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Mexico's balance-of-payments crisis: a chronicle of a death foretold[1]

Guillermo A. Calvo[a], Enrique G. Mendoza[b,*]

[a]*Center for International Economics, University of Maryland, College Park, MD 20742, USA*
[b]*Division of International Finance, Board of Governors of the Federal Reserve System, Washington, DC 20551, USA*

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Abstract

This paper claims that the roots of Mexico's balance-of-payments crisis are found in the prevailing high degree of capital mobility and financial globalization. Under these circumstances, shifts in foreign capital flows and anticipation of a banking-system bailout may produce large imbalances between stocks of financial assets and foreign reserves, threatening the sustainability of currency pegs. Econometric analysis suggests that half of Mexico's reserve losses could be accounted for by these phenomena. Large financial imbalances are also fertile ground for self-fulfilling-prophesy crises which lead devaluations to produce deep recessions. These difficulties can be partly remedied by appropriate policies.

Key words: Balance-of-payments crises; Devaluation; Herding behavior; Mexican crisis; Global economy

JEL classification: F31; F32; F34; F36

* Corresponding author.

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1. Introduction

At first sight, the Mexican financial crash of December 1994 and the deep economic crisis that followed resemble previous Mexican crises. Five previous attempts at fixing the exchange rate since 1945 were followed by economic expansion, sharp real appreciation, and large external deficits. Eventually, each attempt ended with a large devaluation and the abrupt reversal of the initial process. In a remarkable account of these cycles, Gomez-Oliver (1981) shows that expansionary policies and adverse external shocks triggered the devaluations. Since 1976 the crises have been almost perfectly timed with the presidential elections.

In 1994, the crash coincided again with presidential elections. It followed again from a period of economic expansion, real appreciation, and widening external imbalances associated with the exchange-rate-based stabilization initiated in March, 1988.[2] Upon closer scrutiny, however, several elements of the 1994 crash do not fit previous crises. The Salinas administration implemented a far-reaching program of structural reform. Fiscal and monetary discipline were restored. Aggressive trade liberalization replaced the import substitution philosophy. Public enterprises were privatized, and liberalization and deregulation of several industries were undertaken. The North American Free Trade Agreement culminated these efforts, giving stability to the new outward growth strategy. Thus, by late 1993 the familiar symptoms of expansionary policies and falling foreign reserves typical of the near-crisis stages of the past were not present. The overall public sector balance reported a surplus of 1% of GDP, compared with an 11% deficit in 1988, inflation was near single-digit levels, and gross reserves were at a record level above US$26 billion.

Prior to the collapse, the large external deficit and real appreciation were the subject of a heated policy debate. Traditional arguments of the Dornbusch–Rodriguez overshooting model were used to push for a devaluation (Dornbusch and Werner, 1994), while the logic of equilibrium adjustments induced by structural reform was used to defend the currency peg (Sachs et al., 1995). However, there was agreement on the country's sound 'fundamentals.' In the worst-case scenario, a devaluation would re-align the real exchange rate and close the current account gap, and would be followed by a widely expected take-off.

Why, then, did Mexico lose its foreign exchange reserves? Why did the devaluation trigger massive runs against Mexican investments, causing the worst recession of modem times? And why did emerging markets world-wide feel the impact of the Mexican crash? This paper argues that these phenomena are characteristic of a new kind of balance-of-payments (BOP) crises in the era of the

[2]The stabilization plan formally started in December, 1987. The exchange rate was fixed February 29, 1988.

global capital market. In these new crises, a country's fixed-exchange-rate regime becomes vulnerable as large imbalances emerge between stocks of liquid financial assets and gross reserves. Banking fragility, exogenous shifts in world capital flows, and the policy response in the early stages of the crisis contribute to these imbalances. Vulnerability leads to large devaluations and a financial crash because of 'panic' runs against financial assets. Thus, according to this view, in the new BOP crises *flow* imbalances (i.e. large current accounts and overvalued real exchange rates), while not irrelevant, are much less critical than *stock* imbalances.

We propose a mechanism linking banking fragility and world capital flows to currency vulnerability that produces similar predictions as the classic models of BOP crises by Krugman (1979) and Obstfeld (1986). Foreign reserves fall first gradually and then precipitously as the currency peg is abandoned. However, the crisis does not originate in a fiscal deficit, as in the classic models, but in the perception that a lending boom caused by poorly managed capital inflows leads to a banking-system bailout.

To the extent that the Mexican crisis is consistent with the above argument, one could argue that the crisis or 'death' was foretold (or predictable).[3] However, the violence of the crisis that erupted once the exchange rate floated requires further explanation, since in our banking-bailout model devaluation marks the end, not the beginning, of the crisis. Thus we offer a second mechanism that links the devaluation to massive runs against domestic assets. Like other mechanisms offered to explain this phenomenon (see Cole and Kehoe, 1996), the one we propose incorporates self-fulfilling or herd-behavior (i.e. multiple equilibria) elements. Our approach is perhaps simpler, however, because we show that herding by global investors can be a natural outcome of mean-variance portfolio optimization as the global market grows. The larger the market, the smaller the incentives for gathering information, and hence the more likely investors are to move in herds. We argue, however, that this herd behavior may not be enough to justify the depth of the Mexican recession. To explain the latter, the policy reaction to the financial crash must be highly distortionary.

The paper is organized as follows. Section 2 reviews Mexico's economic developments leading to the devaluation, emphasizing financial vulnerability. Section 3 sketches out the two key components of our model. Section 4 provides econometric evidence showing that Mexico's monetary transmission mechanism reflects co-movements consistent with our view. Section 5 draws conclusions and policy lessons.

[3]We acknowledge, however, that Mexico's severe political crisis, with assassinations and social unrest unseen for more than 60 years, also plays a role in any sensible explanation of the financial crash. A high degree of political uncertainty is likely to magnify the effects at work in the model of BOP crises we propose.

2. The Mexican economy: 1988–1995

2.1. The syndrome of exchange-rate-based stabilizations

In December of 1987, the Mexican government introduced an exchange-rate-based stabilization plan. A key component of this plan was a social agreement (the 'pact') by which workers, firms, and government convened to meet regularly to set price, wage, and exchange-rate policies. As noted earlier, the plan was accompanied by sweeping structural reforms.[4] The currency was not fully pegged, as the exchange rate regime shifted from a fixed rate to an adjustable narrow band. Still, the response of the economy was typical of exchange-rate-based stabilizations. There was an economic boom, monetary aggregates grew faster than GDP, the real exchange rate appreciated markedly, and the external imbalances widened.

Fig. 1 illustrates the real effects of the plan. Economic activity recovered sharply in 1988–1994. GDP and private consumption rose by about 30%, while investment grew more than 70%. However, growth during this period was uneven, falling in 1993 to 0.6%, well below the 1988–92 average and the 1994 estimate (3.5% in both cases).[5] The trade deficit worsened considerably as imports grew more than 300% relative to their level at the time the plan was introduced. By late 1994, the trade balance showed record deficits exceeding US$1.5 billion month^{-1} (see Fig. 2). Fig. 2 also shows that the real effective exchange rate appreciated for most of the duration of the plan, with two episodes of sharp appreciation – 1988 and 1991–1993. At its peak, the real exchange rate appreciated by nearly 60%, relative to the March-1988 level. Fig. 3 shows that M2 money supply rose sharply both in real consumer-price terms and in US dollar terms. Real M2 doubled, while M2 in US dollars went up almost three times.

Explaining these stylized facts has been the focus of a large literature, recently reviewed by Rebelo and Végh (1995). This paper does not aim to add to that literature. However, to motivate the idea that our approach to BOP crises has some merit, we discuss how the stylized facts challenge conventional theories.

Consider first the hypothesis that Mexico in 1994 went through the slow-growth, declining-inflation stage of the output-inflation spiral of an overshooting model driven by backward indexation. The main weakness of this approach is the evidence that its key policy prediction was erroneous. According to this approach, a once-and-for-all devaluation, accompanied by a dismantling of indexation, should have realigned the real exchange rate without complications. Dornbusch and Werner (1994) called for a real depreciation of 20% in March. Since half of that was produced prior to the crash (as a result of the nominal depreciation

[4]See Aspe (1993) for a detailed description of the plan.

[5]Unless otherwise noted, data used in this paper are from the Banco de Mexico's monthly *Indicadores Economicos*.

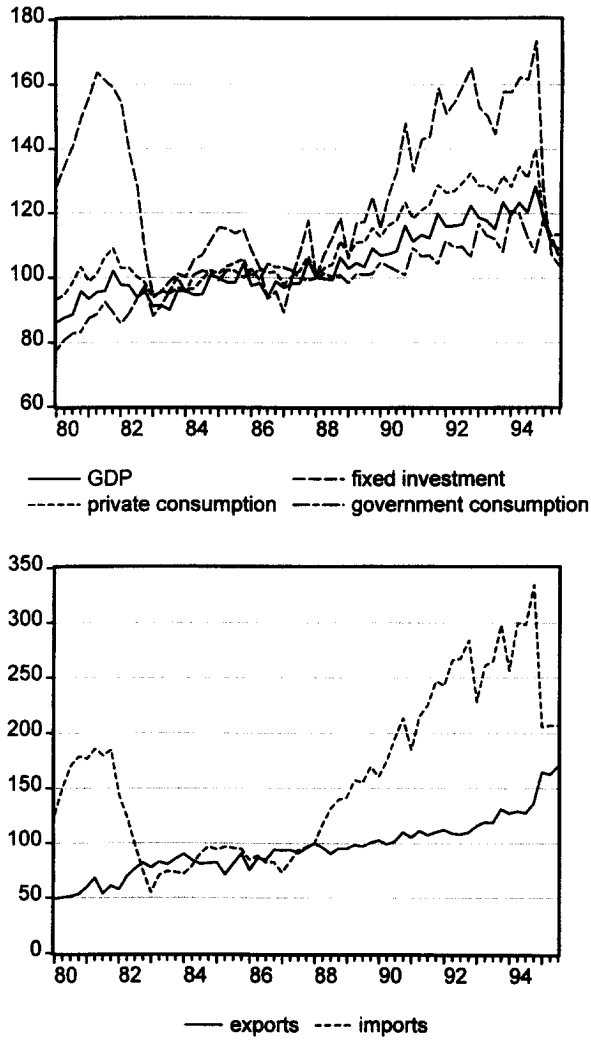

Fig. 1. Real effects of the 1988–1994 exchange-rate-based stabilization (1988:1 = 100).

allowed within the existing exchange-rate band and the convergence of non-tradable goods inflation, see Fig. 3) a modest 10% managed devaluation should have completed the process. However, the attempt at a managed devaluation resulted in a run against short-term, dollar-denominated public debt (Tesobonos), and the real costs of the credit crunch that followed in 1995 were enormous.

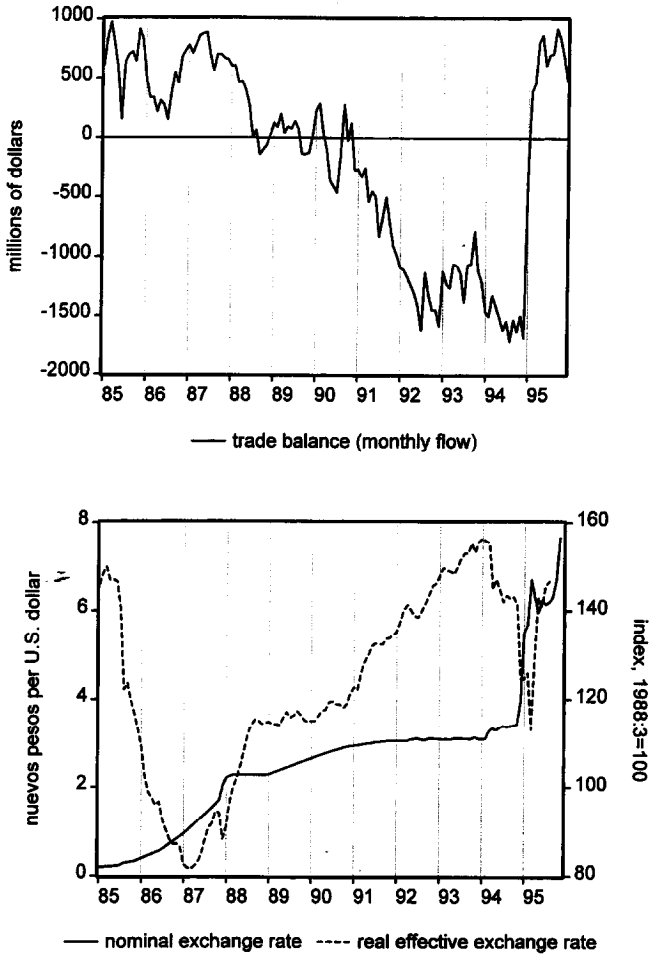

Fig. 2. The trade balance, the nominal exchange rate, and the real exchange rate.

It is also difficult to find direct evidence of backward indexation.[6] Inflation followed a highly persistent autoregressive process, as evident from Fig. 3, but this is not sufficient evidence to support the view of the sticky inflation model. Moreover, there were no across-the-board increases in real wages, as predicted by backward indexation. In fact, since an explicit objective of the pact was the removal of wage inertia by setting minimum wage increases (the benchmark for

[6]Edwards (1993) and Santaella and Vela (1994) find econometric evidence against backward indexation.

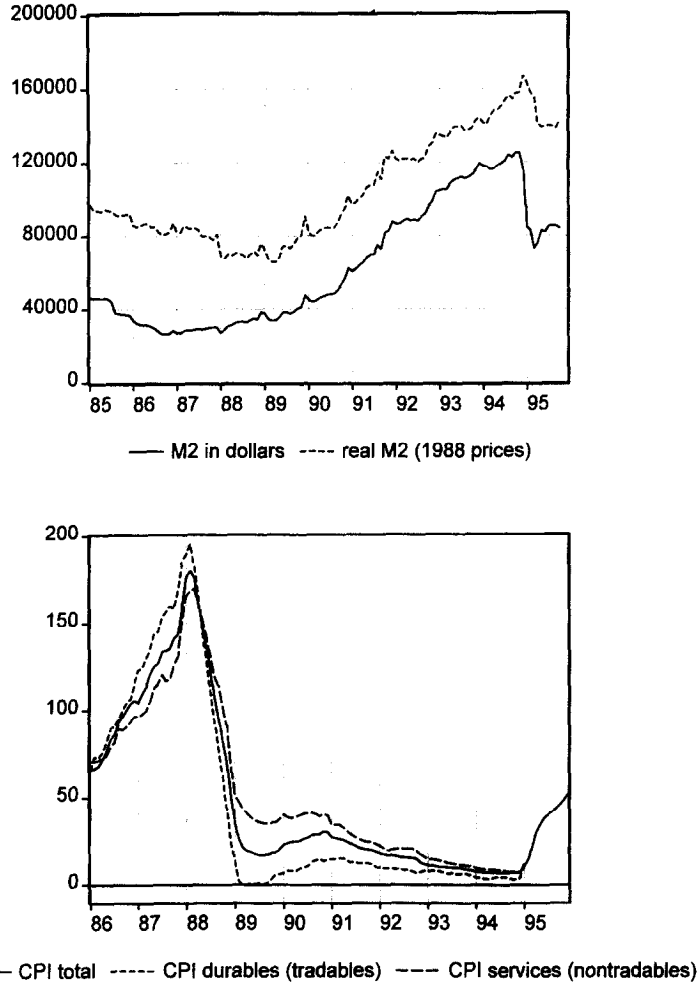

Fig. 3. M2 money balances in billions and CPI inflation (1988:3 = 100).

contractual wages) below past inflation, sectors in which salaries were directly linked to the pact experienced large real wage declines. As Calvo and Mendoza (1995) show, the average real wage in manufacturing rose 24% during 1989–1993, while average wages in construction and contractual government wages fell more than 18% in real terms.

Equilibrium theories view the trade deficit and the real appreciation as natural outcomes of transitional dynamics induced by structural reforms. These phenomena are temporary and reflect improved long-run growth prospects. Large inflows

of private foreign capital and gradual convergence of inflation to single-digit levels are given as evidence in favor of this approach. In this setting, the crisis results from large exogenous shocks. Once again, a key criticism of this view is that the December crisis refutes it. Despite the resolution of some of the political uncertainty after the presidential elections, capital inflows did not return, and the investor's decision to attack the peso and dump Tesobonos conflicts with the view of temporary shocks to a fundamentally sound economy. There is also quantitative evidence showing that equilibrium theory cannot easily account for a 60% real appreciation. In fact, this theory has serious difficulty in explaining actual real-exchange-rate dynamics (see Mendoza, 1995; Obstfeld, 1995).

A third well-known explanation for the dynamics of exchange-rate-based

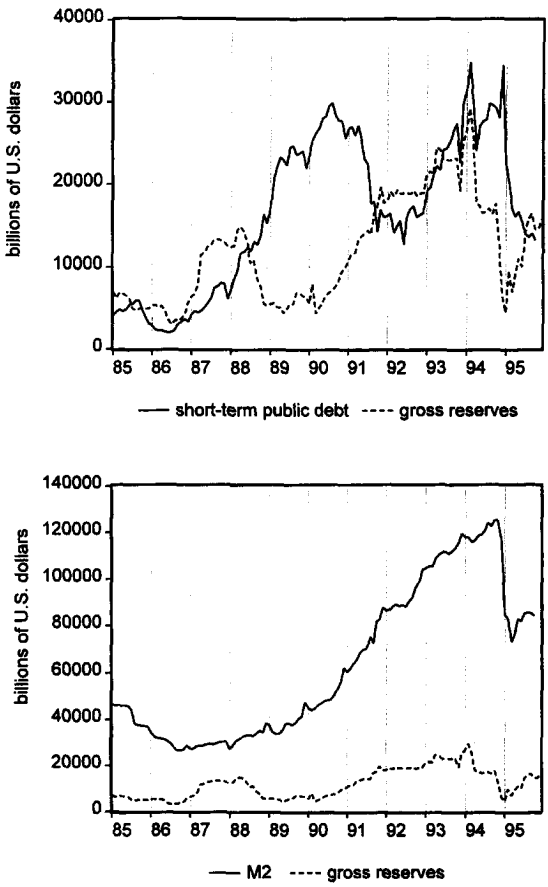

Fig. 4. Short-term public debt vs. gross reserves and M2 vs. gross reserves.

stabilizations is lack of policy credibility. Empirical studies by Calvo et al. (1995), Calvo and Mendoza (1994), Mendoza and Uribe (1996), and Rebelo and Végh (1995) provide promising results in this area. However, these models only produce the initial conditions leading to reserve losses, and do not explain runs against financial assets.

2.2. Financial vulnerability, the collapse, and the global stampede

In what follows, we take as given the above-reviewed facts and focus on key financial aspects of the crisis. First, we note that conventional explanations of the crisis based on large current account deficits and real appreciation are not very convincing because the decision to float the peso resulted from the country's inability to meet its *financial* obligations. Before the crisis there were two indicators of financial vulnerability that signaled the possibility of a BOP crisis driven by a run against domestic assets: (1) the gap between M2, valued in US dollars, and gross foreign reserves, and (2) the gap between short-term public debt held by the private sector, also in dollars, and gross reserves. These gaps are plotted in Fig. 4.

Before the devaluation, the stock of highly liquid M2 in dollars reached US$110 billion, far exceeding maximum reserves. The danger is not so much the size of this gap, but the risk that sudden and large shocks to M2 can imply a large drain of foreign reserves, thus compromising the currency peg. Calvo (1995a) shows that in countries like Austria the ratio of M2 to reserves is very large, but also very stable. It is the instability of the ratio in countries like Mexico or Argentina that is dangerous.

The large expansion of M2 in Mexico is attributed to (1) the 1988–89 far-reaching financial liberalization, which eliminated tight credit controls and reserve requirements, doubling the M2 multiplier from 4.2 in 1988 to 8 in 1994, (2) the large capital inflows starting in 1989, part of which took the form of bank deposits, and (3) the recovery of economic activity and private expenditures. The imbalance between M2 and reserves became a cause for concern because of the sharp reversal of the last two conditions that began in late 1993. To substantiate this argument, we conjecture here and prove later that M2 in Mexico is influenced by foreign capital flows and private expenditures. The effect of capital inflows is consistent with the evidence documented in Calvo et al. (1993), showing that inflows into Latin America are negatively related to changes in US interest rates and output. This explains part of the surge of capital inflows in 1989–1993 and, likewise, predicts outflows after US interest rates rose early in 1994 and clear signs of US recovery were being displayed. Since part of the inflows affected bank deposits, the adverse effect of the outflows on M2 was to be expected. The effect of private expenditures can be interpreted as the outcome of an environment in which M2 is proportional to expenditure (e.g. cash-in-advance). Thus, rising expenditures account in part for rapid M2 growth during 1988–93, and therefore

the slow-down of consumption and investment growth in 1993 should be expected to reduce M2 growth. Moreover, the effects of capital flows and expenditures on M2 may be related if, as in Mexico, capital flows result in high current account deficits, so that aggregate demand rises.

The second financial imbalance critical for understanding the excessive vulnerability of the peso is the gap between short-term public debt and reserves. The former includes peso-denominated bills (Cetes, Pagafes, and Bondes) and Tesobonos because under a nearly fixed exchange rate the monetary authority may be called upon to back all short-term public debt with foreign reserves. Three considerations are important in this regard. First, dollar debt has the additional disadvantage that it cannot be deflated by a devaluation. Second, whether the debt is held by foreign or domestic residents may also make a difference because the former do not have a liquidity motive for holding it. Third, the shorter the maturity the larger the liquidity crisis that a refusal to roll it over may generate. As argued below, the massive swap of peso-denominated bonds for Tesobonos that took place in 1994 was inappropriate in all three accounts.

From 1991 to mid-1993 short-term public debt was smaller than gross reserves. A large debt-reserves imbalance developed in 1993–94, and ended with the collapse of the currency, which occurred when Tesobonos matured and could not be rolled-over.[7] We refer to this phenomenon as a 'bonds-led speculative attack.'[8] When the crisis erupted, short-term public debt was nearly three times larger than reserves. Tesobonos alone, including commercial bank holdings, exceeded US$22 billion in December of 1994, compared with gross reserves of less than US$13 billion at the beginning of the month. By end-December, reserves fell to nearly US$6 billion, well below the critical US$10 billion set by the Bank of Mexico (see Aspe, 1995).

The policy response to large political shocks and an incipient liquidity squeeze in early 1994 was a key factor that contributed to widen the debt-reserves imbalance. During 1994, short- and long-term peso-denominated bonds were massively converted into Tesobonos. The fraction of total privately held public debt allocated to Tesobonos rose from 4 to 75% between end-1993 and end-1994 (see Fig. 5). Foreign investors acquired a larger share of the debt, as holdings of Mexican residents fell from 43 to 34%. Thus, prior to mid-1993, a refusal to roll over Tesobonos and a run on Cetes could have been met by running down international reserves, and in the event of a devaluation the mismatch debt-

[7]Interestingly, in mid-1990 Mexico also exhibited a large debt-reserves imbalance. In this instance, however, the authorities offered long-term indexed bonds (Ajustabonos) to replace a large fraction of maturing Bondes. Also, contrary to Tesobonos, Bondes were peso-denominated and held mainly by Mexican residents. Moreover, in 1990 foreign capital inflows were gaining strength, while the opposite occurred in 1994.

[8]It is interesting to note that as late as November 20, 1994, the government was not concerned by the huge Tesobonos-reserves imbalance or its ability to roll-over debt (see the statement by Aspe, 1995).

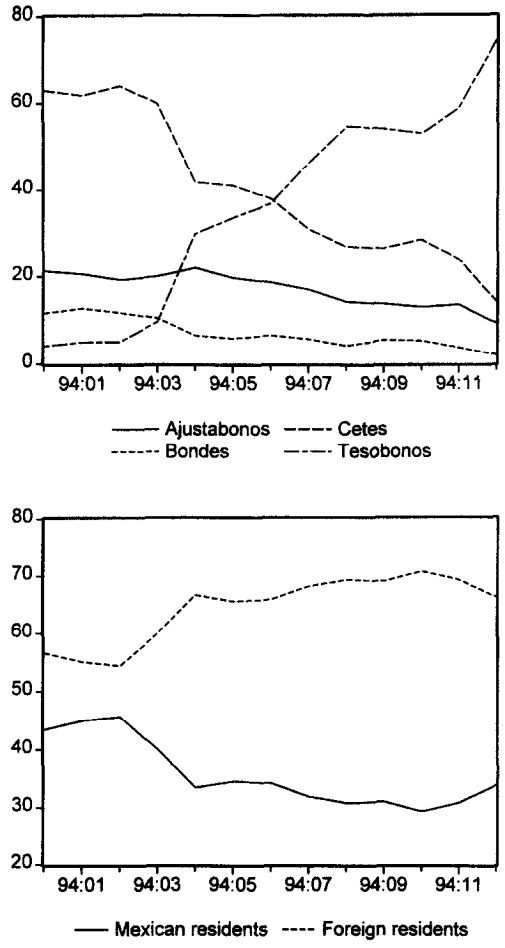

Fig. 5. Decomposition of government debt by instrument and residence of holders.

reserves would have been deflated by the fall in the dollar value of Cetes. By late 1994 these options were no longer viable.

From a simple accounting perspective, the large imbalance between debt and reserves was the result of an overexpansion of central bank credit. In the aftermath of the Colosio assassination there was a run against Cetes by banks (which entered in large repurchase agreements with the central bank) and the private sector that resulted in a loss of about US$10 billion of foreign reserves. In response, the

authorities decided to (a) sterilize the effect on the monetary base by expanding domestic credit, and (b) begin the dollarization of the debt by issuing Tesobonos to partially contain the run on Cetes. These policies were justified on the belief that the assassination was a large transitory shock. However, given the growing fragility of the banking system (as described below), one can also interpret them as aiming to prop up commercial banks during the liquidity squeeze that surged in April, when the differential between the interbank interest rate (TIIP) and the benchmark 28-day Cete rate widened sharply. The average differential climbed to 3.3 and 4.1 percentage points in the second and third quarters of 1994, compared with 1.3% in the first quarter.

In November there was a second large run on reserves and the central bank responded again with sterilized intervention and placements of Tesobonos. The TIIP–Cete differential rose to 5.6 and 9.5 percentage points in November and December, respectively. The central bank found it increasingly difficult to place new debt, until the collapse arrived December 20. The attempt at a managed devaluation failed in less than a day, and caused a final run on reserves and Tesobonos that forced the Bank of Mexico to allow the exchange rate to float.

Fig. 6 shows clearly the sterilized-intervention response to the attacks on reserves. Sterilized intervention effectively meant sharp expansions of net credit to

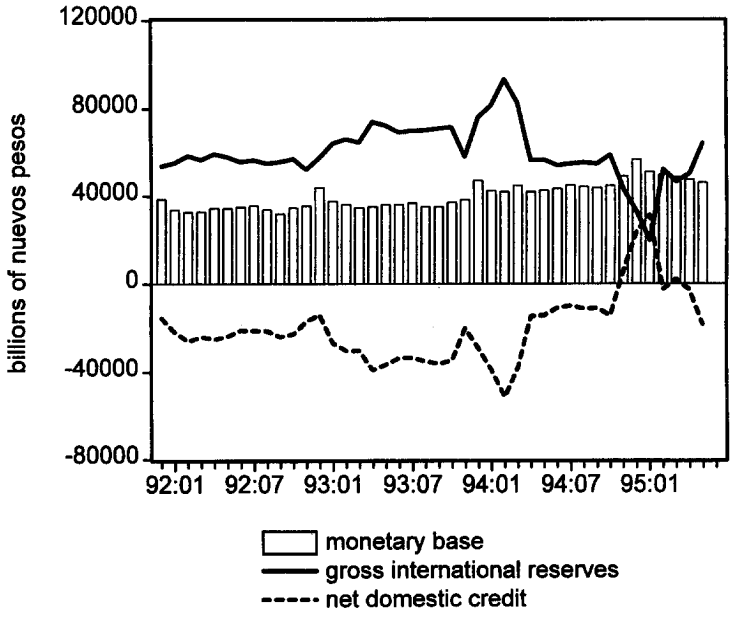

Fig. 6. Base money, foreign reserves, and net domestic credit of the Bank of Mexico.

commercial banks, with credit flows at end-April and end-December of more than N$10 and N$96 billion, respectively, relative to end-December, 1993.

Since Mexican bank liabilities are of much shorter maturity than assets (see Rojas-Suarez and Weisbrod, 1995), and non-performing assets were rising rapidly, the expectation of slower M2 growth could help to explain the widening of the TIIP–Cete differential.[9] If the central bank had not entered in as many repurchase contracts of Cetes with banks as it did, a sharp rise in interest rates would have followed. However, the policies just described prevented this from happening, and in this sense sterilized intervention contributed to continued reserve losses. It is true that sharp reserve losses coincided with large political shocks. But since in principle reserve losses could have been contained by a sufficiently large monetary contraction, sterilized intervention is the clearest proximate cause for the loss of reserves. Moreover, the critical second large attack on reserves in November cannot be easily attributed to large political shocks – in fact, the 'official version' that the devaluation was prompted by hostilities in Chiapas does not match Aspe's account (Aspe, 1995) of the attack.

The above discussion takes as given banking fragility. Explaining it in full is beyond the scope of this paper, but we argue that external effects and the perverse incentives provided to banks by the exchange rate policy and the financial reform played an important role. As described, financial reform and foreign capital inflows contributed to a large increase in the supply of loanable funds. The nearly fixed exchange rate provided the incentive to allocate those funds disregarding currency and maturity risks, as these were being implicitly transferred to the central bank. As the banks weakened, the peg became less credible since agents realized that the intent to commit effectively to it would compromise the central bank's ability to act as lender of last resort. Under pressure, the central bank either would choose to protect the banking system using sterilized intervention, and hence weaken the currency to the point that it may be devalued, or tighten monetary policy as required to maintain the peg, risking to push commercial banks into bankruptcy.

The second main component of Mexico's BOP crisis is the abrupt change of mind on the merits of Mexican investments by global investors that helps to rationalize the bonds-led speculative attack in the days and weeks after the devaluation, and the Tequila Effect (i.e. the spill-over of Mexico's crisis into emerging stock markets worldwide). In early 1994, foreign investors maintained their expectations of strong Mexican economic fundamentals despite political uncertainty and falling reserves. The currency insurance provided by Tesobonos was enough to get them to hold on to Mexican private and public debt (the share of public debt held by foreigners rose from 55 to 71% between January and October of 1994, see Fig. 5).

[9]By end-1994 the mean risk ratio of the banking system (i.e. non-performing assets in percent of capital) was 59%. Six banks had ratios exceeding 75% (the third largest, Serfin, had a ratio of 95%).

One interpretation of the second component is that investors prospects on Mexico's fundamentals *suddenly* changed, in part because of the ongoing political conflicts. However, most of the information available until the end of 1994, including the assessments of international financial organizations, praised Mexico as a country with sound policies and set for strong growth on the basis of its far-reaching reforms. In fact, on the day of the devaluation there was wide agreement that it was the right 'medicine' for the country's problems: Stanley Fischer argued that "the exchange rate adjustments...will help reinforce the economic recovery that has been evident since early 1994 and secure the viability of Mexicos external position" (IMF News Brief No. 94/18, 12/22/94). Moreover, the Tequila Effect is also seriously at odds with the view that changes in fundamentals determine investors' behavior.

There is ample evidence, although mostly anecdotal, of the run on Mexican financial assets after the devaluation. The Finance Minister Guillermo Ortiz noted in a statement to the American Chamber of Commerce that "after the devaluation, financial markets for Mexico practically disappeared, and there was a true stampede on those weeks, in which *all* Mexican public and private debt documents were literally thrown away" (*La Jornada*, July 26, 1995, translated by the authors). Mexican markets have remained extremely vulnerable to wild rumors originating at home or abroad, as vividly illustrated by the sharp fall in the peso on November 3, 1995 on unfounded rumors of a military coup and the resignation of Mr. Ortiz. A Reuters cable quoted one trader as saying "the day has been one of total anguish, we dropped as low as 7.72 pesos per dollar but now the rumors have been denied, the market breathes again." More formally, the statistical evidence of strong contagion effects provided by Calvo and Reinhart (1995) is consistent with the hypothesis of a herding panic in the days after the Mexican crash and with the Tequila Effect.

3. A model of balance-of-payments crises in the global marketplace

3.1. Death foretold: banking crises and balance-of-payments crises

In Krugman's model of BOP crises (Krugman, 1979), the exchange rate is fixed if there are reserves (R) above or at their 'critical' level (which we set at zero) otherwise, the exchange rate is allowed to float. The government runs a deficit (defined in real terms as d) that is fully monetized. Under perfect capital mobility and perfect foresight, the domestic interest rate (i) equals the international one (i^*) during the fixed-rate period, and the international interest rate *plus* the rate of devaluation, during the floating-rate period. Demand for real money balances is given by $L(i)$, with $L'(i) < 0$, and purchasing power parity (PPP) holds with zero world inflation, so that the domestic price level equals the exchange rate. During the fixed-rate period reserves fall at a rate equal to $-d$. This occurs because

money demand is constant at $L(i^*)$, and thus net domestic credit produces an excess supply of money that inflation cannot absorb because of the currency peg and PPP.

The period of smooth reserve losses ends at 'switch time' T when reserves suddenly fall to their critical level. This occurs for two reasons. First, after reserves are exhausted they can no longer be used to expand domestic credit to finance the public deficit. Instead, since the exchange rate floats and prices rise in line with the devaluation, seignorage finances the deficit. Define inflation (equal to the devaluation rate, due to PPP) as π. Then, in the floating-rate phase $\pi L(i^* + \pi) = d$. Thus, there is at T an abrupt jump in i and a sharp fall in money demand. Second, with perfect foresight the exchange rate cannot jump at any time because, if it did, individuals would reap unbounded arbitrage profits. Thus, at T the exchange rate does not appreciate or depreciate, and the sudden decline in reserves is given by $\Delta R = L(i^*) - L(i^* + \pi)$.

T is an endogenous outcome of the model determined by d. Given interest rates, d determines the inflation rate needed to finance the deficit, and thus the size of ΔR. The smooth fall in reserves at rate d lasts until there are ΔR reserves left above the critical level.

Two features of Krugman's model make it appealing for interpreting Mexico's crisis: (a) the large loss of reserves that occurs at T, preceded by gradual reserve losses, and (b) the fact that the result holds, with stable interest rates, even if the collapse is perfectly anticipated. The model fails dramatically, however, because in 1993 there was a fiscal surplus. In contrast, banks were rapidly accumulating bad loans and there were concerns for the health of the financial system. Therefore, we borrow from Calvo (1995b) a model in which the anticipation of a banking-system bailout triggers a Krugman-like attack.

Consider an episode of capital inflows, part of which are channeled through banks. If the central bank is a lender of last resort, depositors lack incentives to monitor the quality and characteristics of bank loans. In particular, they do not react to a growing maturity mismatch between long-term loans and short-term deposits. If bankers' expectations of inflation in the long run are not zero, they do not offer attractive returns on long-term deposits given the expected higher cost. Thus, the incentive structure gives rise to the maturity mismatch, and as M2 rises the central bank de facto acquires short-term obligations. In this context, a bank run forces the central bank to bail out banks, and the loss of reserves at T is augmented by the bailout.

This result is demonstrated as follows. We introduce banks which liabilities are bonds denominated in local currency and generating no *liquidity*. Assume no operations costs and no reserve requirements. Loan and deposit interest rates are identical in equilibrium, and both are equal to either (a) i^*, before T, or (b) $i^* + \pi$ after T. Let the initial stock of deposits be zero. Assume that the discovery of an endowment of natural resources, or the expected gains of structural reforms, induce agents to plan investment expenditures financed by foreign capital.

Investment goods are imported until their price-adjusted marginal productivity equals i^*. Denote the real sums involved by Z. Funds are intermediated by banks, which extend an infinite-maturity loan financed by instant maturity deposits.

A bank run is a situation in which deposits are withdrawn to buy foreign reserves. To make this possible, the central bank issues high-powered money in exchange for the banks' portfolio. After a bank run:

$$\pi L(i^* + \pi) = d - Zi^* \tag{1}$$

The fiscal deficit is reduced by the yield on the bank loan Zi^*. Furthermore, the loss of reserves at T is:

$$\Delta R = L(i^*) - L(i^* + \pi) + Z > 0 \tag{2}$$

The effect of Z is ambiguous because, by Eq. (1), it reduces the fiscal deficit and, thus, inflation after T is lower. The latter implies, by Eq. (2), that the fall in money demand at T is smaller. Thus, the loss of reserves at T is larger or smaller than in the Krugman model depending on the relative strength of two opposing forces: (a) a negative force represented by a higher demand for money after T, and (b) a positive force represented by the direct effect of a bank run of size Z. This direct effect dominates if $i^*=0$ because, by Eq. (2), π after T would then be independent of Z. Thus, by continuity, Z magnifies the fall in reserves at T if i^* is sufficiently small.

Since this does not alter the result that reserves initially decline at the rate $-d$, the result that at T reserves are suddenly depleted remains valid. In addition, since ΔR is larger, T is smaller. Therefore, the perception of an inevitable banking crisis speeds up the timing of the BOP crisis.

The above analysis is incomplete in many respects. First, it does not explain what triggers the bank run. Banks offer competitive interest rates and depositors gain nothing by withdrawing deposits. The problem is that *if there were a bank run* banks could not meet their obligations. This triggers the central bank to act as lender of last resort, which prompts the loss of reserves.[10] Second, we defined a bank run as complete depletion of bank deposits, but what if only a share φ is withdrawn at T? If no further runs are anticipated, this affects the timing of the crisis, but not the central message of the experiment. However, if φ is arbitrary and/or runs occur in stages, a multiple-equilibrium situation could arise.

The model is also incomplete as an explanation of the process leading to peso vulnerability in Mexico. Despite the strong evidence predicting that M2 *should* have collapsed in 1994 (see Section 3), the fact is that M2 remained high.

[10]This analysis resembles Diamond and Dybvig (1983). However, their story is non-monetary and relies on technological constraints. In their case, the lender of last resort (a fiscal authority that raises lump-sum taxes) is part of the solution, while here it is part of the problem.

Moreover, reserve losses reflected liquidation of Cetes, not withdrawals of bank deposits. Reinterpreting the model in terms of a run on Cetes is not difficult (see Calvo, 1995b), in essence one can add short-term public debt and interpret the model as applying to M3. Explaining how monetary aggregates are kept high despite strong pressures for a collapse is more complicated. By nature, a BOP crisis reflects reduced demand for domestic financial assets. Calvo (1995a) argues that sterilized intervention can sustain temporarily monetary aggregates, at the cost of enlarging the loss of reserves at T.

3.2. Violent death: optimal herding behavior by global investors and self-fulfilling prophesies

We now present a simple mean-variance ($\mu - \sigma$) model of optimal portfolio allocation that rationalizes the large negative reaction of global investors to the December devaluation. In this model, rational investors become extremely susceptible to 'small' news as opportunities for diversification rise. This occurs because highly diversified investors have lower incentives to acquire information than investors with fewer investment opportunities. This in turn results from the fact that as the number of countries in which to invest rises, the marginal gain from information-gathering eventually declines. Outcomes in which the equilibrium response to news is a self-fulfilling panic become plausible, and the behavior of policy-makers becomes as important as their policies (i.e. a poorly handled devaluation can have disastrous effects).

These arguments are formalized as follows. Suppose there are J countries with different investment projects, each indexed by j. Country j has the random return r^j. Unless investors spend resources in learning about a specific country, rs are perceived as independently and identically distributed (i.i.d.) processes with mean ρ and variance σ^2. The representative individual has a Von Neumann–Morgenstern utility function, U, that is quadratic in the portfolio's return. Thus, a risk-averse investor initially allocates equal amounts of wealth across countries. Assuming, without loss of generality, that he has one unit of wealth, expected return and variance are ρ and σ^2/J, respectively.

The investor hears now a 'market' rumor that country I's return has a new mean r, $r \neq \rho$, but its variance is still σ^2. Let θ be the portfolio share devoted to Countries 2, 3,..., J. Whatever amount is invested in these countries, its allocation will be constant across them. Thus, the portfolio's mean and variance are:

$$\theta\rho + (1-\theta)r \tag{3}$$

$$\left[\frac{\theta^2}{J-1} + (1-\theta^2)\right]\sigma^2 \tag{4}$$

Given the quadratic utility function, expected utility, EU, is:

$$EU = \theta\rho + (1-\theta)r - \frac{\gamma}{2}\left[\frac{\theta^2}{J-1} + (1-\theta)^2\right]\sigma^2, \quad \gamma > 0 \tag{5}$$

Maximizing Eq. (5) with respect to θ yields the following first-order condition:

$$1 + \frac{\rho - r}{\gamma\sigma^2} = \theta\frac{J}{J-1} \tag{6}$$

This framework allows us to establish two key results:

Proposition 1. As opportunities for diversification rise, the impact of 'news' on the allocation of investment funds in a single country, relative to initial allocations, grows without bound.

Proof. The change in portfolio composition is given by the implicit derivative of θ with respect to r in Eq. (6):

$$-\frac{\partial\theta}{\partial r} = \frac{J-1}{J}\frac{1}{\gamma\sigma^2} \to \frac{1}{\gamma\sigma^2} \text{ as } J \to \infty. \tag{7}$$

Prior to the 'news,' investment in Country 1 as a proportion of total investment was $1/J$. Thus, as J rises, the change in funds allocated to Country 1 as a proportion of the original investment becomes arbitrary large. □

Proposition 2. If information on asset return r can be acquired at a cost, the benefit derived from knowing r eventually declines as the number of diversification opportunities, J, rises.

Proof. Assume that by spending a fixed sum κ in learning about Country 1, an individual learns the actual realization of r^1 before choosing a portfolio. Start the analysis at the point in which r^1 is revealed, and denote its realization by r. The variance on the return in Country 1 is by definition zero. θ is now given by:

$$\theta = \frac{\rho - r}{\gamma\sigma^2}(J-1) \tag{8}$$

Ruling out short sales, $\theta = 0$ if $r \geq \rho$, and $\theta = 1$ if $r \leq r_{\min}$ where $r_{\min}$ is given by:

$$r_{\min} = \rho - \frac{\gamma\sigma^2}{J-1} \tag{9}$$

Thus, interior solutions require $r_{\min} < r < \rho$. $r_{\min}$ rises with J, and converges to ρ as J grows without bound.

By Eq. (9), in the limit as J reaches ∞, information gathering pays off (ignoring κ), only if $r \leq \rho$.[11] However, for small J, information-gathering pays off even

[11] This is so because at the limit there is a portfolio that yields ρ with full certainty.

though $r \leq \rho$ (but as long as $r \geq r_{\min}$). Furthermore, in all cases, information gathering pays off if $r > \rho$. Thus, (a) if ex post $r > \rho$, utility is the same for high- and low-diversified investors and (b) if ex post $r \leq \rho$, then only the low-diversified investor has a chance to gain from having paid for information on Country 1. Therefore, noticing that expected utility increases with J, the marginal gain from information-gathering eventually falls off as J rises. □

In sum, Propositions 1 and 2 show that (1) *investment to or away from a given country is highly sensitive to news in a world in which investors are highly diversified, and* (2) *highly diversified investors have lower incentives to learn about individual countries than investors with few opportunities to diversify.*

The above model rationalizes massive runs against domestic assets as a result of slight changes in profitability expectations. Thus, the model may explain the sudden dumping of Mexico's assets by global investors in response to small negative shocks. The devaluation could qualify as one of such shocks because it may have signaled that the new administration was less reliable than the previous one, despite its intentions to maintain previous policy guidelines. The model, however, cannot explain why the situation did not stabilize after a drop in stock market prices, which would have restored the profitability of domestic assets.

In our view, the effect of the initial run was magnified by the large stock of maturing Tesobonos. As the latter came up for redemption the only option left for government, short of default, was to seek refinancing. However, this required investors to be persuaded that the government could offer *effectively* higher rates of return on newly issued Tesobonos. Unfortunately, the latter is not accomplished by simply offering a higher rate of return. In particular, if solvency is at stake, a decline in the price of Tesobonos may have the opposite effect and add to the investors' misgivings.

How could solvency become an issue when, on the whole, Mexico had been pursuing prudent, if not tight, policies? Here is where we enter into the realm of self-fulfilling prophesies. A possible story is that Mexico was forced to adopt a draconian adjustment program in order to get international support and, thus, avoid outright default on Tesobonos. The expectation of social unrest in reaction to the required tough austerity measures, coupled with the severe political crisis and the tensions related to the Chiapas uprising, may have led investors to expect a large negative supply shock. Their consequent refusal to roll over Tesobonos at a reasonable interest rate made the strong adjustment policy inevitable, causing the economy to move to a deep-crisis equilibrium. Calvo (1995b) provides a formal model yielding this result.

4. Empirical evidence on the death foretold and monetary transmission

Our model of BOP crises relies on a monetary transmission mechanism in which expenditures and capital flows affect M2. This section provides some

econometric evidence in favor of this view, and quantifies the extent of the reserve losses that it predicted. The goal is not to assess the relevance of competing theories of the crash, but simply to provide some empirical evidence consistent with our theory.

4.1. Single-equation models of M2

Kamin and Rogers (1996) show that an error-correction model of quarterly money demand fits well Mexican data over the last decade. They also show that, despite the remarkable stability of money demand regressions (after the 1988 financial reform), actual real M2 exceeded significantly predicted M2 in 1994. This residual is the first indication that notional money demand, as predicted by the stable relationship found in the data, was weakening. Row I in Table 1 reproduces the Kamin–Rogers model. The model explains the quarterly change in real M2 as a function of the 28-day Cete rate, the annual change in the Cete rate, and the first lag in the logarithm of velocity of circulation.[12] The specification assumes a strong co-integrating relationship between velocity and the Cete rate that cannot be rejected by the data.

We identify two additional features of the behavior of M2 that are central from the perspective of our model: (1) private expenditures are significant determinants of M2, and (2) variables that proxy the effect of foreign capital inflows were significant for predicting M2 up to the first quarter of 1994. These results are reported in rows II–VI of Table 1. Consumption and investment provide useful additional information for explaining M2 not included in the variables used in row I. Examination of residual plots shows that this new information accounts for part of the 1994 residuals of the first regression. Note, however, that in reversed regressions real M2 is a significant determinant of consumption and investment. We explore issues of simultaneity and dynamic interaction between variables later in the section.

Rows IV–VI present the second result. During 1988:2–1994:1, the period of financial liberalization and large capital inflows, two widely used indicators of capital inflows (the interest rate of 3-month US Tbills or the stock of gross foreign reserves) were significant determinants of M2. The short-term elasticity of M2 with respect to the Tbill rate is nearly four times larger than that with respect to the Cete rate. This results in part from the longer maturity of Tbills (3 months) compared with Cetes (28 days). Moreover, the Tbill rate is meant to capture not only an opportunity-cost feature, but is also a proxy for the effects of capital inflows channeled through banks. This follows from the empirical evidence in Calvo et al. (1993) showing that the Tbill rate is a major determinant of capital

[12]We use quarterly national accounts indices provided in *Indicadores Económicos*. Velocity is proxied as the ratio of the GDP index divided over real M2 at consumer prices. This increases the coefficient on velocity from 0.15 in the Kamin–Rogers model to 0.19, without affecting other coefficient estimates.

Table 1
Regression models for M2 real money balances

	Explanatory variables							Adj.$R2$	SE	Sample
	CETE	DCETE	LVEL(−1)	DLINV	DLCONS	USTBILL	RESERVES			
Quarterly models										
I	−0.148	0.116	0.190					0.762	0.040	83:1–94:4
	(−5.510)*	(3.202)*	(3.451)*							
II	−0.135	0.121	0.173	0.351				0.800	0.037	83:1–94:4
	(−5.876)*	(4.190)*	(3.411)*	(3.047)*						
III	−0.141	0.130	0.178		0.813			0.778	0.039	81:1–94:4
	(−5.965)*	(4.391)*	(3.363)*		(2.239)**					
IV	−0.503	0.138	0.655			−1.989		0.861	0.032	88:2–94:1
	(−4.056)*	(3.789)*	(3.772)*			(−2.061)**				
V	−0.512	0.166	0.611				0.053	0.868	0.031	88:2–94:1
	(−3.616)*	(4.408)*	(4.270)*				(2.197)**			
Monthly model										
VI	−0.106	0.052	0.210			−0.988		0.520	0.026	88:06–94:02
	(−1.753)***	(2.607)*	(3.026)*			(−1.761)***				

The dependent variable is the quarterly change in M2/P. The explanatory variables are the 28-day Cete interest rate (CETE), the annual change in the Cete rate (DCETE), the first lag of the logarithm of velocity of circulation (LVEL(−1), the difference of the logarithm of investment (DLINV), the difference of the logarithm of private consumption (DLCONS), the interest rate on 3-month Tbills (USTBILL), and the first lag of the logarithm of gross foreign reserves minus gold (RESERVES). Velocity is proxied by the ratio of M2/P to the quarterly GDP index in the quarterly models and by the ratio of M2/P to the index of industrial production in the monthly model. Figures in parentheses are t-statistics obtained using Heteroskedastic-consistent standard errors. An asterisk denotes significance at the 1% level, two asterisks denote significance at the 5% level, and three asterisks denote significance at the 10% level. All regressions include seasonal dummies.

inflows. Alternatively, row V reports results that detect a significant effect of capital inflows on M2 using gross reserves as a more direct measure of those inflows.

Our theoretical arguments tend to view the link between M2 and capital inflows as a feature of money demand, but in the empirical tests they may also capture an effect through money supply. The intent of the tests is to show that prior to 1994 there was a stable link between M2 and capital inflows, and that on that basis a sharp contraction of M2 was predictable in 1994. The key issue of identifying whether this was a supply or demand effect is left for future work. Note, however,

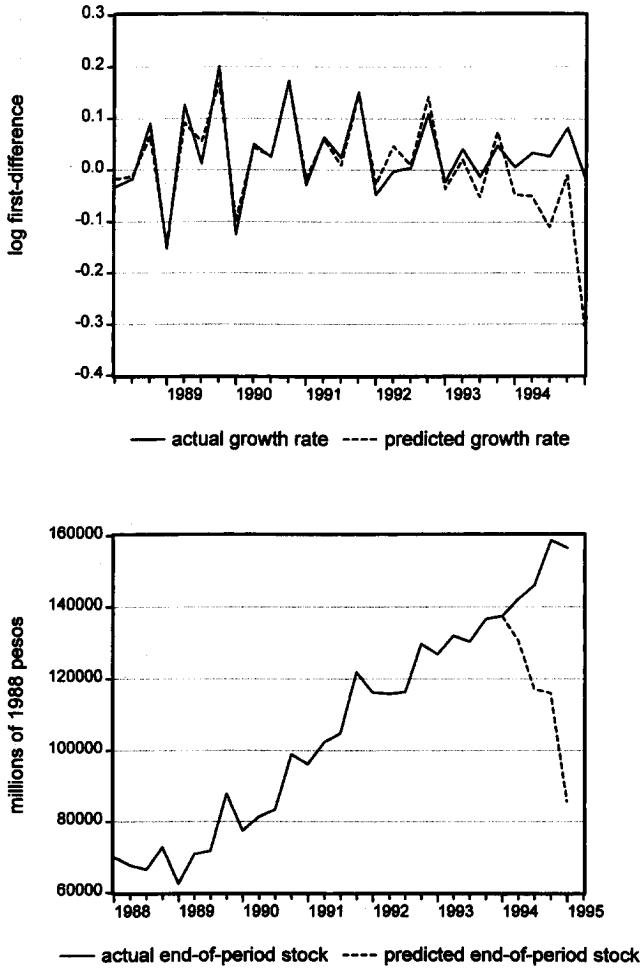

Fig. 7. Actual and predicted real M2: the death foretold.

that under a pure currency peg Hume's specie-flow mechanism implies that monetary aggregates cannot rise systematically in response to capital inflows *unless* money demand rises. In practice, the Bank of Mexico intervened at times to lessen the effect of capital inflows on domestic prices, and thus the inflows may have affected money supply.

After the first quarter of 1994, capital flows are no longer significant for explaining M2. There is such a large structural break in the aftermath of the first attack on reserves that estimating the regressions in rows IV–VI adding only an extra quarter of data fails to produce statistically significant coefficients on the Tbill rate or foreign reserves. Estimation of recursive coefficients shows that the Tbill elasticity in row IV jumps from around -2 to 0 in 1994:2. This evidence is critical to support the argument that the policies of sterilized intervention and Tesobono placements played a key role in the crisis. Fig. 7 plots the growth and level forecast of M2 based on the observed values of the right-hand-side variables in the regression of row IV, together with actual real M2. In this case, M2 residuals are much larger than in the Kamin–Rogers model, particularly in the last quarter. The M2 residuals are a good proxy of the liquidity squeeze that was temporarily avoided by sterilized intervention. Had M2 responded to its determinants as it did prior to 1994, the stock of M2 would have contracted during 1994 by the equivalent of US$12.6 billion, or nearly half of the stock of gross reserves at the beginning of the year. This would have left only US$3 billion of reserves in excess of the noted 'critical' level of US$10 billion. Therefore, there is strong evidence that Mexico was treading on very dangerous financial grounds and that a BOP crisis was by no means unlikely. On this basis, we conclude that the crisis was highly predictable. Death was foretold.

Additional important evidence on the effects of sterilization is obtained by comparing the static and dynamic relationship between net domestic credit of the central bank, reserves and base money demand, all valued in Mexican pesos. Under sterilized intervention, credit expansion is determined by exogenous reserve movements and systemic base money demand changes. Accordingly, we found strong evidence of a one-to-one static link between current net domestic credit and foreign reserves in a regression in which changes in foreign reserves, the Cete rate, and seasonal dummies explain changes in central bank credit-using instrumental variables and monthly data from January, 1992 to April, 1995.[13] In contrast, when dynamic elements are considered, using multivariate Granger-causality regressions with two lags and controlling for changes in the Cete rate, past changes in net domestic credit predict current reserve changes, but the opposite is not true.[14] Thus, the contemporaneous link between reserves and central bank credit reflects

[13]The analysis is limited to this sample because, due to recent methodological changes, consistent data are available as of 1992. The instruments are three lags of reserves and the Cete rate, the current and lagged Tbill rate, and the seasonal dummies. The coefficient on the change in reserves is -0.96 with a t-statistic of -23.54.

[14]The Chi-square statistic for credit in the reserves regression is 5.46, with a probability value of 6.5%. The same statistic for reserves in the credit regression is 3.28, with a probability value of 19.4%.

sterilized intervention, but the dynamic relationship is in line with the earlier stages of a BOP crisis, in which reserves fall gradually in response to excessive net domestic credit expansion.

4.2. Dynamic analysis of monetary transmission

The single-equation analysis of M2 featured a long-run cointegrating relationship between M2 and its determinants, and a high-frequency relationship between first differences of the variables. However, the interactions emphasized by our theory may be features of macroeconomic dynamics at the 'business cycle' frequency, which lies between the high frequency of first-differenced data and the long-run trends of cointegrating vectors. Moreover, single-equation analysis ignores the interaction among several variables that are likely to be endogenous. To address these issues, we proceed to examine whether the linkages between M2, capital flows, and expenditures found earlier are features of Mexican business cycles, and whether the direction of statistical causality in the data is consistent with our interpretation once dynamic interactions are allowed. This analysis also provides the means for studying the monetary transmission mechanism of the main instrument of monetary policy (the Cete rate) in a vector auto regression (VAR) setting similar to those typical of the recent literature on monetary transmission (see Sims, 1992).

Aware of the debates on methods for isolating cyclical components of time series, we examined the data using both a quadratic time trend (QT) and the approximate Baxter–King band-pass (BP) filter (see Calvo and Mendoza, 1995 for details). QT regressions cover the period 1983:1–1994:4 and include seasonal dummies. Augmented-Dickey–Fuller unit root tests confirmed that QT cyclical components are stationary. The BP filter isolates frequencies between 5 and 24 quarters, or 1 and 6 years, using six leads and lags in centered, weighted moving averages. This takes out seasonal components and reflects Mexico's 6-year business cycle. The BP filter was calculated extending the sample to 1980:1 so that both filters produce 48 usable observations. Since the two filters produced similar co-movements, although cycles with the BP filter were smoother and smaller, we conduct most of the analysis below using the simpler quadratic trend.

Fig. 8 plots the cyclical components of consumption, investment, and real M2. The scattered diagrams in the top part of the figure show a strong positive relationship between M2 and investment or consumption. The chart below plots the three series and shows the sizable booms in expenditures and M2 in 1984–85 and 1990–93, following the implementation of stabilization programs. Note that by mid-1993 expenditures and M2 were moving below trend. Contemporaneous correlation coefficients confirmed the strong co-movements relating M2 and expenditures. The correlations of M2 with consumption and investment are 0.48 and 0.44, respectively. There is also a strong negative correlation between M2 and the Tbill rate (at -0.5) which provides further evidence suggesting that a major driving force of capital inflows is closely related to M2.

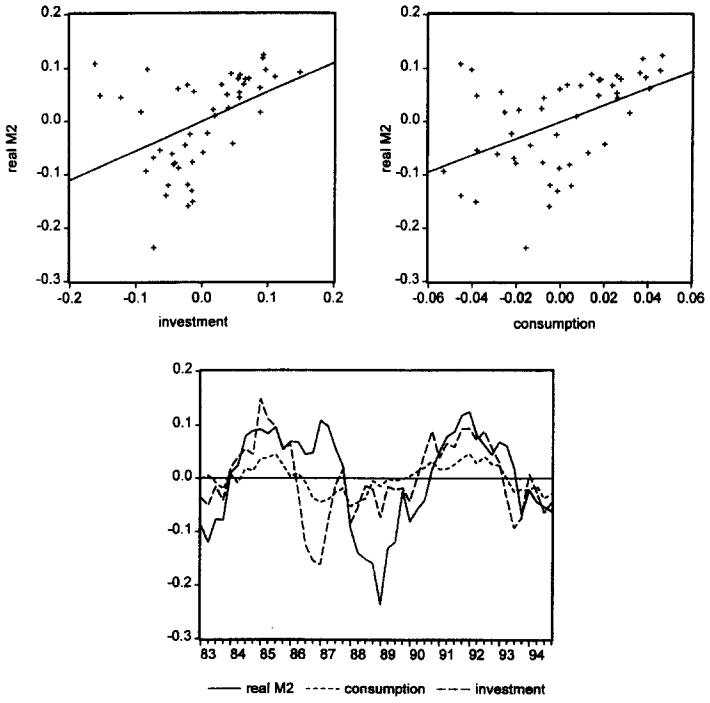

Fig. 8. Cyclical components of real M2, private consumption, and investment.

We conducted multivariate Granger causality tests to determine whether the ordering in which variables contain information relevant to predict each other is consistent with our view of the transmission mechanism, once the information of other relevant variables is considered. The tests examine the predictive power of lagged GDP, real M2 (M2/P), interest rates (CETE and USTBILL), expenditures (consumption, C, investment, I and net exports, TB), the terms of trade (TOT), and the real exchange rate (RER), to explain current values of M2/P, C, I, GDP, TB, and CETE. The regressions were estimated using two- and four-lag structures, and replacing GDP with TOT to avoid possible simultaneity bias between C, I, and GDP.[15]

The main results of causality tests are: (a) M2/P Granger-causes GDP and expenditures (particularly I), (b) GDP and expenditures do not Granger-cause M2/P, except in tests between M2 and C with two lags, (c) CETE Granger-causes M2/P, GDP, C, I, and TB, and (d) USTBILL Granger-causes CETE and M2/P

[15]Calvo and Mendoza (1995) provide complete results of the tests.

(the latter in tests with two lags).[16] These results show that the rapid cyclical expansion of real balances cannot be explained by the traditional scale effect attributed to GDP growth, and instead was predicted by capital inflows (proxied by USTBILL) and the consumption boom. The Tbill rate has a direct effect on M2, in line with the models of Table 1, but there is also an indirect effect that depends on the effect of USTBILL on CETE. Inspection of coefficient estimates shows that declines in the Tbill rate predict increases in the Cete rate, in accordance with the evidence of limited sterilization of capital inflows before 1994. The rapid growth of M2 contributes significantly to predict the booms in GDP, C, and I, and the widening trade deficit. The Cete rate and M2 also help predict the trade deficit, adding to conventional effects via faster GDP growth and real appreciation that are statistically significant.

These causality links support a cash-in-advance (CIA) framework as a first approximation to modeling money demand. This framework is consistent with M2/P Granger-causing expenditures because in it money carried over from the past pays for current purchases. The limited evidence of two-way causality between C and M2/P, and the significant effects of C and I in the M2 models, are not inconsistent with this view, since the relevant timing of transactions varies and, if the CIA constraint is binding, current expenditures should still be contemporaneously related to money holdings.

Causality from money to expenditures may also reflect credit constraints. Consider, for example, that despite financial reform equilibrium credit rationing continues because of incomplete information in an adverse-selection setting, with low-income 'good' borrowers unable to offer enough collateral to differentiate themselves from 'bad' borrowers. An expansion of the deposit base would ease credit rationing and relax credit constraints. Thus, a rise in M2/P should Granger-cause (i.e. pre-date) expenditures.

The causality tests are also useful for determining the degree of statistical exogeneity of the variables, which in turn is key in the design of the VAR model to be examined next. The VAR system includes five endogenous variables (CETE, M2/P, RER, GDP, and TB) and two exogenous variables (USTBILL and TOT). TB is used as a proxy for expenditures to keep the system small, but essentially the same results are produced using I. Similarly, the nearly fixed exchange rate and stable US inflation imply that RER captures both the dynamics of real appreciation and consumer price inflation. Akaike Information Criterion (AIC) statistics of the causality tests suggest that a 2-quarter lag structure is a parsimonious representation for the VAR. Moreover, the evidence that CETE is exogenous to domestic variables, and that M2/P is exogenous to GDP and expenditures, favors a specification in which CETE and M2/P are first in the ordering of Choleski

[16]GDP and RER are almost significant, at the 10% level with four lags, to predict CETE. Thus, CETE may reflect in part the policy-makers'reaction to the pace of economic activity and real appreciation.

decompositions. This is in line with results of variance decompositions. CETE and M2/P explain 70% of their own forecast errors after 24 quarters – although CETE explains 17% of the M2/P error.

Fig. 9 plots the VAR's impulse response functions to 1% standard-deviation shocks to CETE and M2/P. CETE impulse responses reflect the transmission mechanism of monetary policy, since the Cete rate is exogenous to any other Mexican variable. Moreover, since an element of that policy was partial steriliza-

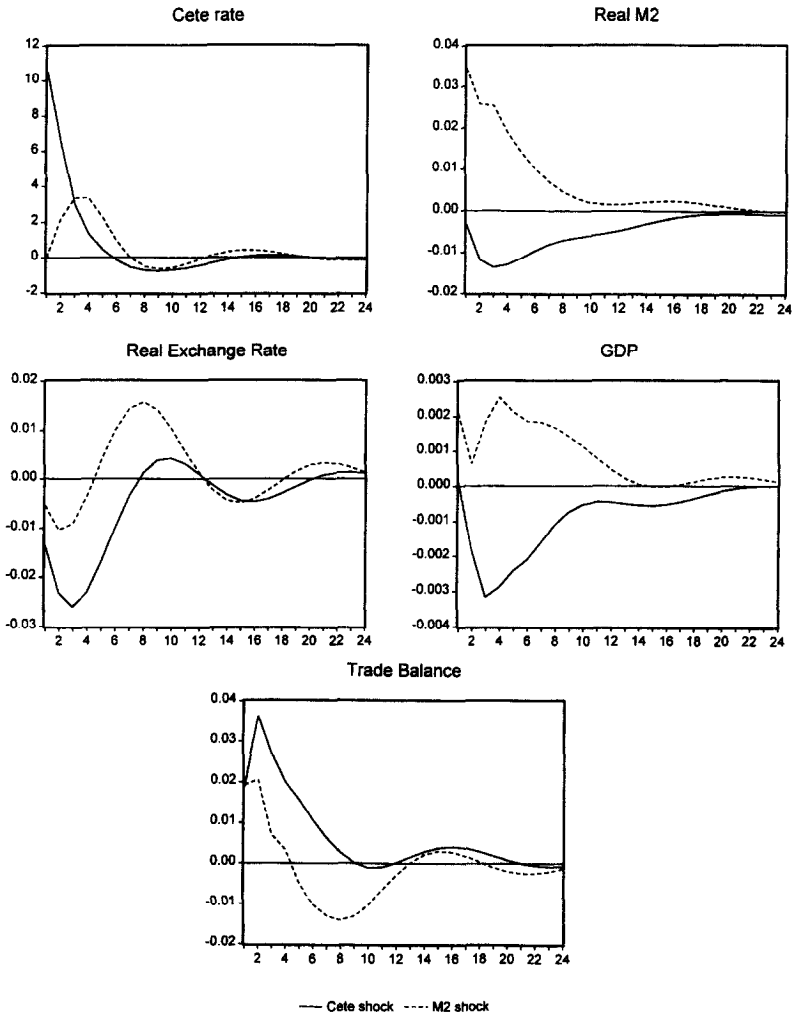

Fig. 9. Impulse response functions to CETE and M2/P shocks.

tion of capital inflows, the CETE shock also reflects in part the effects of a shock to capital inflows. An increase in CETE has significant negative effects on M2/P and GDP, and causes an improvement in TB. Since TB improves as GDP falls, absorption, and hence private expenditures, are falling. Thus, in contrast to the M2 models, the VAR accounts for the steady expansion of M2 and expenditures in 1994 as resulting from the interest-rate effect of sterilized intervention – keeping CETE below trend induces M2/P and TB to remain above trend. Interestingly, the VAR's response to a CETE shock also suggests that a sharp rise in the Cete rate, as an alternative to sterilized intervention, would have been an effective policy to address the vulnerability expressed in the large M2 imbalance, as well as the real appreciation and the large trade deficit.

The direct effect of shocks to capital inflows channeled through banks, or the liquidity surge induced by financial reform or a credibility-induced boom, are examined as an exogenous shock to M2/P. As Fig. 9 shows, this shock has positive effects on expenditures, output, and the Cete rate, and also contributes to appreciate the real exchange rate. The response of CETE is null on impact, and takes about a year to reach its peak, perhaps reflecting policy efforts to accommodate, at least temporarily, fluctuations in monetary aggregates. The real exchange rate falls on impact, but eventually appreciates sharply. Similarly net exports rise at first and after a year become negative. Thus, monetary innovations result in trade deficits, GDP and expenditure booms, and real appreciation, in line with the conjectures proposed in Section 2 and Section 3.

5. Conclusions and policy lessons

This paper argues that the Mexican crisis of December 1994 is an example of a new kind of balance-of-payments crises in the era of the global capital market. Since 1945, six fixed or nearly fixed exchange rate regimes have collapsed in Mexico, but the last episode was unique in that it occurred despite the tight policies pursued in 1988–1993. It was associated with a massive run against Tesobonos by global investors, and it spilled over into emerging markets worldwide. The severe credit contraction that followed in 1995 caused the worse recession in Mexican history and left the banking system at the brink of collapse. These events shocked advocates of the devaluation of the peso as a means for correcting the overvaluation of the real exchange rate and the large current account deficit.

Our discussion shows that a theory of Mexico-type crises could be based on two key components. First, a model explaining how banking fragility and global capital flows contribute to cause large imbalances between stocks of liquid financial assets (i.e. M2 and short-term public debt) and gross reserves in a country with a fixed exchange rate and tight fiscal policy. Second, a model of how devaluation in such a vulnerable situation leads to massive runs against financial assets, seemingly

inconsistent with a country's fundamentals. We propose two models that could form part of the new theory. A model in which anticipation of a banking-system bail out leads to an attack on foreign reserves, and a model in which standard portfolio diversification leads to herding behavior as the global market grows and gains of information-gathering diminish.

Econometric analysis provides evidence consistent with our interpretation of the process leading to currency vulnerability in Mexico. There is strong evidence that global capital flows have significant effects on M2 and that there is a strong link between money and private expenditures. A model of M2 that captures these effects predicts a sharp contraction of the quantity of money in 1994 that explains more than half of the observed loss in foreign reserves. However, the central bank's policies of sterilized intervention and Tesobono placements caused a severe structural change in the behavior of M2 and managed to sustain its growth until the devaluation. The effects of global capital flows and interest rate policy are further examined using a VAR. The evidence of the influence of world capital markets on Mexico's M2 and the close link between M2 and expenditures is robust to the addition of the VAR's complex dynamic interactions.

There are some critical policy lessons to be learned. First, close attention must be paid to indicators of financial vulnerability. Second, it must be recognized that the possibility of herding behavior is an inescapable feature of the global capital market that comes along with its well-known benefits. The costs of this herding behavior are magnified if the stock of short-term public debt is large relative to international reserves. Third, early-warning systems aimed at identifying and containing the sources of the destabilizing dynamics of exchange-rate-based stabilizations need to be developed and implemented.

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