha) \mu_{t+1}^d$  and  $\varphi = 1/[1 - F(k_t)]$ . In (11), the exchange rate expected to materialize conditional on a devaluation is a decreasing function of  $k_t$ <sup>22</sup>. In the event of a floating, the exchange rate will be larger if monetary policy becomes more expansionary, or the world interest rate increases, or if crises elsewhere become more severe as measured by the losses of reserves of other Latin American central banks. The expression in (11) is a non-linear function of  $k_t$ . To aid in the solution of the path of reserves, we linearize it by adopting the following form:

$$Ee_{t+1} = \lambda_0 + \lambda_1 d_t - \lambda_2 \bar{e} + \lambda_3 i_t^* - \lambda_4 c_t. \quad (12)$$

The coefficients  $\lambda_i$  are a function of the parameters of the distribution of the shocks and of the structural parameters of the model.

Substituting (2), (3), (4) and (12) into (1), we obtain the path of reserves in the fixed exchange-rate system when there is a chance that there will be an abandonment of the peg:

$$r_t = \eta_0 - \eta_1(d_t - \bar{e}) - \eta_2 i_t^* + \eta_3 c_t + \eta_4 \mu_t^d. \quad (13)$$

Reserves will fall as a result of a positive shock to monetary policy or to the world interest rate; they will also decrease when crises occur in other Latin American countries (a negative shock to  $c_t$ ). In contrast, a positive shock to money demand will result in an increase in foreign exchange

<sup>22</sup> This result can be verified by linearizing the derivative of (11) with respect to  $k_t$ .

reserves. The VAR to be estimated is based on equations (6)-(8) and (13).

### B. The Dual Exchange Rate Regime

To relieve balance-of-payment pressures, albeit temporarily, Argentina implemented dual rates in the early 1970s and in the 1980s, with a fixed exchange rate for current account transactions and a flexible exchange rate for capital account transactions. We now proceed to develop a simple model of the economy under a dual-rate regime to examine the behavior of the central bank's foreign exchange reserves and the dual market premium.<sup>23</sup> As mentioned earlier, the country is assumed to adopt a fixed exchange rate for all current-account transactions. Capital account transactions are assumed to be successfully segregated from current-account transactions and occur at a freely-floating rate.

The core of our model is still the money market equilibrium condition given by (1). Prices continue to be determined by equation (3). The main difference in this regime is the interest parity condition, which is now written as follows:

$$i_t = \gamma_1 i_t^* + \gamma_2 [Ee_{t+1} - f_t] + \gamma_3 [Ef_{t+1} - f_t], \quad (2')$$

where  $f_t$  is the log of the exchange rate for capital account transactions. Equation (2') is a linear version of the interest parity condition with dual markets. Because interest rate proceeds are channeled through the commercial exchange rate market, the expected return from holding a foreign asset depends on the expected commercial exchange rate at the time of maturity of the bond. The expected return also depends on the expected financial rate because the purchase and sale of assets occur at the financial rate. Using (1), (2'), and (3), we can write the equilibrium condition in the money market as follows:

$$(1 - \beta)(m_t - e_t) = -\alpha[\gamma_1 i_t^* + \gamma_2 (Ee_{t+1} - f_t) + \gamma_3 (Ef_{t+1} - f_t)] + \delta c_t + \mu_t^d. \quad (14)$$

The combination of dual exchange rates and a floating capital-account rate imply that the capital account is always zero. Reserves at the central bank can still change in response to current account imbalances because the central bank intervenes to keep the commercial rate fixed. A persistent deficit in the current account may deplete reserves holdings. When reserves are depleted, the central bank will not be able to intervene again in the foreign exchange market and will have to allow the commercial rate to depreciate. We assume that the dual exchange rate market is still maintained after the abandonment of the peg: the commercial rate will float to equilibrate the current account.

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<sup>23</sup> The model will assume perfect separation of the dual exchange rate markets and a free float of the financial exchange rate even though the central bank of Argentina kept on intervening in capital markets in an attempt to contain the accelerated depreciation of the financial rate. The empirical estimation in section 4 will account for the possibility that the financial exchange rate may not be freely floating.

Naturally investors will try to forecast as best as they can the time and the size of the devaluation. To examine the likelihood of a devaluation, we need to describe the behavior of the current account. We assume the following process:

$$R_t - R_{t-1} = \eta(\bar{e} - p_t) + Qi_t^* + \mu_t^r, \quad (15)$$

where  $Q$  is the stock of foreign assets held by domestic residents,  $(\bar{e} - p_t)$  is the log of the real exchange rate and  $\mu_t^r$  is a shock to the current account. In (15), a real depreciation of the domestic currency will lead to a current account surplus. Similarly, higher returns on foreign assets will improve the current account. Substituting  $p_t$  using (3) and using the linearization of money supply derived in the appendix, we rewrite the current account equation as follows:

$$R_t - R_{t-1} = \eta\beta\phi_1(\bar{e} - d_t) - \eta\beta\phi_2R_t + Qi_t^* + \mu_t^r. \quad (15')$$

We can now examine jointly the behavior of reserves and the financial rate under the assumption that when reserves are depleted, the central bank will allow the commercial exchange rate to float so as to equilibrate the current account. Thus, the probability of a floating commercial exchange rate can be written as

$$\Pr(R_{t+1} < 0) = \Pr[\eta\beta\phi_1d_{t+1} - Qi_{t+1}^* - \mu_{t+1}^r > R_t + \eta\beta\phi_1\bar{e}]. \quad (16)$$

Also, in the event of a currency collapse, the commercial exchange rate will be

$$\tilde{e}_t = d_t - [1/\eta\beta\phi_1][Qi_t^* + \mu_t^r]. \quad (17)$$

We solve for the financial exchange rate by solving the difference equations (6)-(8) and (14). As described in the appendix, the solution to the financial market premium equation can be linearized and written as:

$$f_t - e_t = \kappa_0 + \kappa_1i_t^* - \kappa_2c_t + \kappa_3d_t - \kappa_4R_t - \kappa_5\mu_t^d. \quad (18)$$

In (18), the financial market premium increases with expansionary domestic monetary policy, positive shocks to world interest rates, and contagion across the region; it decreases with the level of reserves and positive shocks to money demand. In Section 4, the VAR specification that corresponds to the dual markets system is based on equations (6)-(8), (15'), and (18).

#### IV. ESTIMATION RESULTS

Our theoretical model implies estimating the following system:

$$AX_t = A(L)X_{t-1} + C\mu_t, \quad V(\mu_t) = \Sigma, \quad (19)$$

where  $X$  is the vector of variables  $[i^*, c, (d - e), r]$  in the unified exchange rate regime and  $[i^*, c, (d - e), r, f - e]$  in the dual exchange rate regime; and  $\mu$  is the vector of the structural shocks,  $[\mu^*, \mu^c, \mu^s, \mu^d]$  in the unified exchange rate regime and  $[\mu^*, \mu^c, \mu^s, \mu^r, \mu^d]$  in the dual exchange rate regime.<sup>24</sup> The theoretical framework of Section 3 provides guidelines for imposing zero restrictions on the elements of  $A$ ,  $A(L)$  and  $C$ . Moreover, given that dual markets were not perfectly implemented in Argentina, we will reinterpret  $\mu^r$  as an “external policy” shock originating from central bank intervention in the financial markets to prevent the financial rate from fluctuating excessively.

$A(L)$  is a matrix polynomial of order  $n$ , where  $n$  is the number of lags, and  $C$  is a full rank matrix. The covariance matrix of the structural innovations is denoted by  $\Sigma$  which, given the assumption of zero correlation across innovations, is diagonal. The matrices  $A$  and  $C$  capture the contemporaneous interactions between all the variables in the system.

We can now obtain the reduced-form VAR representation by multiplying both sides of (19) by  $A^{-1}$ :

$$X_t = B(L)X_{t-1} + \varepsilon_t. \quad (20)$$

$\varepsilon$  is the vector of reduced-form innovations,  $[\varepsilon^*, \varepsilon^c, \varepsilon^s, \varepsilon^d]$  for the unified exchange rate regime and  $[\varepsilon^*, \varepsilon^c, \varepsilon^s, \varepsilon^r, \varepsilon^d]$  for the dual exchange rates system. The structural and reduced-form innovations are related by the following equation:

$$\varepsilon_t = A^{-1}C\mu_t. \quad (21)$$

The identification restrictions for the unified exchange-rate model, as implied by the analysis of the previous section, can be summarized as follows:

$$\begin{aligned} \varepsilon^* &= \mu^* \\ \varepsilon^c &= \gamma_{21}\mu^* + \mu^c \\ \varepsilon^s &= \mu^s \\ \varepsilon^r &= \gamma_{41}\mu^* + \gamma_{42}\mu^c + \gamma_{43}\mu^s + \mu^d \end{aligned}$$

The counterpart equations in the dual exchange rate regime are:

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<sup>24</sup> Note that for estimation purposes, the theoretical model in the dual exchange rate regime was re-written in terms of  $r$  (the ratio of foreign exchange reserves to domestic credit in dollars).

$$\begin{aligned}
 \varepsilon^* &= \mu^* \\
 \varepsilon^c &= \gamma_{21}\mu^* + \mu^c \\
 \varepsilon^s &= \mu^s \\
 \varepsilon^r &= \gamma_{41}\mu^* + \gamma_{42}\mu^c + \gamma_{43}\mu^s + \mu^r \\
 \varepsilon^f &= \gamma_{51}\mu^* + \gamma_{52}\mu^c + \gamma_{53}\mu^s + \gamma_{54}\mu^r + \mu^d
 \end{aligned}$$

Although some of our variables turned out to be I(1),<sup>25</sup> we estimate an unrestricted VAR in levels in order to allow the data to pick up the underlying long-run cointegrating relationship. We estimate two separate systems, a five-variable system for periods of dual markets (1970:6-1976:11 and 1987:10-1990:2) and a four-variable system (excluding the premium) for periods of unified exchange rates (1976:12-1987:9 and 1990:3-1995:5).<sup>26</sup> We allow for 3 lags in both systems,<sup>27</sup> which was sufficient to produce serially uncorrelated residuals.<sup>28</sup> Figures 3-5 show the dynamic effects of the various shocks on our measures of severity of the crises, the path of reserves of the central bank and the dual-market premium,<sup>29</sup> for a 36-months horizon, with one-standard deviation bands around the point estimates.<sup>30</sup> The responses are generally of the expected signs. Positive U.S. interest rate or domestic policy shocks lead to a decline in reserves while positive contagion effects and money demand shocks raise these reserves. The effects on the exchange rate

<sup>25</sup> Dickey-Fuller tests failed to reject the unit root hypothesis for both the contagion variable and reserves of the central bank of Argentina at the 5 percent significance level. They gave mixed results for the domestic policy variable. The hypothesis was rejected for the U.S. interest rate and the premium.

<sup>26</sup> We allow for interactive dummy variables for the hyperinflation period and for periods in which no stabilization plan was being implemented.

<sup>27</sup> Due to the small number of observations, for the hyperinflation episode we estimated a VAR(1).

<sup>28</sup> Based on the model's assumptions, we formulate the US interest rate equation as a univariate AR(3) and include in the reduced-form equation of Latin American countries reserves lags of the US rate in addition to lags of the contagion variable itself.

<sup>29</sup> Recall that in the estimations, we examine the path of reserves as a proportion of domestic credit in U.S. dollars. Hence in these figures reserves are expressed as a percent of domestic credit in US dollars. The responses of the exchange rate premium are expressed in percent. The same holds for figures 6-12.

<sup>30</sup> The standard deviation of the impulse responses are calculated by 1000 bootstrap replications of the model. The bootstrap procedure uses pseudo-historical data created by drawing with replacement from the empirical distribution of the VAR innovations. All responses are to one unit shocks in the structural innovations of the VAR.

premium run in the opposite direction.

In periods of unified exchange markets (Figure 3) all responses are generally significant for at least a one-year horizon —except for the first few months in the case of the world interest rate and contagion shocks. The effects of U.S. interest rate and contagion shocks peak after 10 to 12 months whereas those of money demand and domestic policy shocks peak immediately. According to the first panel, one percentage point increase in the U.S. interest rate leads to an estimated 16 million-dollar decline in Argentina's foreign exchange reserves in the third month following the shock.<sup>31</sup> This fall in reserves reaches a magnitude of 212 million dollars within one year, after which the effect of the shock starts to decline. The third panel indicates that a billion-dollar increase in domestic credit leads to an immediate decline in reserves by nearly 210 million dollars. This initial effect declines over time. The fall in reserves is around 180 million dollars within a year of the shock and 78 million dollars after two years.

In periods of dual markets (Figures 4-5), a billion dollar increase in domestic credit decreases reserves by 79 million dollars and raises the exchange rate premium by nearly 20 percent in the first month. Both effects decline over time. The fall in reserves is only 28 million dollars within a two-year period after the shock occurs, while the premium increases by just 6 percent. The dual market system implemented in Argentina implied numerous controls on capital flows that isolated the economy from international capital markets. This reduced the link between monetary policy expansion and reserve losses as was just noted. It also implied a lower sensitivity of the economy to external shocks. Indeed, the responses of the endogenous variables to U.S. interest rate shocks are insignificant at practically all horizons.

Figures 6-12 provide information on the buildup of fragilities in the fixed exchange rate regime as captured by the unexpected (at the time of the implementation of the stabilization program) reserve losses (as a percentage of domestic credit in U.S. dollars) and increases in the dual-market premium for the different stabilization episodes.<sup>32</sup> They also provide information on the causes of this vulnerability. The figures span each stabilization episode, from the start to the collapse of the plan. More precisely, these figures report the accumulated historical forecast errors in foreign exchange reserves and the dual-market premium using information up to the time of implementation of each stabilization plan, as well as the part of these errors explained by each structural shock.<sup>33</sup>

An examination of the panels in Figures 6-12 leads to the following conclusions. First, domestic policy shocks were the prevalent forces that led to the collapse of the *Gelbard Plan* in

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<sup>31</sup> Since Figures 2 and 3 report the responses of foreign exchange reserves as a percentage of domestic credit in U.S. dollars, we multiply these responses by the sample average of the domestic credit series to derive the responses of reserves per se.

<sup>32</sup> The vertical bars in these graphs indicate the crises dates.

<sup>33</sup> We pool together the 1981 and 1982 crises on one hand, and the 1989 and 1990 crises on the other, due to data limitations.

1975. Second, a mix of foreign interest rate shocks, domestic policy shocks and money demand shocks contributed to the crises of 1981-1982 while the collapse of the *Austral Plan* in 1987 was primarily driven by money demand shocks. Third, while domestic policy shocks were again the major adverse force that led to the crises of the late 1980s, they practically had no role in the turmoil of 1995. External shocks seem to be at the core of this crisis. Below, we examine the onset of the crises in more detail by linking the results of this estimation to the chronology in section 2.

## V. EXPLAINING THE NATURE OF THE CRISES

Tables 2 and 3 summarize part of the information in Figures 6-12. These tables concentrate on the analysis of the crises, that is, they examine the evolution of the economy from the month in which instabilities start (after foreign exchange reserves errors peak or from the moment the dual market premium errors start to increase) to the month of the final speculative attack. Since the fluctuations of reserves were minor in times of dual markets, the severity of the crisis in episodes of limited convertibility is best captured by the premium. As before fragilities under full convertibility are captured by reserve losses. The first column in each table identifies the stabilization program and the second column dates the onset of the crisis and the final speculative attack. Each table entry shows the share of the cumulative sum of the historical forecast errors (observed during the turmoils) of reserves or the dual market premium explained by each single shock.

As shown in Figures 6-12 and in Tables 2-3, monetary policy shocks were at the heart of many of the seven crises examined. Their role was strongest in the earlier period, as they explain about 73 percent of our index of severity of the crisis during the *Gelbard Plan* episode and about 45 percent of that index during both the *Tablita Plan* and the hyperinflation episode in the late 1980s. Typically, adverse monetary policy shocks in Argentina originated in excessive expansions in money supply due to either fiscal pressures or financial sector fragilities or a combination of both. For example, in the early 1970s under the *Gelbard Plan*, the fiscal deficit was at the heart of the monetary expansion, with domestic credit (in U.S. dollars) more than doubling between September 1973 and February 1975 as the GDP-share of the fiscal deficit rose from 5.3 percent in 1972 to 7.3 percent in 1973 and 7.8 percent in 1974. Fiscal pressures also contributed to the large monetary policy expansion that led to the collapse of the *Tablita Plan* in 1981. The budget deficit had mounted to 10-12 percent of GDP by 1980. However, a much larger destabilizing effect resulted from the banking sector crisis of March 1980. The massive bailouts initiated by the central bank at that time<sup>34</sup> were the driving force behind the 52 percent increase of domestic credit (in dollars) between March and December 1980. Again in the late 1980s, the monetization of the fiscal deficit was at the heart of the crises. With Argentina cut-off from world capital markets, most of the government deficit had to be financed domestically, with domestic credit in U.S. dollars increasing by 63 percent in the first quarter of 1989 after having risen by 30 percent between August and December 1988.

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<sup>34</sup> During 1980 alone, the central bank extended loans to financial institutions in trouble amounting to an estimated 5 percent of GDP (See Giorgio and Sagari, 1996). Other estimates indicate that between March and April 1980 alone the central bank increased liquidity by 27 percent of the country's monetary base to help institutions in trouble (Montanaro, 1990).

<b>Table 2. The Role of the Shocks in Explaining the Severity of the Crises in the Dual Exchange Rate Regime</b>						
Program Name	Crisis Episode	Severity of the Crises: Percentage share explained by				
		U.S. Rate	Contagion	Monetary Policy	External Policy	Money Demand
Gelbard	73:7 - 75:2	13.0	6.9	73.4	5.4	1.4
Primavera	89:1 - 89:3	-7.7	-0.1	44.0	27.0	36.7
Note: The severity of the crises is measured by changes in the dual market premium errors						

<b>Table 3. The Role of the Shocks in Explaining the Severity of the Crises in the Unified Exchange Rate Regime</b>					
Program Name	Crisis Episode	Severity of the Crises: Percentage share explained by			
		U.S. Rate	Contagion	Monetary Policy	Money Demand
Tablita	79:10 - 81:3	-9.9	6.6	45.2	58.1
Tablita/Alemann	79:10 - 82:6	45.2	4.7	4.3	45.8
Austral	85:9 - 87:8	2.3	4.6	-3.2	96.3
Convertibility	93:12 - 95:2	60.3	29.7	-36.8	46.8
Note: The severity of the crises is measured by changes in the foreign exchange reserves errors					

While excessive money supply shocks were at the core of the most dramatic collapses of the peso since 1970, shocks to money demand were also important triggers of many crises. Adverse money demand shocks were, in large part, the result of the escalating inflation. As inflation accelerated in the mid-1980s, households and firms started to substitute away from domestic money in favor of foreign assets, using the latter not only as a store of value but also as a medium of exchange. As a result, a vicious circle of large deficits leading to high inflation, dollarization, and to more inflation set in. Fragilities in the banking sector and the confiscation of an important part of the deposits in the early 1980s and then again in January 1990 also contributed to the dollarization of the economy as households switched from non-guaranteed deposits at commercial banks to holding dollar notes. While inflation and confiscation of deposits were at times the main force behind the precipitous collapse of money demand, they were not the only triggers of the demonetization of the economy. Rounds of liberalization of the domestic banking sector soon reversed at the first signs of balance-of-payments problems contributed to this phenomenon. The re-institution of credit and interest-rate controls was frequently followed by the development of an intra-firm financial market and by households' liquidation of their deposits in the traditional banking sector. Overall, money demand shocks explain between 40 and 60 percent of our index of severity at the onset of the 1995, 1981-82, and 1989-90 crises. Their role is even more important during the collapse of the Austral Program, explaining about 96 percent of the decline in foreign exchange reserves.

In particular, the collapse of the *Tablita Plan* occurred in the midst of several bank runs

fueled by financial uncertainty following the failure of a major bank. Adverse money demand shocks in the early 1980s were also triggered by the menace of the reintroduction of capital account restrictions and capital tax levies, with fears of new controls escalating even further after the outbreak of the Malvinas war in the Spring of 1982 and fueling a dramatic increase in capital flight.<sup>35</sup> Fears became reality in April 1982 as drastic exchange rate controls were re-imposed to cope with the problems caused by the war. Later on, in July a dual exchange market was reintroduced. Ultimately, the escalating inflation and the Pastore-Cavallo scheme<sup>36</sup> to erode the value of existing bank loans and deposits put the nail in the coffin of the already defunct peso. The effect of the reform on the size of the financial system was dramatic, with the real value of the banking sector's assets and liabilities falling by about 20 percent within a few months and by 50 percent by the end of 1984. It is in this period that dollarization in the economy accelerated, with dollar-notes circulating in Argentina estimated to be about 5 billion dollars by mid 1980s (See, Ericsson and Kamin (1993)). In 1985, with the implementation of the Austral Plan, the financial system stabilized. However, it was short-lived. As shown in Figure 9, while money demand increased sharply after the implementation of the *Austral Plan* in June 1985, it declined shortly afterwards as fiscal adjustment proved to be transitory and renewed fears of inflation flared again.

The acceleration of dollarization and financial instability in the late 1980s again contributed to the collapses of the *Primavera* and *BB Plans* in 1989-90, with money demand shocks explaining about a third of the increase in the financial rate premium at the time. In January 1990, a new scheme to reduce the value of debt had a lasting impact on the already shaky confidence in the financial system. This time, the government imposed a freeze on most domestic-currency denominated bank time deposits and converted them to 10-year dollar-denominated bonds known as Bonex that immediately lost 70 percent of their face value. By March 1990, M3, which includes currency and all domestic-currency denominated deposits, had collapsed to 3.1 percent of GDP. The share of dollar holdings (currency and deposits) in total assets jumped to 80 percent in the first quarter of 1990 (See, Ericsson and Kamin (1993)).<sup>37</sup>

A decade of confiscations and financial repression had enormous effects on the speed at

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<sup>35</sup> The increasing foreign debt, which soared in the early 1980s –by 52 percent in 1979 and 42 percent in 1980– may have also contributed to heighten risk aversion and capital flight (See, Ize and Ortiz (1987) who argue that increasing public debt fuels tax evasion and/or asymmetric risk factors and leads to capital flight). Dornbusch and de Pablo (1989) present evidence of substantial capital flight in that period: external assets of Argentine residents increased by \$23.4 billions between 1978 and 1982.

<sup>36</sup> To cope with the internal debt problem, the government re-introduced interest rate controls and fixed the nominal interest rate far below the rate of inflation. While controls were supposed to be of a transitory nature, the regulated segment of the banking sector continued to grow while the free segment gradually faded following the central bank prohibition in August 1983 of new deposits in the un-regulated banking segment.

<sup>37</sup> The crisis corresponding to the collapse of the BB plan is not included in Table 2 due to data limitations arising from the fact that this crisis follows the previous within 8 months only.

which Argentines respond to the first signs of trouble in the financial system. No wonder then, that as financial fragilities mounted in 1994 and 1995, households rapidly responded withdrawing their deposits in large amounts. Overall, during the first quarter of 1995 the loss of commercial banks' deposits reached almost 20 percent. The central bank's attempt to ease the crisis at the time raised doubts about the commitment of the government to the currency board system that had been in place since April 1991.<sup>38</sup> This stimulated a run against the currency as depositors switched their bank holdings from peso- to dollar-denominated instruments. Overall, adverse money demand shocks explain about 47 percent of the unexpected decline in foreign exchange reserves between January 1994 and February 1995.

So far, the discussion focused on the role of internal economic shocks driven by either government policy or private sector behavior. However, external factors also played an important role in some of the crises. In the mid-1970s Argentina was isolated from world capital markets; by the late 1970s, however, it had re-entered these markets with full force. It is during this period that fluctuations in world interest rates had a major impact on foreign exchange reserves of the central bank. In fact, as shown in Figure 2 and Table 2, U.S. interest rates increased by about 4 percentage points only in the first half of 1980, with these sharp increases explaining about 45 percent of the decline in the unexpected foreign exchange reserve losses between late 1979 and mid-1982. After the crisis in 1981-82, Argentina became again a pariah in international capital markets, and fluctuations of world interest rates had a minor role on the onset of the subsequent crises. By the early 1990s, however, Argentina and other emerging markets were reintegrated as major players in world capital markets. Fluctuations in world interest rates regained an important role in explaining fluctuations in foreign exchange reserves. In particular, the onset of the 1995 crisis was partly triggered by monetary tightening in the United States —the Federal Reserve increased the Federal Funds rate by 25 basis points in February 1994 and further hikes in subsequent months led to a total 3.5 percentage point increase in that rate. It is not surprising therefore that more than 60 percent of the total decline in the historical forecast error of Argentina's reserves between January 1994 and February 1995 was triggered by world interest rate shocks.

In the 1990s, external shocks were not limited to those fueled by changes in monetary conditions in industrialized countries. Spillover effects from other Latin American countries (as captured by our contagion shock) multiplied the losses triggered by the tightening in the United States. While this study cannot disentangle the different channels of contagion, the evidence points to financial rather than trade links.<sup>39</sup> In fact, the 1990s look very different from the late 1980s. In the early 1990s alone, capital flows to Latin America increased tenfold from their late-1980s

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<sup>38</sup> In February 1995, the central bank allowed a more flexible use of rediscounts to ease the credit crunch on banks, and this was interpreted as a move away from the convertibility plan (D'Amato et al., 1997). However, the monetary authority ultimately chose to suffer the woes of a recession instead of abandoning the currency board. GDP fell by 4.5 percent and investment by 16 percent in 1995 while the peg of the peso to the dollar survived the crisis.

<sup>39</sup> Bilateral trade links between Argentina and Mexico are basically irrelevant since only 2 percent of Argentina's exports are destined to Mexico. Third-party trade links are not important either since Argentina's exports have little in common with Mexican exports.

flows, with equity investment soaring to unprecedented levels, reaching almost 50 percent of all private flows in 1993.<sup>40</sup> International mutual funds played a major role in this process; dedicated emerging market mutual funds invested at least 5, 13, and 8 percent of their portfolio in Argentina, Brazil, and Mexico, respectively. But as international investors become diversified in emerging markets, losses in one of these countries can prompt them to sell in other countries. This is what happened after the Mexican crisis in December 1994, with the devaluation of the Mexican peso prompting investors to sell their assets in other emerging markets. Naturally, they can only sell in those markets where they hold equities. Since Argentina and Brazil have the most liquid stock markets, those were the countries that suffered the most during the Tequila crisis. In fact, as discussed in Kaminsky, Lyons, and Schmukler (1999), the downturn in the Argentine stock market following the Mexican devaluation reached about 40 percent. Our empirical estimations suggest that about one-third of the fall in reserves from January 1994 to February 1995 can be explained by this factor.

## VI. CONCLUSION

Economists have puzzled at length over the causes and severity of currency crises. As a result, research in this area has surged, specially since the ERM crises in 1992-1993. Most of the empirical research has focused on predicting crises, however, leaving unexplained the sources of the changing severity of currency turmoils. This paper uses an old methodology to study this new problem, implementing VAR techniques to quantify the role of different shocks in the severity of currency crises. Our case study is Argentina, a country that not only has been at the center stage in every single episode of international financial turmoil (such as the 1982 debt crisis, the 1994 Tequila crisis, and the 1999 Brazilian crisis), but also has had many currency collapses of its own. Thus, while our analysis is confined to one country, it does provide a glimpse on the nature of worldwide currency turmoils. Our results confirm previous findings in the literature but also suggest new findings and important areas for future research.

The major conclusions that emerge from our analysis are as follows. First, our estimations confirm the results obtained by Calvo, Leiderman, and Reinhart (1992) regarding the role of monetary tightening in industrial countries during the episodes of capital flows reversals of the early 1980s and mid 1990s. Both, the collapse of the *Alemann Plan* and the speculative attack against the peso in 1994-95 in the midst of the *Convertibility Plan* were in large part precipitated by the shift to a contractionary monetary stance in the U.S.

Second, as expected, inconsistent monetary and exchange rate policies did trigger many of the main speculative attacks against the peso. Moreover, the accelerating pace of money creation fueled a complete dollarization of the economy with pesos even being replaced by U.S. notes as means of payments. The demonetization of the economy intensified after the hyperinflation of the late 1980s-early 1990s, as the ratio of M1 to output (measured by industrial production) collapsed in February 1990 to a fifth of its February 1987 value. But, as our chronology of events and historical decompositions suggest, loose monetary policy was not the only culprit. The erratic

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<sup>40</sup> See Kaminsky, Lyons, and Schmukler (1999) for the evolution of equity flows to Latin America.

nature of capital account restrictions and interest rate and credit controls also played a key role, with the reversals in liberalization on both fronts leading to capital flight and exerting downward pressure on money demand. Finally, the deliberate policies implemented throughout the 1980s to reduce the real value of internal debt, either private or public (for example the inflation tax and interest rate controls on deposits imposed in June 1982, or the direct confiscation of commercial banks' deposits in the context of the Bonex Plan in January 1990) further undermined the shaky faith of households in their financial system and accelerated the dollarization of the economy.

Third, the 1990s do look somewhat different. Spillovers from Mexico and other Latin American countries seem to have been a source of financial distress for Argentina, explaining about 30 percent of the severity of the speculative attack in 1995. This should not come as a surprise. After all, in the 1980s, there were only a handful of mutual funds and a reduced number of them had any exposure to emerging markets. The 1990s offer a completely different panorama, as emerging markets became well integrated in world capital markets and mutual funds became important players in Latin America. Naturally, this provided a new channel for spillovers, as was the case when mutual funds retreated from several countries in Latin America after the losses they suffered from the Mexican devaluation.

While our results go a long way in supporting the informal explanations about the nature of Argentina's crises, there is still a wide scope for research ahead. Since dollarization has played an important role in many crises, a further understanding of the nature of speculative attacks begs for precise measures of capital account and interest rate controls to directly quantify how episodes of liberalization followed by sharp reversals affected money demand. Also, on the account of rapidly changing world capital markets, we need to better understand the nature of financial market channels to help in making countries less crisis prone and more immune to contagion.

### THE DATA

The data used in the VAR estimation is in monthly values and covers the period 1970:1-1995:5. Some of the graphs in Figures 1-2 go up to 1995:12 due to the availability of the corresponding series.

- **Data Sources:**

- International Financial Statistics, IMF.
- Fundación de Investigaciones Económicas Latinoamericanas, F.I.E.L.

- **Definitions and units of the variables plotted in Figures 1 and 2:**

- Foreign Exchange Reserves: End-of-month stock of foreign exchange reserves held by the central bank of Argentina, in billions of U.S. dollars.
- Dual Market Premium: Percentage difference between the black market exchange rate and the commercial exchange rate.
- Domestic Credit: Total domestic credit of the banking sector, measured in billions of U.S. dollars at the commercial exchange rate.
- Real Exchange Rate:  $eP^{US}/P^{Arg}$ , where  $e$  is the commercial exchange rate and  $P^{US}$  and  $P^{Arg}$  are the consumer price indices of the U.S. and Argentina, respectively.
- U.S. Real Interest Rate: Nominal interest rate on one-year U.S. bonds adjusted for CPI inflation (in percent).
- Regional Contagion Variable: First principal component of foreign exchange reserves of the following countries: Brazil, Chile, Colombia, Mexico and Venezuela (index number). The reserves series were taken from the IFS tape and the principal component constructed as a linear combination of the five series, where the weights correspond to the eigenvector associated with the largest eigenvalue of the covariance matrix of the individual series. (Refer to Drhymes (1974) for an explanation of principal components analysis.)

- **Definitions and units of the variables used in the VARs:**

- $i^*$ : U.S. Real Interest Rate (as above).
- $c$ : Regional Contagion Variable (as above).
- $d - e$ : Domestic Credit (as above).
- $r$ : Ratio of Argentina's Foreign Exchange Reserves to the above measure of Domestic Credit.
- $(f - e)$ : Dual Market Premium (as above, used as a proxy for the financial rate premium).

### EQUATION DERIVATIONS

#### Derivation of Equation (15')

From equation (3),  $p_t = (1 - \beta) \bar{e} + \beta m_t$ . Plugging this in (15) yields

$$R_t - R_{t-1} = \eta\beta (\bar{e} - m_t) + Qi_t^* + \mu_t^r. \quad (\text{B.1})$$

But  $M_t = D_t + \bar{E}R_t$ , so that factoring  $D_t$  out and taking logs implies that  $m_t = d_t + \bar{E}R_t/D_t$ .

We adopt the following linearization of the second term on the right-hand side:

$\bar{E}R_t/D_t = \phi_1 (\bar{e} - d_t) + \phi_2 R_t$ . Using this in equation B.1 yields

$$\begin{aligned} R_t - R_{t-1} &= \eta\beta (\bar{e} - d_t - \phi_1 (\bar{e} - d_t) - \phi_2 R_t) + Qi_t^* + \mu_t^r \\ &= \eta\beta (1 - \phi_1) (\bar{e} - d_t) - \eta\beta\phi_2 R_t + Qi_t^* + \mu_t^r \end{aligned}$$

Equation (15') is then obtained after resetting  $\phi_1 = (1 - \phi_1)$ .

#### Derivation of Equation (18)

Combining equations (14) and (17) and noting that the central bank floats the currency when reserves are depleted, we obtain the following

$$\begin{aligned} \left( \frac{(1 - \beta - \alpha\gamma_2)}{\eta\beta\phi_1} Q + \alpha\gamma_1 \right) i_t^* + \alpha\gamma_2 d_t - \delta c_t - \mu_t^d + \frac{1 - \beta}{\eta\beta\phi_1} \mu_t^r &= \alpha\gamma_2 f_t \\ &\quad - \alpha\gamma_3 (E f_{t+1} - f_t) \end{aligned} \quad (\text{B.2})$$

We stipulate a solution for the financial rate of the form

$$f_t = A_0 + A_1 d_t + A_2 i_t^* + A_3 c_t + A_4 \mu_t^d + A_5 \mu_t^r. \quad (\text{B.3})$$

Using the method of undetermined coefficients, (B.2) and (B.3) yield the following solution for the financial rate

$$f_t = d_t + \left( \frac{\gamma_1}{\gamma_2} + \frac{\gamma_3 w \delta}{\alpha \gamma_2^2} + \frac{1 - \beta - \alpha \gamma_2 Q}{\alpha \eta \beta \phi_1 \gamma_2} \right) i_t^* - \frac{\delta}{\alpha} c_t - \frac{1}{\alpha (\gamma_2 + \gamma_3)} \mu_t^d + \frac{1 - \beta}{\eta \beta \phi_1 \alpha (\gamma_2 + \gamma_3)} \mu_t^r. \quad (\text{B.4})$$

Hence, using (B.4), (16) and (17), the financial market premium is given by

$$\begin{aligned} f_t - e_t &= f_t - (\bar{e} \cdot \Pr(R_t > 0) + \tilde{e}_t \cdot \Pr(R_t < 0)) \\ &= f_t - (\bar{e} + (\tilde{e}_t - \bar{e}) \Pr(R_t < 0)) \end{aligned}$$

$$\begin{aligned}
 &= (d_t - \bar{e}) + \left( \frac{\gamma_1}{\gamma_2} + \frac{\gamma_3 w \delta}{\alpha \gamma_2^2} + \frac{1 - \beta - \alpha \gamma_2}{\alpha \eta \beta \phi_1 \gamma_2} Q \right) i_t^* - \frac{\delta}{\alpha} c_t - \frac{1}{\alpha (\gamma_2 + \gamma_3)} \mu_t^d + \\
 &\quad \frac{1 - \beta}{\eta \beta \phi_1 \alpha (\gamma_2 + \gamma_3)} \mu_t^r + ((d_t - \bar{e}) - [1/\eta \beta \phi_1][Q i_t^* + \mu_t^r]) \Pr(R_t < 0) \\
 &= (d_t - \bar{e}) + \left( \frac{\gamma_1}{\gamma_2} + \frac{\gamma_3 w \delta}{\alpha \gamma_2^2} + \frac{1 - \beta - \alpha \gamma_2}{\alpha \eta \beta \phi_1 \gamma_2} Q \right) i_t^* - \frac{\delta}{\alpha} c_t - \frac{1}{\alpha (\gamma_2 + \gamma_3)} \mu_t^d + \\
 &\quad \frac{1 - \beta}{\eta \beta \phi_1 \alpha (\gamma_2 + \gamma_3)} \mu_t^r + ((d_t - \bar{e}) - [1/\eta \beta \phi_1][Q i_t^* + \mu_t^r]) \Pr(\mu_t^s - Q \mu_t^* - \mu_t^r) \\
 &> Q i_t^* + R_t - \eta \beta \phi_1 (d_t - \bar{e}) \tag{B.5}
 \end{aligned}$$

where

$$\begin{aligned}
 &\Pr(\mu_t^s - Q \mu_t^* - \mu_t^r > Q i_t^* + R_t - \eta \beta \phi_1 (d_t - \bar{e})) \\
 &= \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} \int_x^{\infty} (\mu_t^s - Q \mu_t^* - \mu_t^r) f^s(\mu^s) f^*(\mu^*) f^r(\mu^r) d\mu^s d\mu^* d\mu^r \tag{B.6}
 \end{aligned}$$

and

$$x = -Q i_t^* - R_t + \eta \beta \phi_1 (d_t - \bar{e}) + \mu_t^s + Q \mu_t^*$$

Given the expression in (B.6), it turns out that equation (B.5) is a non-linear function of  $d_t - \bar{e}$ ,  $i_t^*$ ,  $c_t$ ,  $R_t$  and  $\mu_t^d$ . But it would be straightforward to linearize it and obtain an expression in the form of equation (18) of the text.

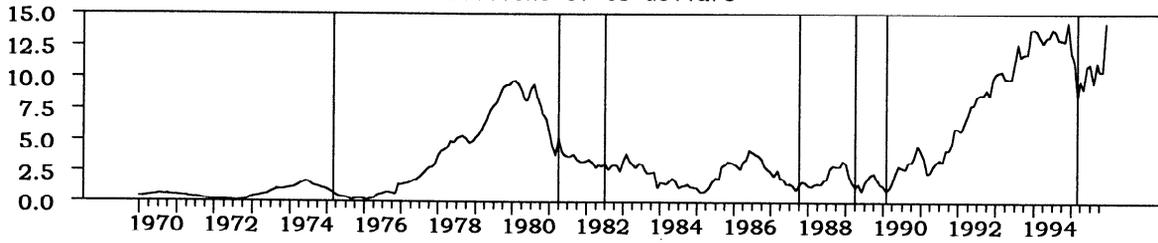
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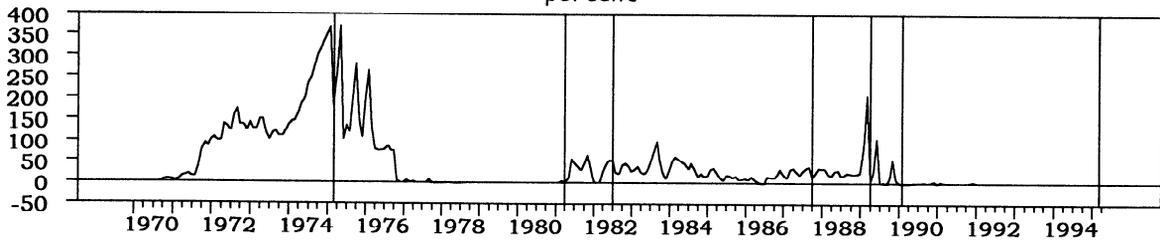
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### 1. Domestic Indicators

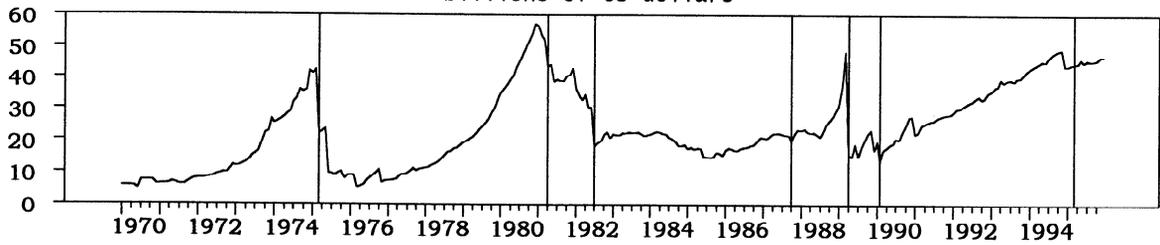
**Foreign Exchange Reserves of the Central Bank of Argentina**  
billions of US dollars



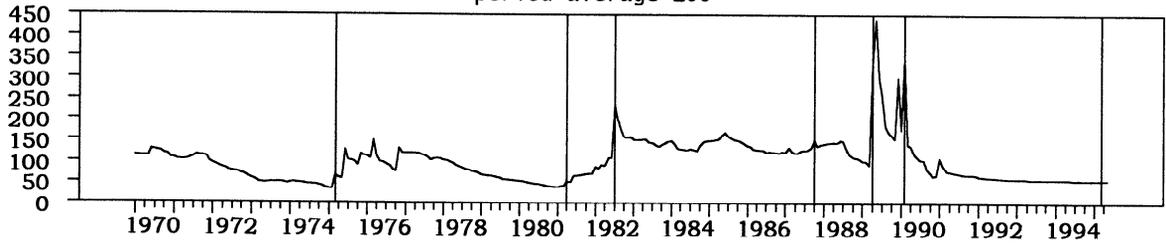
**Dual Market Premium**  
percent



**Domestic Credit**  
billions of US dollars



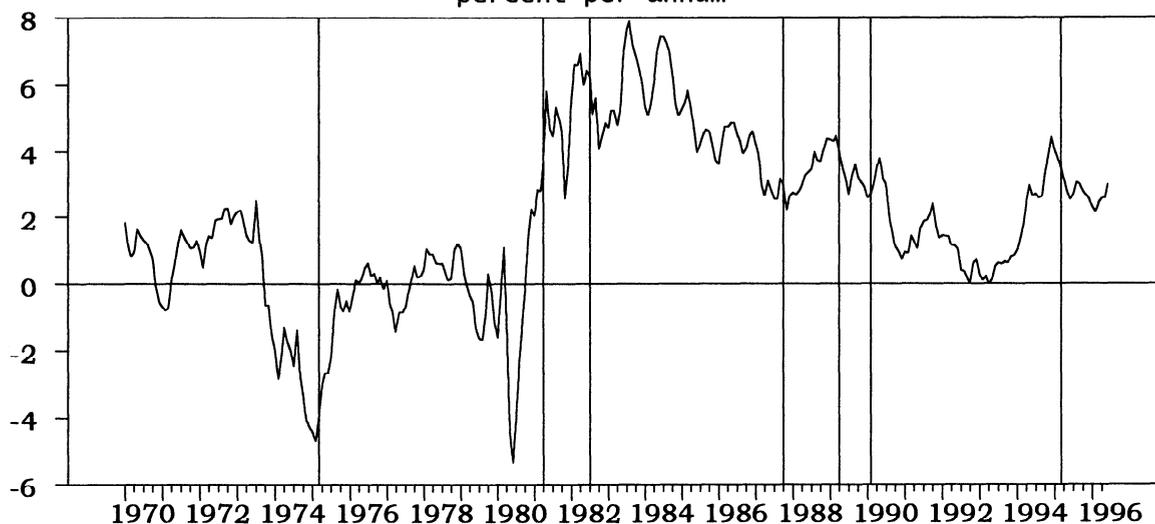
**Real Exchange Rate**  
period average=100



## 2. International Indicators

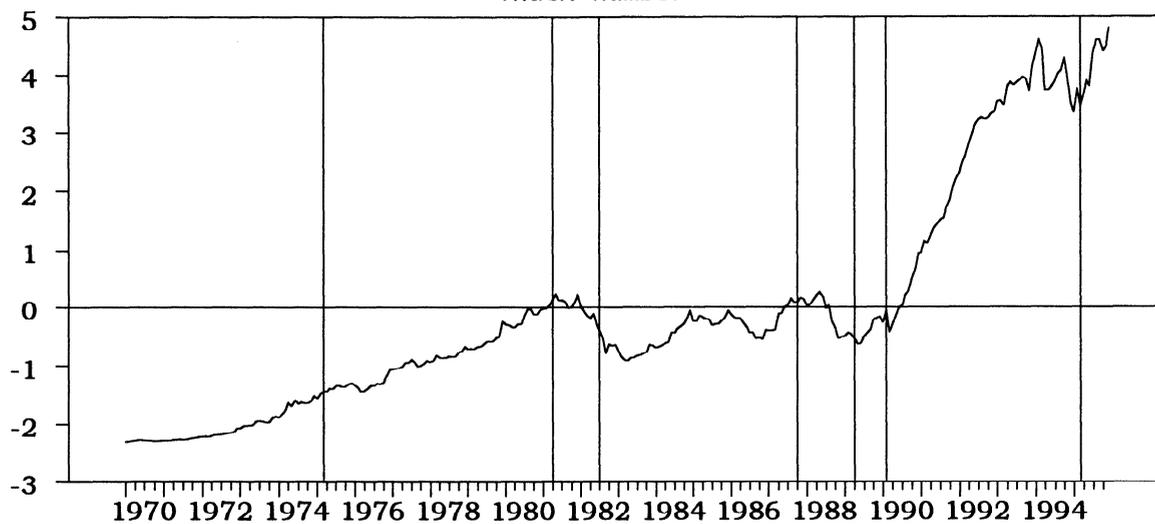
### US Real Interest Rate

percent per annum

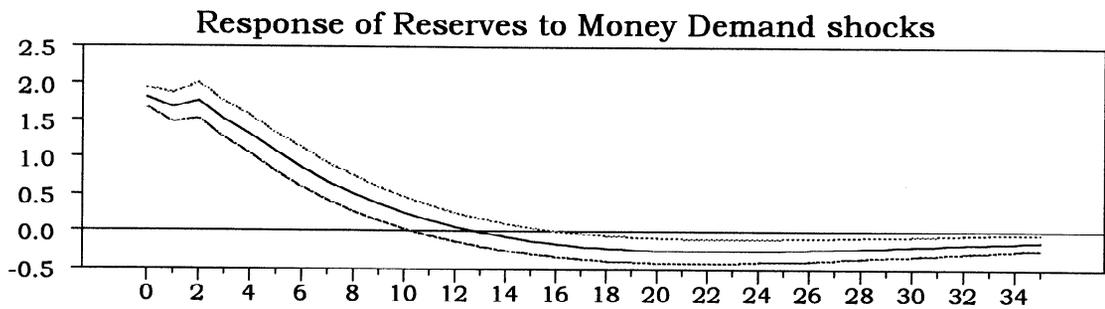
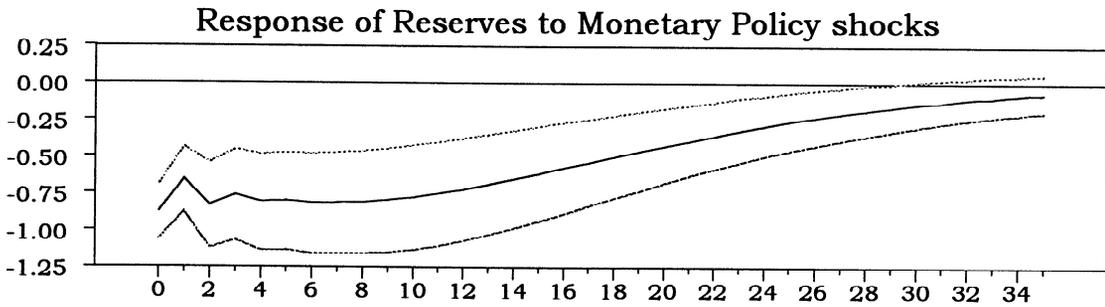
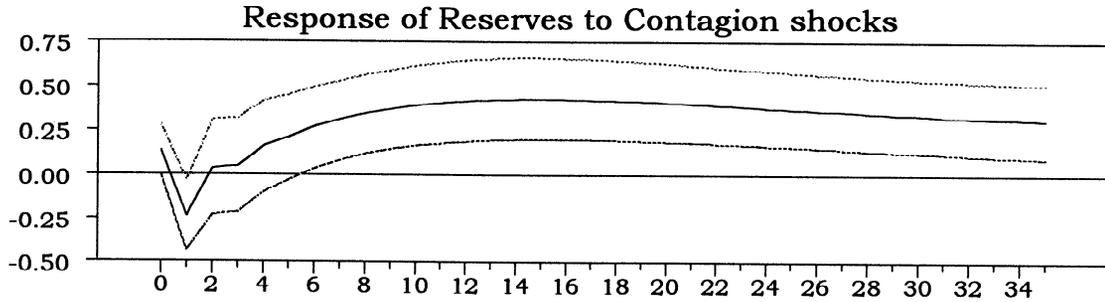
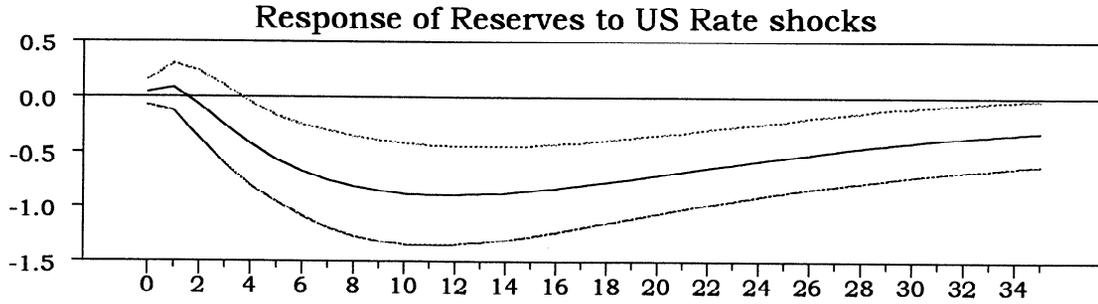


### Regional Contagion Variable

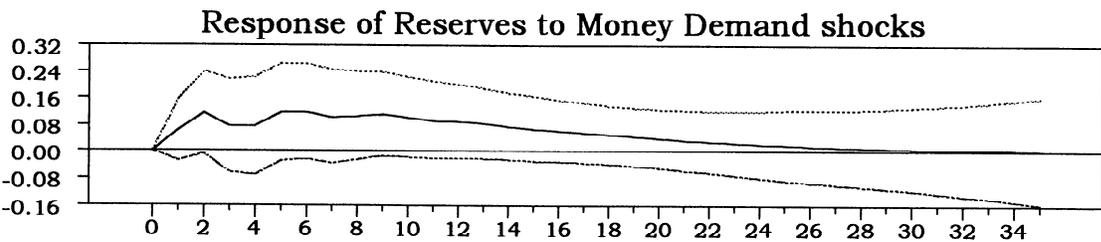
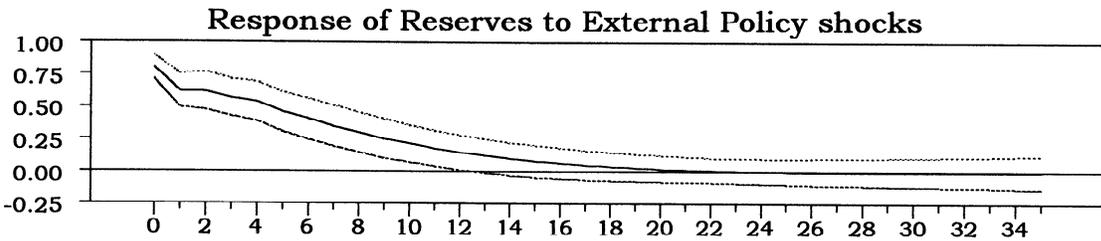
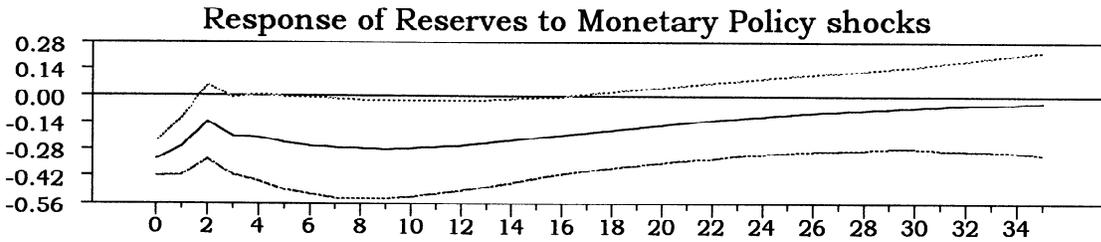
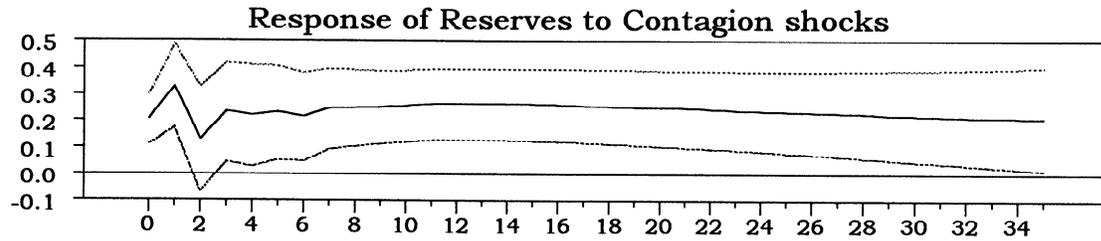
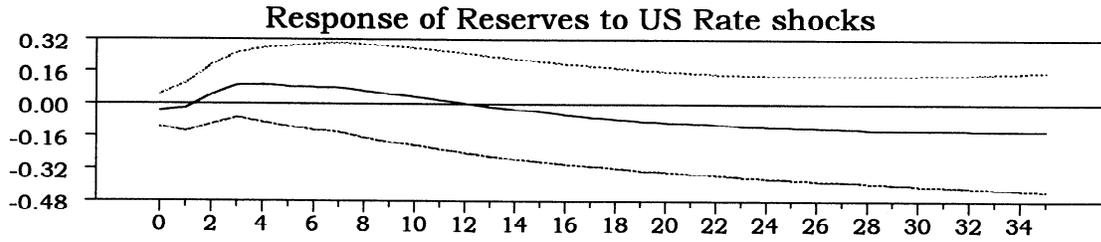
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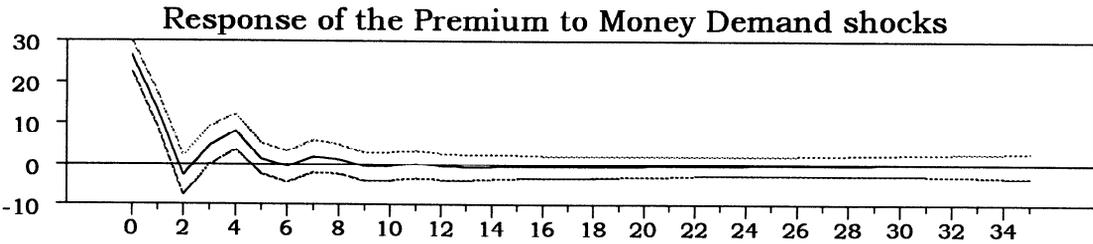
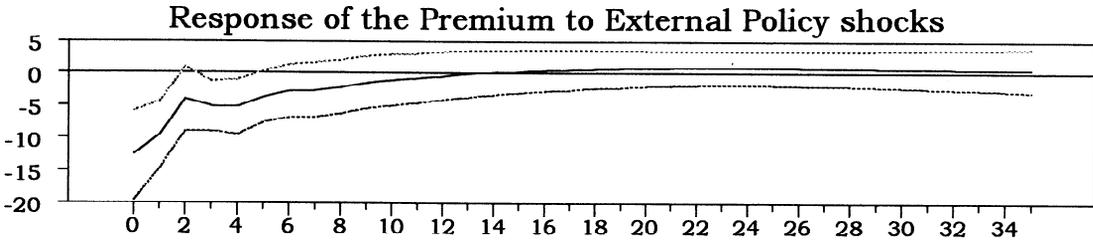
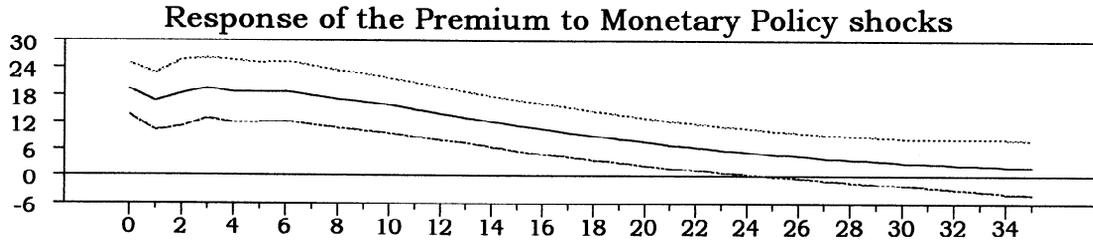
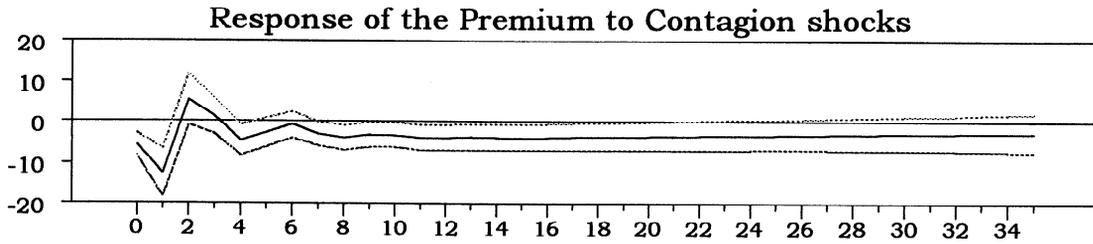
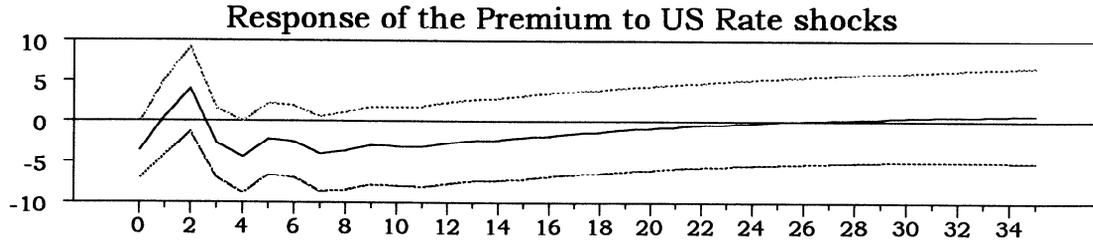
### 3. Impulse Response Functions in the Unified Exchange Rate Regime



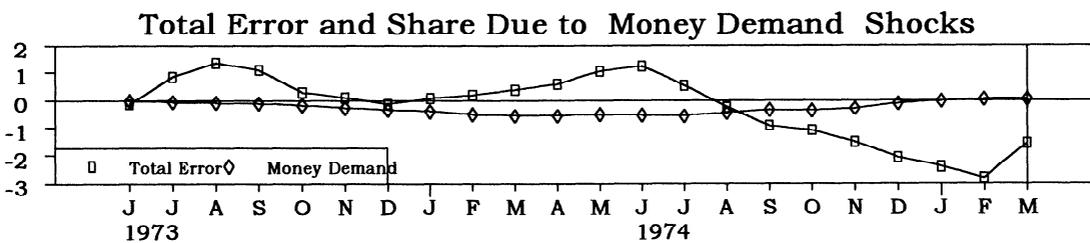
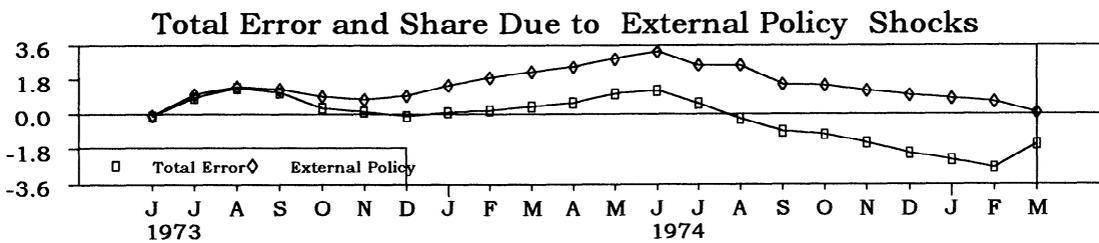
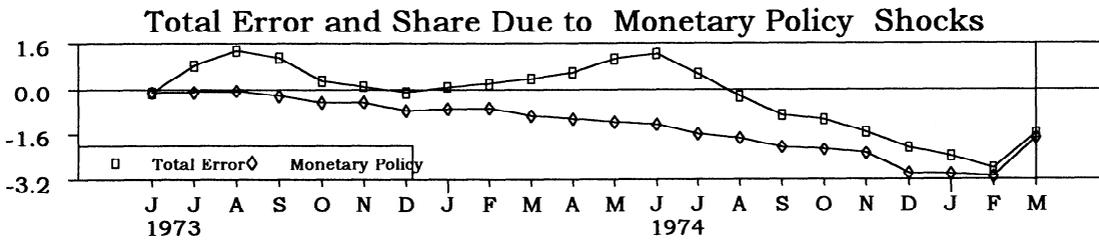
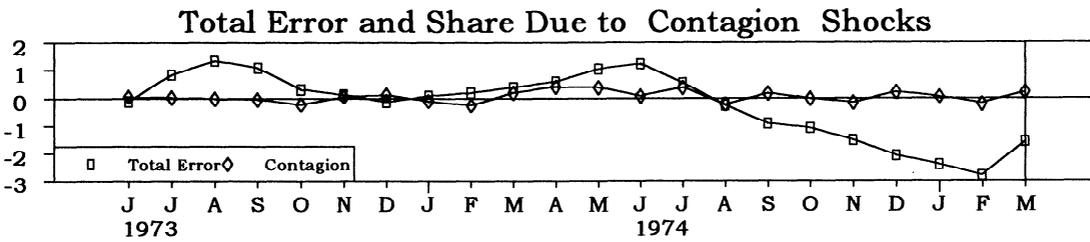
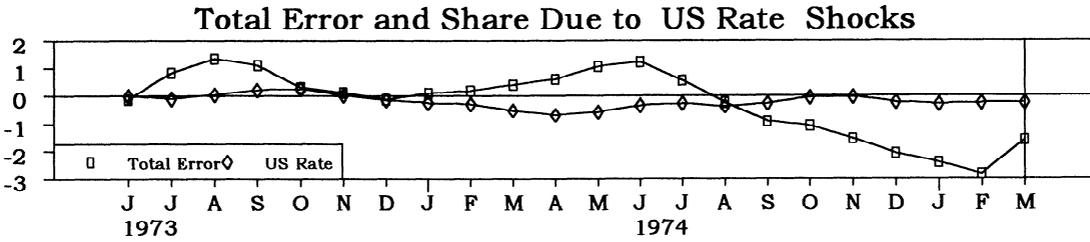
#### 4. Impulse Response Functions in the Dual Exchange Rate Regime



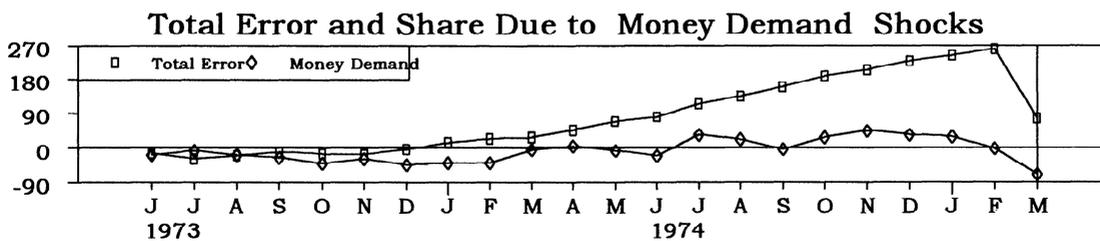
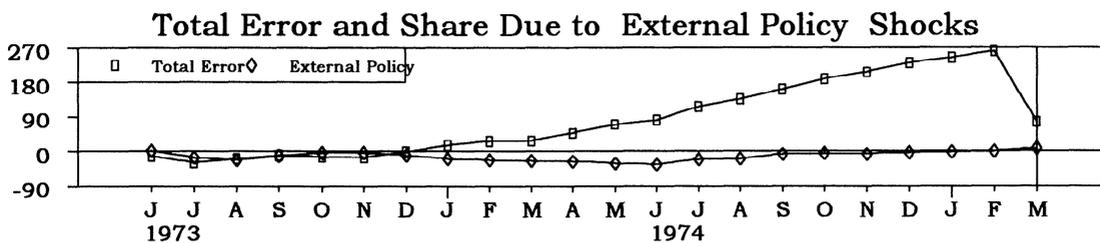
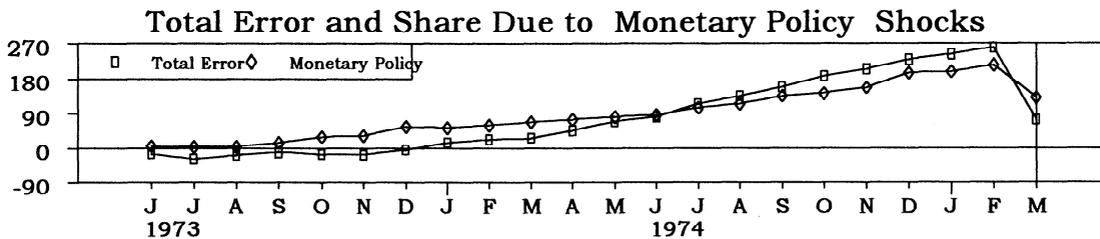
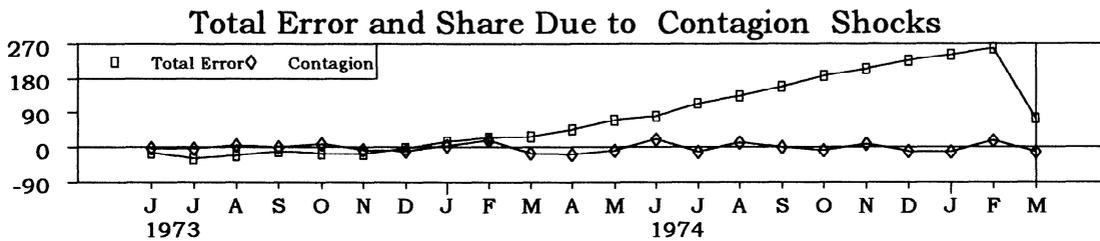
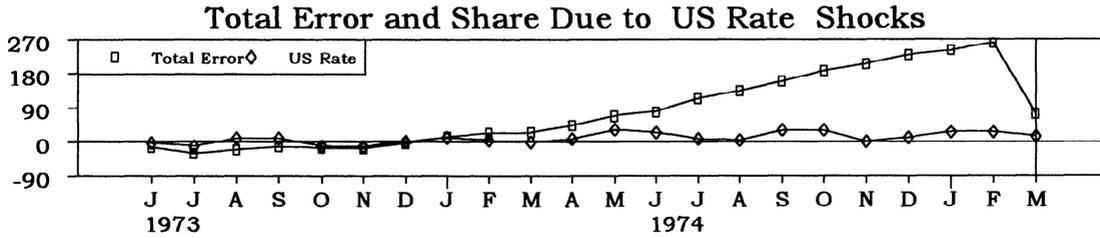
### 5. Impulse Response Functions in the Dual Exchange Rate Regime



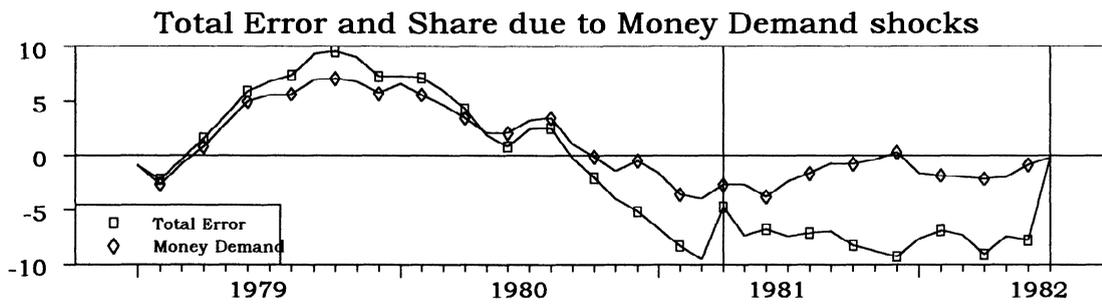
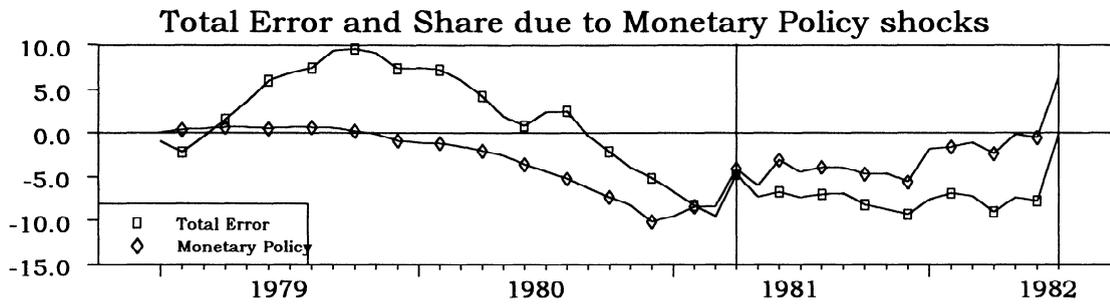
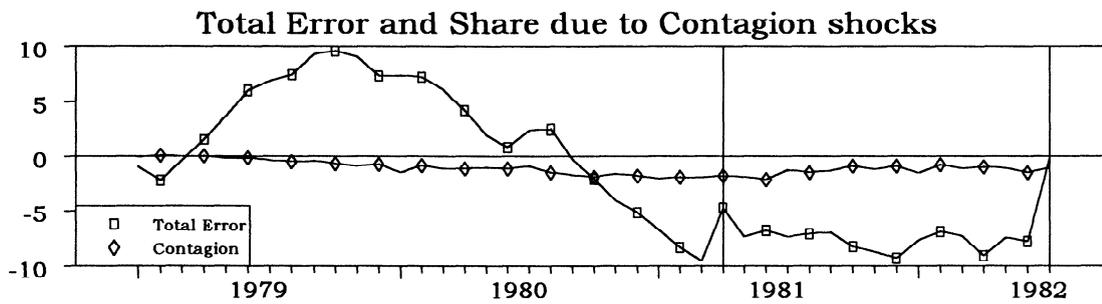
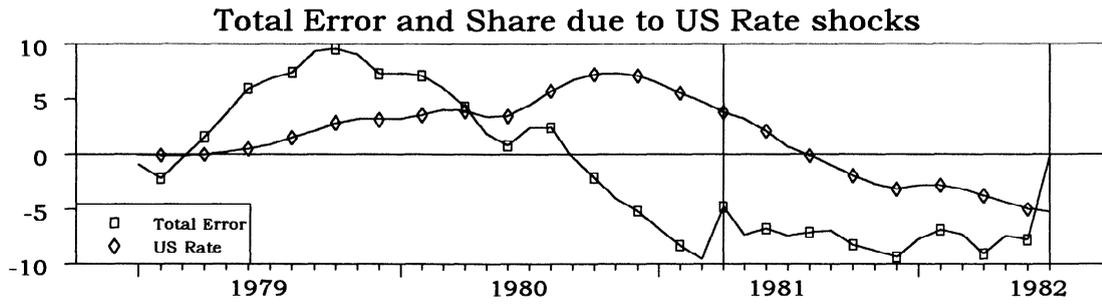
6. Decomposition of the Historical Forecast Errors of Foreign Exchange Reserves (Gelbard Plan, 1973:5-1975:3)



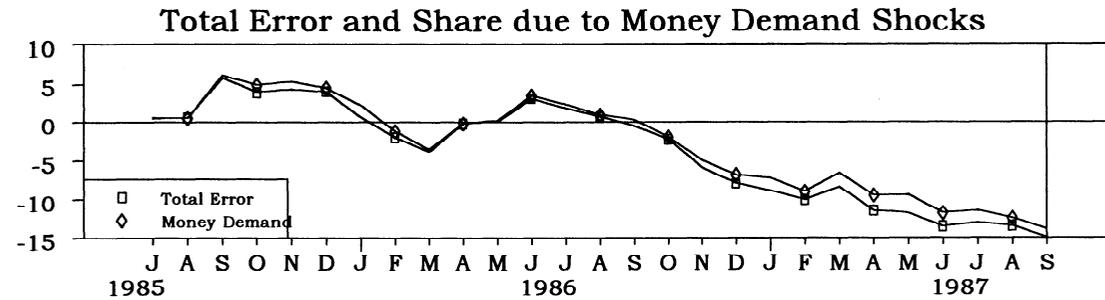
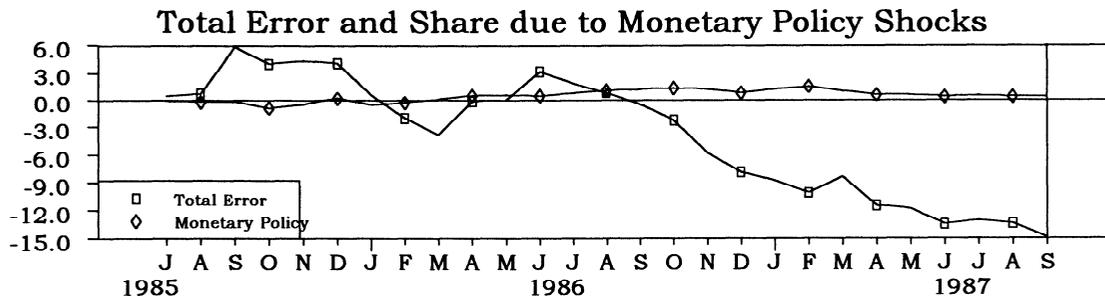
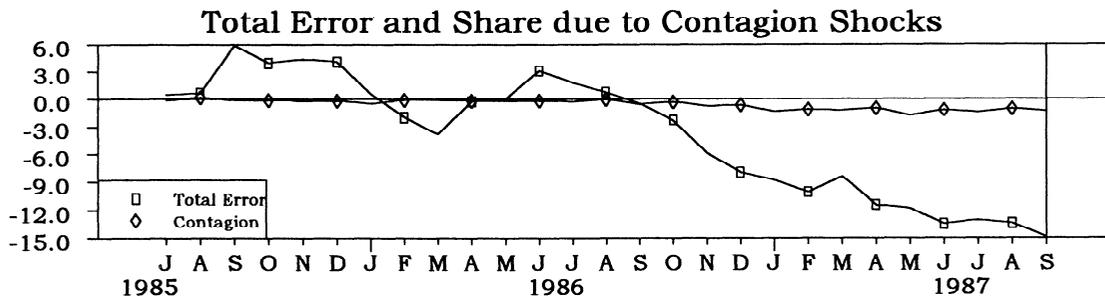
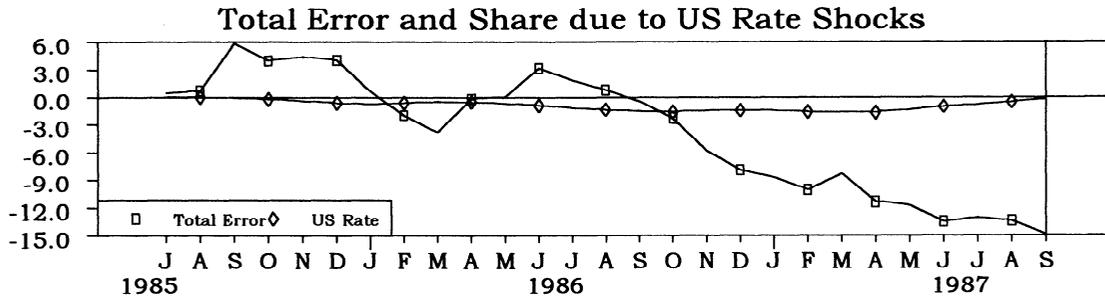
7. Decomposition of the Historical Forecast Errors of the Dual Market Premium (Gelbard Plan, 1973:5-1975:3)



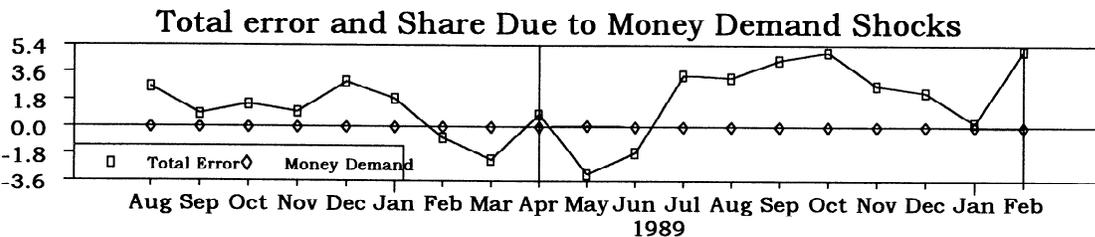
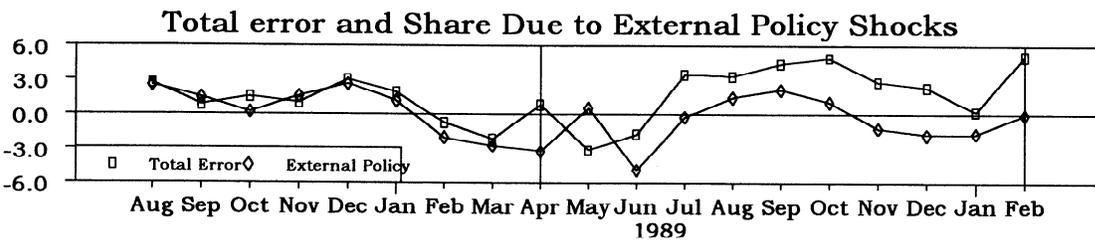
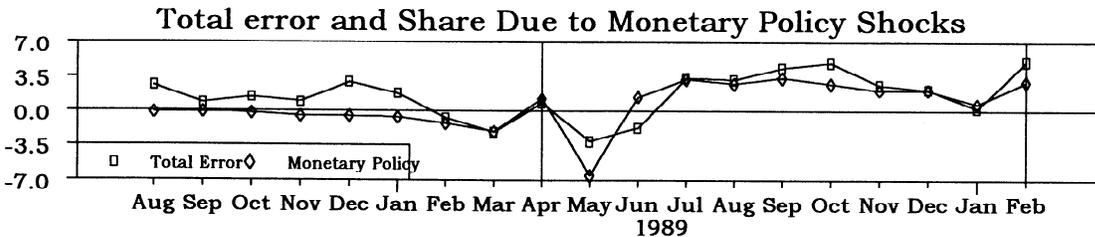
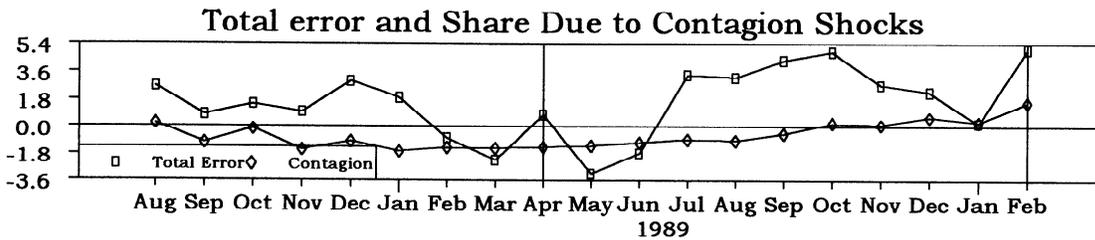
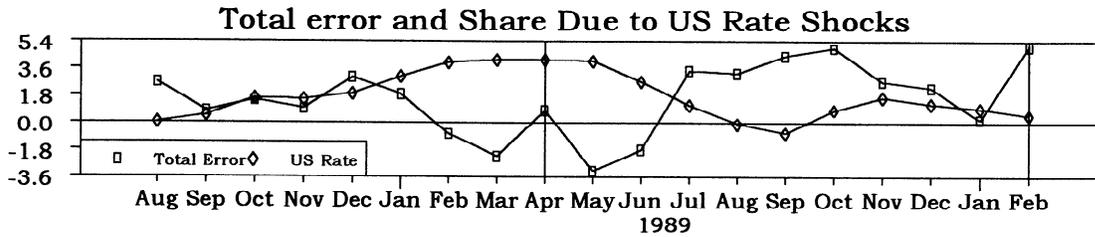
8. Decomposition of the Historical Forecast Errors of Foreign Exchange Reserves (Tablita & Alemann Plans, 1978:12-1982:7)



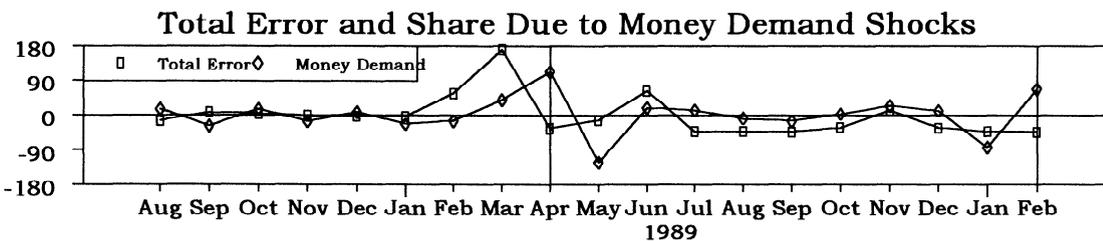
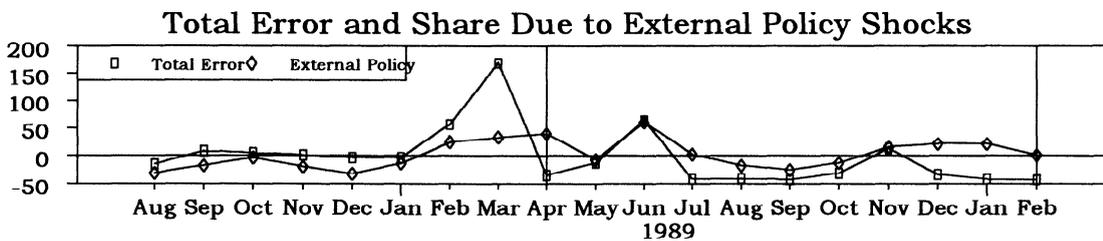
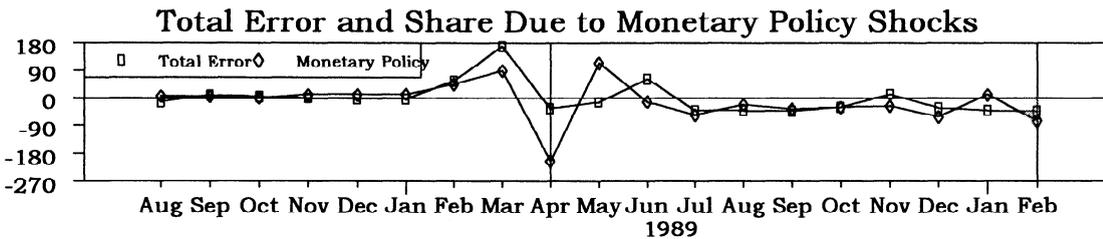
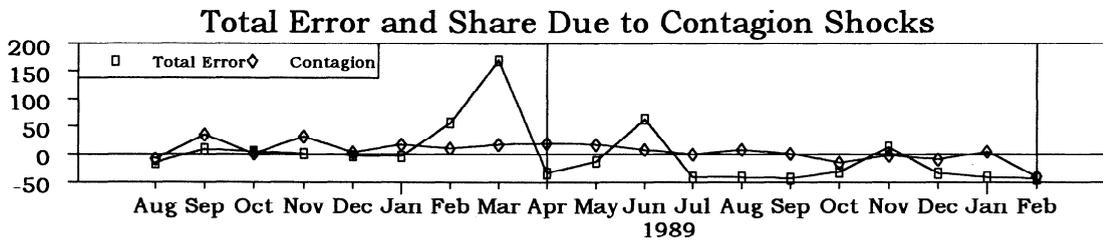
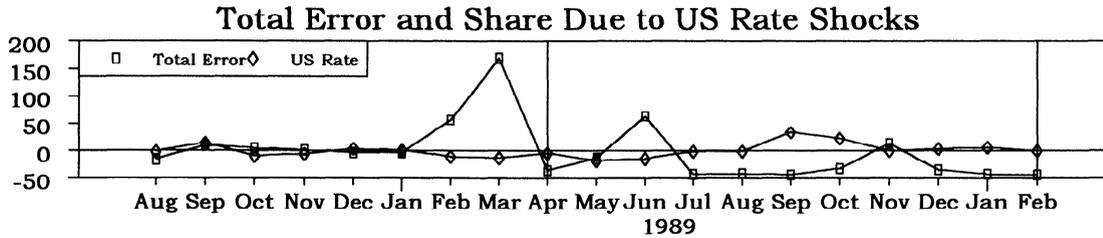
9. Decomposition of the Historical Forecast Errors of Foreign Exchange Reserves (Austral Plan, 1985:6-1987:9)



10. Decomposition of the Historical Forecast Errors of Foreign Exchange Reserves (Primavera & BB Plans, 1988:8-1990:2)



11. Decomposition of the Historical Forecast Errors of the Dual Market Premium (Primavera & BB Plans, 1988:8-1990:2)



12. Decomposition of the Historical Forecast Errors of Foreign Exchange Reserves (Convertibility Plan, 1991:4-1995:3)

