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Comments

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1. *Introduction*

I have always found Paul Krugman's papers to be thoughtful and provocative, and this paper is no exception. It deals with an important and controversial question: Which of two sets of theories better explain current account crises—the classical theories in which such crises are determined by fundamentals, or the new theories in which, although the possibility of a crisis may be determined by fundamentals, the crisis

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itself is triggered by what journalists and finance ministers call the herd behavior of investors and economic theorists call, for want of a better term, sunspots? The first set of theories produces crises that are, in the absence of large shocks to the fundamentals, predictable. A Monday-morning quarterback can explain exactly why the crisis should have been foreseen. The second set of theories produces crises with a more arbitrary character. Although we can see the role of fundamentals in determining the conditions that allow the crises to occur, we can also imagine a different outcome.

Paul definitely favors the first set of theories, and not surprisingly—Krugman (1979) was one of the seminal papers in the development of these theories. As economists, we should all favor these sorts of theories *a priori:* ideally, economic fundamentals should pin down outcomes. Recent events, however, especially those in Mexico in 1994 and early 1995, have pushed me in the direction of the second set of theories (see Cole and Kehoe, 1995).

Although Paul's argument that, reinterpreted correctly, the classical theories can still explain the recent current account crises in Europe and Mexico did not convince me, I learned a lot from reading his paper. The next section briefly lays out what I thought to be the most important contributions of the paper. The third section critiques Paul's theory and suggests an alternative in which the economic actors recognize the dynamic nature of the model. The fourth, and final, section argues that the 1994–1995 Mexican crisis had an arbitrary character that is better explained using the second set of theories.

2. *Contributions of the Paper*

In discussing the new crisis theories that have followed the work of Obstfeld (1994), Paul distinguishes between the modeling of endogenous policy and the possibility for multiple equilibria in the models. The decision to devalue is made by a government that acts to maximize welfare in the domestic economy but cannot commit to its future actions. The government therefore faces a time-consistency problem in the sense of Kydland and Prescott (1977). As Barro and Gordon (1983) have stressed, in this sort of environment the expectations of private agents about government actions have an important feedback in determining what those actions should be.

As Paul points out, in a model with endogenous government policy, any economic variable can be a fundamental in terms of explaining a devaluation if we can imagine that variable in the government's objective function. As Paul's discussion of the European Exchange Rate Mecha-

nism crises of 1992–1993 illustrates, this greatly widens the scope for explanations of devaluations that depend on changes in fundamentals.

The theoretical emphasis in Paul's paper is on an example in which deterioration in fundamentals sharply limits the possibilities for multiple equilibria. The intuition for this example is simple. In models like that of Obstfeld (1994, 1995), the government faces a very different maximization problem if private agents have made decisions in expectation of the devaluation than it does if private agents have made decisions in expectation of maintenance of a fixed exchange rate. This opens the way for multiple equilibria: if private agents expect a devaluation, the government finds it optimal to devalue, but, if private agents expect a fixed exchange rate, the government finds it optimal to maintain that exchange rate. Suppose now, that because of deteriorating fundamentals, private agents know that there will be a devaluation on or before a fixed date T. Then this knowledge should reduce the arbitrariness of expectations in period $T - 1$, thereby reducing the possibilities for multiple equilibria. Using an ingenious argument that relies heavily on rational expectations, Paul is able to work backwards and show that a devaluation will occur as soon as it is possible to expect one. This result is, of course, in line with those in the earlier generation of crisis theories that followed Krugman (1979). Paul shows that this result can be at least partially extended to examples in which private agents are uncertain about the government's objective function and in which the deterioration of fundamentals follows a stochastic process.

3. *Critique of the Theory*

In this section I argue that what drives the results that Paul obtains in his example is a very special objective function for the government, an objective function that is very different from those employed by Barro and Gordon (1983) and by Obstfeld (1994, 1995). This is not to say that Paul's results do not make some intuitive sense nor that they are not indicative of results that might emerge from analysis of more fully specified models. In fact, I argue that deteriorating fundamentals do act to limit the possibilities for multiple equilibria in a model whose government's objective function generalizes those of Krugman and of Obstfeld, but it does not completely eliminate these possibilities.

I begin by considering a simplified version of Obstfeld's (1995) model of self-fulfilling currency crises and show that deteriorating fundamentals play no role in limiting the possibilities for multiple equilibria, at least up until the period in which devaluation is certain. In this model, which I have designed to look a lot like Paul's, there are discrete time periods and two types of economic actors, private agents and the government. To simplify the presentation, let us call periods days. Private agents take their actions in the morning. These actions depend on, and can be summarized by, the expectations that private agents have of what exchange rate the government will set in the afternoon, e_t^E. In the afternoon the government takes its actions. These actions can be summarized by the exchange rate that the government sets, e_t. In equilibrium $e_t = e_t^E$. In period t there is an exchange rate e_t^* that would be the optimal rate to set in the absence of other commitments. There is also a fixed exchange rate $\bar{e}$ to which the government has committed itself. In the first period that the government breaks this commitment by devaluing it incurs a cost of C. The government chooses e_t to minimize the static loss function

$$[a(e_t^* - e_t) + b(e_t^E - e_t)]^2 + \delta C,$$

where δ is an indicator function that takes on the value $\delta = 1$ if the government breaks its commitment to maintaining the fixed rate $\bar{e}$ and takes on the value of $\delta = 0$ if it keeps its commitment. The term $a(e_t^* - e_t)$ captures cost of deviating from the optimal rate e_t^*. In Obstfeld's model the analogous term emerges from a simple Keynesian macro model that includes the current devaluation of the currency, $e_t - e_{t-1}$. The term $b(e_t^E - e_t)$ captures the cost of having private agents make decisions based on expectations that later prove to be mistaken.

Suppose that private agents expect there to be a devaluation and set $e_t^E = e_t^*$. Then the government will, in fact, devalue and set $e_t = e_t^*$ if the cost of doing so is less than the cost of maintaining the fixed rate $e_t = \bar{e}$,

$$C < (a + b)^2(e_t - \bar{e})^2.$$

Suppose, however, private agents expect there not to be a devaluation and set $e_t^E = \bar{e}$. Then the government will only devalue and set $e_t = (ae_t^* + b\bar{e})/(a + b)$ if the cost of doing so is less than the cost of maintaining the fixed rate $e_t = \bar{e}$.

$$C < a^2(e_t^* - \bar{e})^2.$$

In the range of parameters for which

$$a^2(e_t^* - \bar{e})^2 \leq C < (a + b)^2(e_t^* - \bar{e})^2$$

there are two possible equilibria, one of which involves a self-fulfilling crisis.

Consider now the case of deteriorating fundamentals in which e_t^* increases either deterministically or stochastically. The possibility of multiple equilibria disappears as soon as e_t^* increases to the point where

$$a^2(e_t^* - \bar{e})^2 > C.$$

In the first period T in which this inequality is satisfied it is no longer rational for private agents to believe that the government will maintain its commitment to the fixed rate. The only possible equilibrium involves devaluation.

Does the knowledge that $e_T = e_T^*$ have any effect on the possibility for multiple equilibria in period $T - 1$? In this model it does not, and here Paul's argument does not work.

Suppose, however, as does Paul, that the government's static loss function is

$$[a(a_t^* - e_t) + b(e_{t+1}^E - e_t)]^2 + \delta C.$$

Implicitly, this loss function assumes that the crucial determinant of private agents' actions this morning are expectations, not of the government's actions this afternoon, but of those tomorrow afternoon. With this loss function, Paul's backward induction argument about certainty of devaluation in period T feeding back into early periods goes through.

There is, however, a minor technical problem with the specification of Paul's loss function in the case of deteriorating fundamentals, $e_{t+1}^* > e_t^*$: Even with a floating exchange rate, it is not a rational-expectations equilibrium to set $e_t = e_t^*$. Instead, e_t should be the solution to the difference equation given by the first-order condition

$$a(e_t^* - e_t) + b(e_{t-1}^E - e_t) = 0$$

and the equilibrium condition $e_{t+1}^E = e_{t+1}$. This solution is

$$e_t = \frac{b}{a + b} \sum_{s=0}^{\infty} \left[\frac{a}{a + b} \right]^s e_s^*.$$

This, of course, makes the interpretation of e_t^* problematical, but it illustrates the need for some care in labeling variables by time period t in dynamic models.

A possible defense of Paul's approach would be that Obstfeld's loss function allows no feedback of expectations about the future on the equilibrium today, and that such a feedback is a desirable feature of a dynamic model. Consider a hybrid loss function that includes both a Barro–Gordon–Obstfeld term to allow for the cost of mistaken expectations of private agents and a Krugman term to allow for the cost of expected devaluation,

$$[a(e_t^* - e_t) + b(e_t^E - e_t) + c(e_{t+1}^E - e_t)]^2 + \delta C.$$

To make the discussion simple, I will deal with the case with constant fundamentals where $e_t^* = e^*$. In the case of deteriorating fundamentals and a floating exchange rate the optimal government policy is to set

$$e_t = \frac{c}{a + c} \sum_{s=0}^{\infty} \left[\frac{a}{a + c} \right]^s e_s^*,$$

and the basic argument stays the same.

If private agents expect a devaluation and set $e_t^E = e_{t+1}^E = e^*$, then it is optimal for the government to devalue if

$$C < (a + b + c)^2(e^* - \bar{e})^2.$$

If, however, private agents expect no devaluation and set $e_t^E = e_{t+1}^E = \bar{e}$, then it is only optimal for the government to devalue if

$$C < a^2(e^* - \bar{e})^2.$$

There are multiple equilibria for parameters in the range

$$a^2(e^* - \bar{e})^2 \leq C < (a + b + c)^2(e^* - \bar{e})^2.$$

In this model is a feedback of expectations about the future on the equilibrium today. To see this, suppose that, for one reason or another, private agents know that the exchange rate will be floating in period T and therefore set $e_T^E = e^*$. If these agents also set $e_{T-1}^E = e^*$, then it is optimal for the government to devalue if

$$C < (a + b + c)^2(e^* - \bar{e})^2.$$

If, however, they set $e_{T-1}^E = \bar{e}$, then it is only optimal for the government to devalue if

$$C < (a + c)^2(e^* - \bar{e})^2.$$

Although certainty about devaluation tomorrow does limit possibilities for multiple equilibria today, it does not completely eliminate these possibilities: For parameters in the range

$$a^2(e^* - e)^2 \leq C < (a + c)^2(e^* - \bar{e})^2$$

multiple equilibria are possible if e_T^E is not pinned down by fundamentals, but multiple equilibria are not possible if $e_T^E = e^*$. For parameters in the range

$$(a + c)^2(e^* - \bar{e})^2 \leq C < (a + b + c)^2(e^* - \bar{e})^2,$$

however, multiple equilibria are possible whether e_T^E is pinned down by fundamentals or not.

There is probably little to be gained from further discussion along these lines. Both Paul's and Obstfeld's (1994, 1995) analysis use minimization of a static loss function as a reduced form for maximization of an intertemporal objective function. Paul's loss function is special because it does not include any cost of private agents' being wrong in the current period. Obstfeld's loss function is special because expectations about the future play no role in determining equilibrium in the current period. Which of these models better approximates a fully dynamic equilibrium model? There is little way to tell without constructing a model in which the economic actors actually recognize the intertemporal nature of the model.

4. *Critique of the Evidence*

In his paper Paul uses his proposed theory to analyze the European ERM crises of 1992–1993. In this section I use the critique of his theory presented in the previous section to analyze the 1994–1995 Mexican crisis. I distinguish between two components of this crisis: the devaluation of December 20–22, 1994 and the failure of the Mexican government bond auctions in late December 1994 and January 1995. The devaluation was the result of a combination of an unprecedented sequence of shocks to the Mexican political and economic system together with government policies that treated these shocks as transitory. This component of the crisis can be analyzed using Paul's model of stochastically deteriorating fundamentals. As I have argued in the previous section, however, there is no reason to suppose that the devaluation should have been fully

expected when it finally occurred. The failure of the Mexican government bond auctions was the result of a debt management policy during 1994 that allowed much of the Mexican government debt to become short-term and dollar-indexed. Currently, the best theory for analyzing this component of the crisis relies on the multiple equilibria feature of the new crisis theories.

In 1994, as it had in 1992 and 1993, Mexico ran a large current-account deficit. What changed in 1994 was the level of foreign portfolio investment. 1994 was a difficult year politically for Mexico: there was an uprising in Chiapas in January; the presidential candidate of the ruling Partido Revolucionario Institutional (PRI), Luis Donaldo Colosio Murrieta, was assassinated in March; the Secretary of the Interior, Jorge Carpizo McGregor, who had been charged with ensuring honest elections in August, threatened to resign in June; the Secretary General of the PRI, Jose Francisco Ruiz Massieu, was assassinated in September; Ruiz Massieu's brother Mario resigned as assistant attorney general in November, charging a high-level coverup of the assassination within the PRI; and there were threats of new uprisings in Chiapas in November and December. I find it hard to agree with Paul's assertion that international financial markets should not have been surprised by these events: Colosio's assassination was the first major political assassination in Mexico since that of Alvaro Obregón in 1928.

The political uncertainty generated by these events, combined with rising interest rates that made the United States a more attractive investment target, resulted in a substantial drop in foreign investment: foreign portfolio investment in Mexico fell from USD 28.4 billion in 1993 to USD 8.2 billion in 1994. (It is worth noting, however, that foreign direct investment actually rose from USD 4.9 billion to USD 8.0 billion.)

Perhaps even more significantly, there were presidential elections in August, with the new president, Ernesto Zedillo Ponce de León, who had replaced Colosio as the PRI candidate, taking office in December. The change of government was, as it has been every six years in Mexico since 1928, a time of great uncertainty. At the end of each of the previous three administrations—in 1976, 1982, and 1987—there had been large devaluations. Mexicans and foreign investors had come to associate ends of presidential terms with devaluations.

In the face of the drop in foreign investment, the administration of President Carlos Salinas de Gortari continued to maintain the value of the peso against the dollar. There were good reasons to do so, at least during the first half of 1994. A series of social pacts negotiated between leaders of government, business, and labor had, since 1987, set a policy of a maximum allowable rate of depreciation of the peso against the

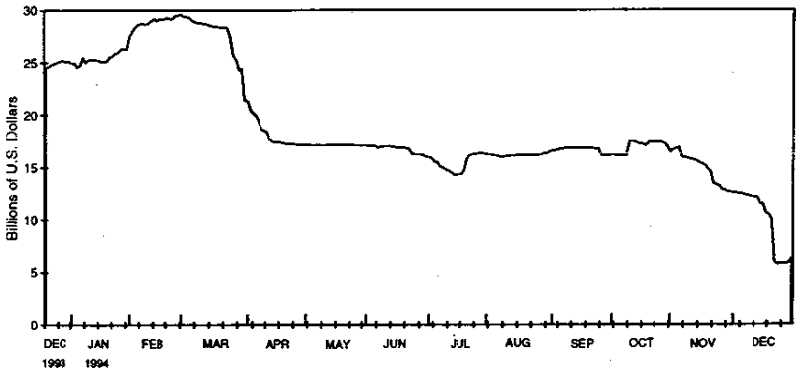
dollar. This policy had resulted in a decline in the rate of inflation in Mexico from 159.2% in 1987 to 7.1% in 1994. At the same time real wages, which had fallen sharply following the 1982 financial crisis, rose by more than 20% between 1987 and 1994.

To the extent to which the Salinas administration believed that the shocks that buffeted Mexico in 1994 were transitory, it was justified in selling the Banco de México's foreign reserves to insulate Mexico from these shocks. At the same time that Mexicans and foreigners were selling pesos for dollars, the Banco de México was sterilizing by reissuing the pesos. This policy was designed to promote a stable money supply and interest rates. With elections upcoming in August, it is easy to understand why these sorts of policies were attractive during the first three quarters of 1994.

Policy judgments often involve calculated risks, and poor judgments are far easier to identify if there is a run of bad luck than if there is not. As political shocks continued to hit Mexico during the fall of 1994, foreign reserves fell to dangerously low levels. November was a crucial month: it was in that month that foreign reserves fell below the Mexican monetary base, and on November 18 alone the Banco de México had to sell USD 1.7 billion to maintain the value of the peso.

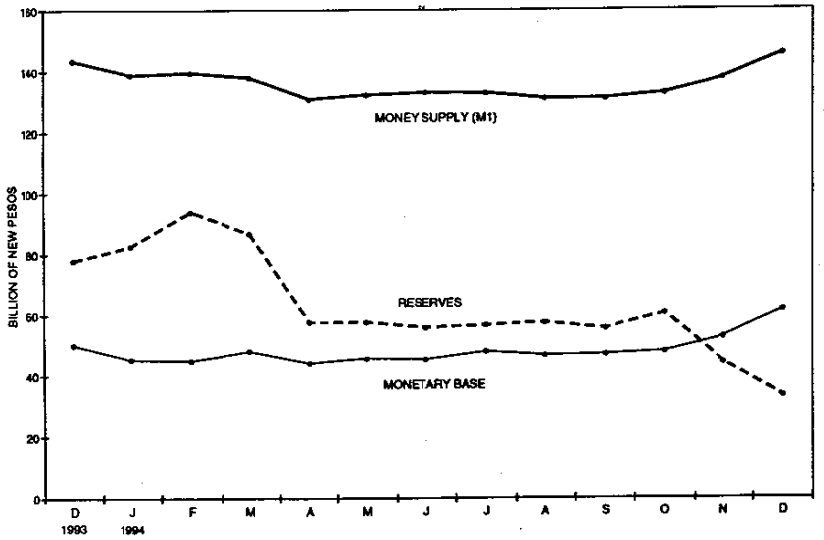
Figure 1 traces out the behavior of foreign reserves held by the Banco de México during 1994. It is worth noting that the Banco de México made significant interventions in the peso–dollar markets only during six brief periods: January 19–February 11, following Mexico's entry into NAFTA,

Figure 1 MEXICAN INTERNATIONAL RESERVES: DECEMBER 1993–DECEMBER 1994



Daily data.
Source: Mancera, *Wall Street Journal*, January 31, 1995.

Figure 2 MEXICAN INTERNATIONAL RESERVES VS. MONEY SUPPLY: DECEMBER 1993–DECEMBER 1994



Source: Secretaría de Hacienda y Crédito Público.

when despite the uprising in Chiapas, the Banco de México had to buy USD 4.2 billion to keep the value of the peso down; March 25–April 21, following Colosio's assassination, when it had to sell USD 10.4 billion to keep the value of the peso up; June 23–July 12, during the uncertainty over the Carpizo resignation, when it sold USD 2.7 billion; November 14–23, during Mario Ruiz Massieu's allegations of a coverup of his brother's assassination, when it sold USD 3.6 billion; December 15–19, during threats of a new uprising in Chiapas, when it sold USD 1.8 billion; and December 20–21, during the first stage of devaluation, when it sold USD 4.6 billion. During these six periods the Banco de México intervened on a total of 53 days. During all of the rest of 1994 the Banco de México only intervened on 18 days, selling a total of USD 1.2 billion. (All of these data are taken from Banco de México, 1995.)

Figure 2 illustrates the response of monetary policy to the decline in reserves: the Banco de México sterilized, in January and February, by contracting domestic credit to keep the money supply down as it sold pesos for dollars, and, later, by expanding domestic credit to keep the money supply up as it bought pesos with dollars. This policy helped insulate the Mexican domestic economy, in particular the banking indus-

try, from a sharp decline in the money supply that would have otherwise resulted in the drop in foreign portfolio investment. In 1994 the Mexican banking industry, which had expanded rapidly following its privatization in 1991, was in fragile condition: nonperforming loans had risen from 2.3% of total loans in 1990 to 9.5% by the end of 1994.

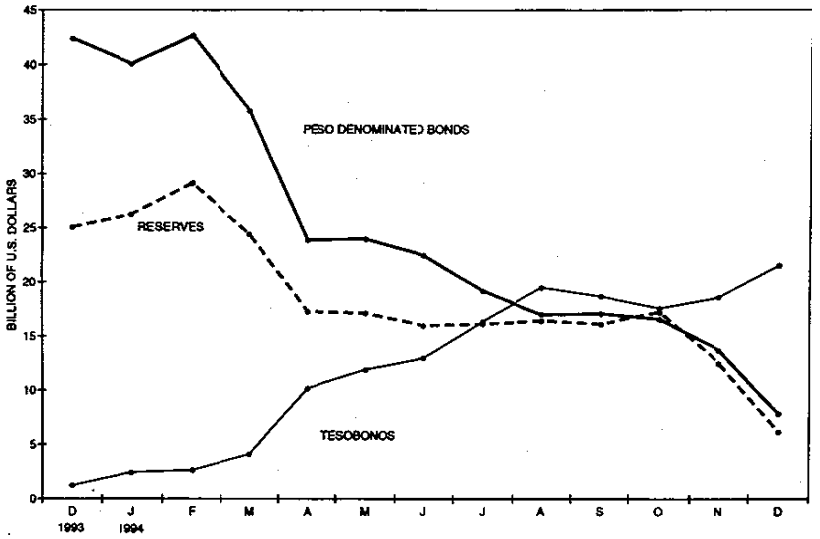
In retrospect, Mexican monetary policy during 1994 can be viewed as a calculated gamble: The Salinas administration reacted to the shocks that led to falls in foreign portfolio investment as though each shock had been the last that would occur. In particular, it ran down foreign reserves in an effort to keep both the exchange rate and the domestic money supply constant. Unfortunately, the shocks kept occurring, and, absent a sharp tightening of monetary policy in the fall of 1994, Mexico was eventually forced to let the peso devalue.

The devaluation occurred more or less simultaneously with, and perhaps touched off, a debt crisis in which the Mexican government found itself unable to roll over its debt. Fears of a default of one sort or another totally paralyzed the economy in late December 1994 and January 1995. It is this second aspect of the crisis that helps explain why Mexico did not emerge stronger after the devaluation, as had European countries following the ERM crisis and as observers like Dornbusch and Werner (1994) had predicted it would.

Mexican government debt can be divided into two broad categories: domestic debt and external debt. This division has nothing to do with who holds the debt; rather it depends on where it is sold. Domestic debt is sold at auctions held by the Banco de México, while external debt is sold abroad. The debt crisis was caused by a run on domestic debt. Although yields on such external debt instruments as Brady bonds increased sharply on secondary markets during the crisis, Mexican external debt has a long maturity structure. The immediate danger of default was the result of the short maturity structure of the domestic debt.

Following the assassination of Colosio in March, the Mexican government steadily converted its domestic debt from peso-denominated *cetes*, *bondes*, and *adjustabonos* into short-term, dollar-indexed *tesobonos*, as depicted in Figure 3. In the second week of March 1994, due to uncertainty about the situation in Chiapas and a possible independent presidential campaign by Manuel Camacho Solís, who had been edged out as the PRI candidate by Colosio, the peso had begun to fall against the dollar. The assassination sharply accelerated this fall, and the peso moved from the bottom to the top of its trading band, devaluing by almost 8 percent over a month. This drop in the value of the peso led to a sharp increase in Mexican interest rates with a resulting drop in the prices of Mexican bonds and equities.

Figure 3 MEXICAN INTERNATIONAL RESERVES VS. GOVERNMENT BONDS: DECEMBER 1993–DECEMBER 1994



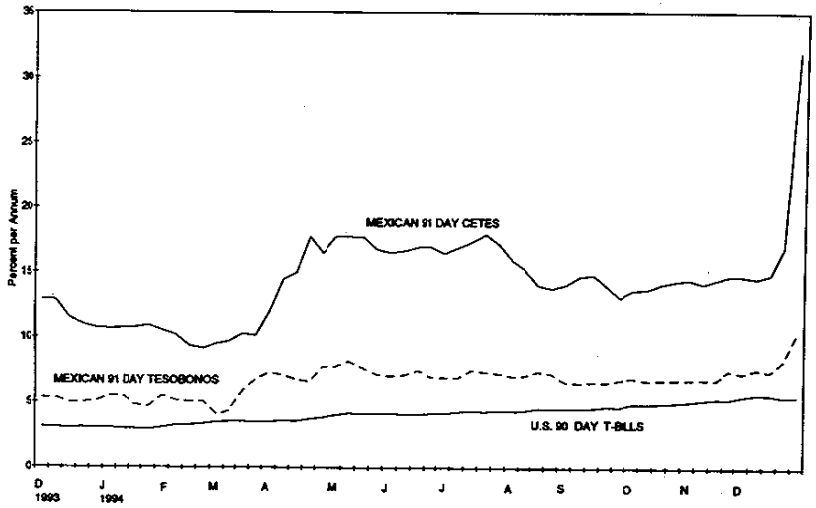
Source: Secretaría de Hacienda y Crédito Público.

The movement away from the peso-denominated debt into short-term, dollar-indexed debt helped to shield debt holders from exchange-rate risk. It also allowed the Mexican government to borrow at substantially lower interest rates, as shown in Figure 4. The movement in the composition of the debt had two adverse effects on Mexican government finances, however: it exposed the government to far more exchange-rate risk, and it sharply reduced the already short maturity structure of the debt.

Following the December 20–22 devaluation, rumors abounded that the Mexican government would impose dual exchange rates, paying off *tesobonos* at an official rate lower than the market rate. It did not take too long a memory to recall that the Mexican government had resorted to similar policies during the 1982 financial crisis. The *tesobono* auctions of December 27, January 3, and January 10 were complete failures: the Banco de México was able to sell only USD 143 million worth of bonds out of USD 1.5 billion offered.

Calvo and Mendoza (1995), Cole and Kehoe (1995), and Sachs, Tornell, and Velasco (1995) all argue that the Mexican debt crisis can be best understood in terms of models with multiple equilibria: Investors feared

Figure 4 MEXICAN AND U.S. GOVERNMMENT BONDS: DECEMBER 1993–DECEMBER 1994



Source: Bloomberg Financial Market.

that Mexico would be unable to honor its commitments on bonds becoming due. These fears made these investors unwilling to purchase new bonds. The resulting failure of the government's auctions put the government into a position where default seemed inevitable, thereby justifying the expectations that the Mexican government would be unable to honor its commitments. Had these expectations not been present, however, no crisis would have occurred.

To explain the logic of this approach, I will briefly sketch out the Cole–Kehoe model and its central results. This model has three sorts of actors: domestic consumers, who make consumption and investment decisions; foreign investors who purchase government debt and are risk-neutral, reflecting the small size of the country relative to world capital markets; and a government which taxes, spends on public goods, offers new bonds for sale, and decides whether or not to honor commitments on old bonds. The central actor in the model is the government. Cole and Kehoe (1995) model the government as benevolent in that it seeks to maximize the welfare of the domestic consumers; they show, however, how it is also possible to model the government as more impatient than consumers or international investors. The consumers', and government's, welfare depends both on private consumption and on provision of the public good.

The government cannot commit to repaying its debt; all of the actors know that the government resolves its maximization problem every period. If the expected present value of defaulting exceeds that of repaying old debt, the government will default. If the government defaults, the country is subject to a penalty that results in a decline in domestic productivity. This penalty reflects, for example, the large distortion created by the imposition of dual exchange rates. In the model, for high enough levels of government debt, a crisis can occur depending on the realization of a random event that is extrinsic to the fundamentals of the model, a sunspot variable. An unfavorable realization of this sunspot variable can lead to a panic in which the international investors are unwilling to purchase new government debt. This panic is rational if the failure of the new-debt auction puts the government in a situation where it prefers to default. At the same time, however, the panic is somewhat arbitrary because a favorable realization of the sunspot variable would not lead to a panic, the government would be able to sell its new debt, and no crisis would occur.

In this model a self-fulfilling crisis is possible if the government would choose to default if no new borrowing were possible, but would choose to honor its commitments if new borrowing were possible. Cole and Kehoe (1995) show that, if a crisis is possible, the probability of its occurrence is arbitrary: for any probability of an unfavorable realization of the sunspot variable, there is a different equilibrium. Although Cole and Kehoe model the crisis as dependent on a sunspot variable, it is also possible to model it as dependent on a random event connected to the fundamentals, such as political shock. The essential point is that there are multiple equilibria: there is an equilibrium in which the shock touches off a crisis and there is an equilibrium in which it does not.

The crucial insight of the model is that the government finds itself in a far different position if it cannot sell its new bonds than if it can. If the level of government debt is low compared to its ability to raise revenue, however, these positions are not very different: the government will choose to repay its debt and to avoid the default penalty whether or not new borrowing is possible. Similarly, if the maturity structure of the debt is long enough, these positions are not very different: with government debt of long maturity little new borrowing has to be done in any one period.

Paul makes the point that self-fulfilling-crisis models are a concession by economic theorists to the government officials in countries subject to speculative attacks who complain about nefarious forces, herd behavior, and so on. If so, it is a limited concession. These models, like the Cole–Kehoe model just sketched out, tend to say that it is government policy that puts a country into a situation where such an attack can succeed. Alternative government policies can eliminate the possibility of a self-fulfilling crisis.

It is worth returning to one final point discussed by Paul: Obstfeld and Rogoff (1995) have argued in favor of self-fulfilling-crisis models by showing that interest premia are often low before the attack takes place. Figure 4 shows the relevant data for Mexico in 1994, which indicate that neither the devaluation, which decreased the value of *cetes*, nor the debt crisis, which decreased the value of *tesobonos*, were anticipated by financial markets. Paul characterizes Obstfeld and Rogoff's argument as ingenious but dismisses it because of its heavy reliance on the assumption of rational expectations on the part of investors. This heavy reliance on rational expectations is present in most theories of crises, however, including Paul's own.

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