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Credibility, Reputation, and the Mexican Peso Crisis

A model emphasizing the trade-off between the costs of changes of domestic interest rates and exchange rate stability is used to assess the role of credibility and reputational factors in the lead-up to the December 1994 crisis of the Mexican peso. Devaluation expectations are decomposed into the probability that the authorities do not truly put a high weight on exchange rate stability and the probability that an exogenous shock will make a devaluation the preferred policy. Estimates indicate that prior to the peso collapse there was no significant increase in devaluation fears and no perceived shift in the authorities' policy preferences. But the increase in the differential that occurred after the devaluation may have resulted from such a shift.

AMONG THE FACTORS UNDERLYING the December 20, 1994, collapse of the Mexican peso, the role of economic fundamentals remains a matter of debate. While some commentators have stressed the role of loose fiscal policies and growing real appreciation, others have emphasized the role of political instability and external factors, such as the increase in interest rates in the United States.[1] This paper attempts to contribute to the ongoing debate by assessing the extent to which economic fundamentals affected the credibility of Mexican policymakers and exchange rate expectations in the period leading to the peso collapse. The notion of credibility on which the analysis dwells is viewed, as in Drazen and Masson (1994) and Masson (1995), as consisting of two elements: an assessment of the policymaker's "type" (which could be termed reputation), and (given the type of policymaker) an assessment of the probability that a policymaker will actually decide to stick to announced policies in the presence of adverse shocks.[2] In the context considered here, the policy commitment is to maintain an exchange rate peg in the face of shocks to reserves.

The authors thank, without implication, Alex Cukierman, Robert Flood, Linda Goldberg, Dale Henderson, Steven Kamin, Mohsin Khan, Julio Santaella, Brian Stuart, Andrés Velasco, Alezandro Werner, and two anonymous referees for helpful discussions and comments, Jeffrey Frankel for providing some of the data used here, and Brooks Calvo for research assistance. The paper has also benefitted from comments of participants at seminars at the University of Maryland, and at Strathclyde and Tilburg Universities.

1. An overview of the events leading to the Mexican peso crisis is provided by Masson and Agénor (1996). See also Calvo and Mendoza (1996), and Sachs, Tornell, and Velasco (1995).

2. The notion of credibility used here is by no means the only possible one. Cukierman and Liviatan (1991), for instance, use an alternative concept according to which credibility is defined as the ability of the government to precommit its actions—that is, its capacity to convince private agents that it will carry out policies that may be time inconsistent.

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Journal of Money, Credit, and Banking, Vol. 31, No. 1 (February 1999)

The paper proceeds as follows. Section 1 reviews the evolution of exchange rate expectations in the lead-up to the December crisis. Section 2 presents the model through which the effect of credibility and reputational considerations on the formation of devaluation expectations is captured. The policy loss function emphasizes the trade-off between the cost of changes in the nominal exchange rate (through for instance its effect on inflation) and deviations in domestic interest rates (which are determined from money market equilibrium) from their desired level. Estimates of the model using a Kalman filter technique are provided in section 3. Finally, section 4 summarizes the results of the analysis and discusses some possible explanations for the collapse of confidence following the December 20 devaluation.

1. EXCHANGE RATE EXPECTATIONS

Exchange rate expectations in the period leading to the collapse of the Mexican peso can be measured in two ways. The first approach is to use a direct measure of the expected rate of depreciation of the peso, derived from the monthly survey of some major participants in international financial markets conducted by the *Currency Forecasters' Digest.*[3] The second and more general approach, because it includes all market participants, is to use as a measure of currency risk the differential between interest rates on Cetes assets (short-term treasury bills denominated in pesos) and Tesobonos (short-term dollar liabilities repayable in pesos) issued by the Mexican government.[4]

Figure 1 shows that survey-based expectations reflected a growing perceived risk of devaluation between November 1993 and August 1994—that is, until the time of the presidential election. Devaluation expectations rose significantly in September (at a time when there were rumors of a possible change in exchange rate policy) but were sharply revised downward in October 1994. Figure 2 indicates that the Cetes-Tesobono interest rate differential fell from a peak of about 10 percent in early November 1993 to about 3 percent in early April 1994. The perceived currency risk appears to have been significantly influenced by a series of adverse political events (unrest in Chiapas in January and the assassination of presidential candidate Luis D. Colosio in March), which brought the Mexican peso under severe pressure in the first half of 1994. The differential rose above ten percentage points in April and remained high until the presidential election in August. Again, however, this measure of devaluation expectations declined in the following month and displayed little fluctuation until December.

Two sets of factors may help explain why both measures of currency risk indicate

3. The *Currency Forecasters' Digest* (which is now the *Financial Times Currency Forecasters*) publishes currency forecasts (as well as indicators of forecasting risks) received from multinational companies, commercial and investment banks, and companies providing forecasting services. The data we use are those related to the "consensus" forecast.

4. At times, the interbank interest rate may be a better measure of short-term interest rates on peso-dominated assets than the Cetes rate, because of liquidity factors. Overall, however, differences in the two series are relatively small.

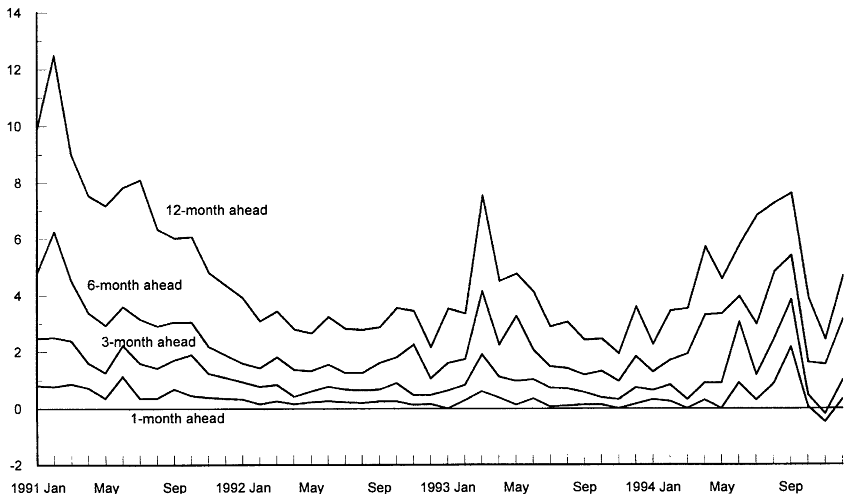

FIG. 1. Mexico: Expected Depreciation Rate of the Peso, January 1991–December 1994. Source: *Currency Forecasters' Digest,* various issues.

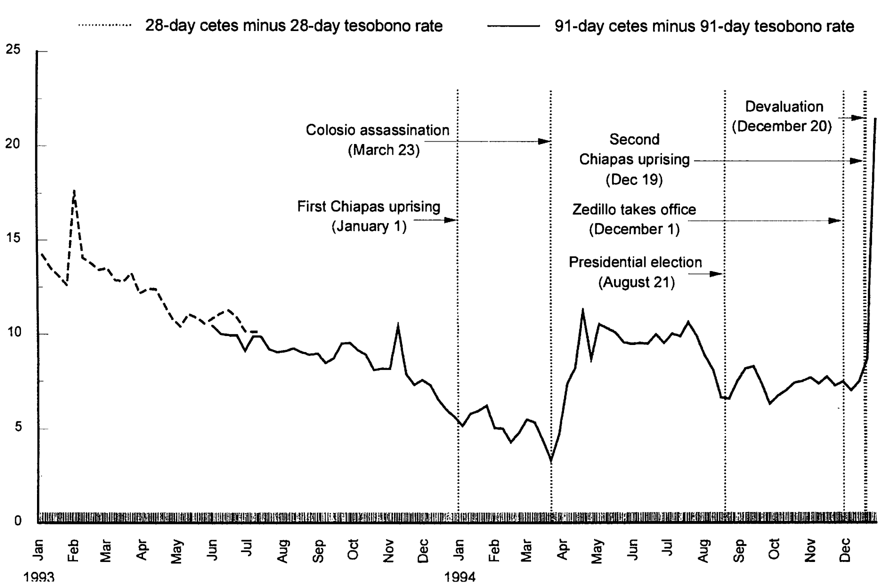

FIG. 2. Mexico: Currency Risk Indication (monthly averages of weekly auction rates, in percent). Source: Data obtained from Jeffrey Frankel, Merrill Lynch, Bloomberg, Inc., and Bank of Mexico.

relatively subdued devaluation expectations just prior to the peso collapse.[5] First, it may be that investors perceived economic fundamentals to be improving, since the real exchange rate (after the sizable appreciation that occurred during 1988–93) began to depreciate in early 1994.[6] Second, investors may have been reassured regarding the commitment of the newly elected president and his team to the announced exchange rate policy. The exchange rate anchor was indeed an important element of the adjustment program implemented by the previous government in the late 1980s (see Calvo and Mendoza (1996)), and the newly elected president was himself a member of that team. The drop in the Cetes-Tesobonos interest rate differential from an average of about 10 percent between April and July 1994 to about 7 percent between August and early December may thus be viewed as reflecting increased confidence in the authorities, as well as reduced concern about political instability. The analysis below attempts to disentangle the effects of economic fundamentals and confidence in the intentions of the authorities on the evolution of devaluation expectations.

2. A MODEL OF EXCHANGE RATE CREDIBILITY

In what follows we present a simple model that captures the effect of credibility and reputational factors on exchange rate expectations. Its essential features are uncertainty about policymakers' preferences and exogenous shocks that directly or indirectly affect the variables that enter into those preference functions. Specifically, the model posits an objective, or loss, function guiding the actions of the authorities in the face of domestic or external shocks—in particular, the choice of whether to devalue or not, relative to the preannounced path for the exchange rate. Devaluation expectations will thus reflect assessments about the policymaker's "type," as captured by the relative weights that the authorities attach to each of their policy objectives, which are not known by private agents. In addition, private agents—knowing that random shocks hitting, say, foreign reserves, will alter the balance of costs and benefits associated with a parity adjustment relative to maintaining the exchange rate path—will reevaluate on the basis of observed variables the probabilities that a particular type of government will decide to devalue in the future. Put differently, if there is persistence in the effects of policies, then a restrictive policy carried out today may make it less likely that such a policy will be continued in the future.[7]

5. A third factor, which has been emphasized by Werner (1996), is that movements in the Cetes-Tesobonos differential may have been moderated by the large increase in the outstanding stock of Tesobonos in the second and third quarters of 1994. As discussed below, we do not find much evidence in favor of this effect. Nevertheless, as noted by Calvo and Mendoza (1995), the switch from peso-denominated assets to dollar-denominated securities may have increased (at least initially) incentives to absorb government debt by reducing the risk associated with a potentially large devaluation.

6. The lack of relevant and timely data on some important macroeconomic aggregates (such as government spending and the level of foreign currency reserves) may have hampered investors' assessment of Mexico's situation during 1994, and may have led to the erroneous perception that economic policies were fundamentally sound.

7. The distinction between "types" of policymakers has become standard since the work of Backus and Driffill (1985) and Vickers (1986). The analytics of the modeling strategy followed here are discussed more fully in Drazen and Masson (1994) and Masson (1995).

Specifically, the model emphasizes the perceived trade-off between limiting fluctuations in domestic interest rates on one hand, and maintaining exchange rate stability on the other. The first component of (lack of) credibility in the model, the probability that policymakers put a low weight on maintaining the exchange rate peg, is modeled using Bayesian updating, on the assumption that there are two possible types of policymakers, each with a known set of weights on its objectives. As a shorthand (and in line with most of the literature in this area), we can call these two types "weak" and "tough" policymakers. Thus, private agents can calculate the likelihood ex ante of each type deciding to devalue, or alternatively maintaining the announced crawling peg[8] ex post, the absence of devaluation gives information about whether the policymaker is weak (even if the shocks cannot be observed), so that initial priors about that probability are updated on the basis of the relative likelihood that each policymaker would have devalued, given the distribution of the unobserved shocks. In addition, we also allow for political events in assessing the type of government—in particular, for the Colosio assassination and the election of President Zedillo. These events can reasonably be assumed to have affected the public's perceptions of actual (and future) governments' policy intentions.

Formally, the authorities' one-period loss function L is assumed given by[9]

$$L_t = (i_t - \tilde{i})^2 + \theta \Delta e_t \, \theta > 0 \qquad (1)$$

where i_t is the interest rate on domestic-currency denominated assets (with $\tilde{i}$ its desired level), e_t the (logarithm of) the nominal exchange rate (measured as units of domestic currency per unit of foreign currency) and the weight θ can take on one of two values θ^W and θ^T, for weak and tough governments respectively, with $\theta^T > \theta^W$. The first term in equation (1) measures the costs associated with deviations of the domestic interest rate from its desired level. These costs may be related to the direct output cost and/or potential indirect effects through the health of the banking system.[10] The second term measures the cost of devaluing which can be related to the cost of higher

8. The analysis that follows assumes that the exchange rate commitment takes the form of an announced peg. This is not a bad approximation in the case of Mexico. Between November 1991 (when the exchange rate band with a sliding ceiling was adopted) and late 1993, the peso-U.S. dollar rate was very stable, remaining in the lower half of the band. In early 1994, the exchange rate moved quickly toward the ceiling of the band and remained at or near that level throughout the year. Modifying the model to account for a constant, nonzero rate of devaluation of the ceiling of the band is straightforward. It would involve penalizing deviations of exchange rate movements from the rate of crawl in equation (1) below. Moreover, the constant in the interest differential equation (12) below would have an additional element reflecting the rate of crawl. As it is, that constant is unrestricted.

9. A more general multiperiod formulation, along the lines of Drazen and Masson (1994), would allow considering the role of future potential gains in reputation in choosing today's policies. However, such a specification would complicate considerably the analysis, and would preclude the use of a closed-form solution for estimation.

10. Both considerations were important in Mexico in 1994. Several commentators have attributed the reluctance of the Mexican authorities to raise domestic interest rates after the Colosio assassination (in order to stem capital outflows) to their concerns with the banking system, which had shown signs of weakness since late 1992–early 1993 (see Rojas-Suárez and Weisbrod 1995). The authorities were also concerned with potentially adverse affects on economic activity—a particularly important consideration prior to a presidential election in which, for the first time in recent history, the election prospects for the ruling party's candidate appeared uncertain, at least up to a few weeks before the contest.

inflation, if the exchange rate is viewed as an intermediate target. For expositional clarity, the interest rate target is treated as constant and the term in Δe_t is linear (since only pressures for devaluation or inflation, not revaluation or deflation, were relevant for our sample period).

Domestic and foreign goods are imperfect substitutes, and so are domestic and foreign interest-bearing assets. In this setting, changes in official reserves R_t, which are equal to the sum of capital and current account balances, can be specified as a quasi-reduced form that depends on the differential between the domestic interest rate and the foreign interest rate i_t^* plus expected devaluation (which should affect capital flows positively, because it captures the attractiveness of investing in peso assets) and on beginning-of-period relative prices, converted into a common currency at the end-of-period exchange rate (this measure of competitiveness, which embodies short-run stickiness of prices, should influence the current account positively). In addition, there is a random shock to reserves, ϵ_{1t}:

$$\Delta R_t = \alpha(i_t - i_t^* - E_{t-1}\Delta e_t) + \gamma(e_t + p_{t-1}^* - p_{t-1}) - \epsilon_{1t} \tag{2}$$

where $\alpha, \gamma > 0$. p_t^* denotes (the logarithm of) foreign prices, and p_t (the logarithm of) the price of the domestic good. $E_{t-1}\Delta e_t$ is the expected devaluation rate and i_t^* the world (U.S.) interest rate.[11]

The domestic interest rate is determined by the equilibrium condition of the domestic money market, which is given by

$$i_t = \delta_0 - \delta m_t, \ \delta > 0 \tag{3}$$

where m_t denotes the (logarithm of the) base money stock (defined in proportion of nominal output in the previous period), which, assuming partial sterilization, can be related to the lagged value of the money stock and changes in official reserves:

$$m_t = \mu_0 + \mu_1' m_{t-1} + \mu' \Delta R_t + \epsilon_{2t}, \ 0 < \mu_1' < 1, \ \mu' > 0 \tag{4}$$

where ϵ_{2t} is a random term.[12]

Normalizing constant terms to zero, equations (2), (3), and (4) yield

11. The limitations of our assumption that capital flows occur at a finite rate in proportion to the uncovered yield differential are well known, but it is adopted for tractability. A more general approach would be to follow Connolly, Rodriguez, and Tyler (1994) and account explicitly for currency risk and risk aversion, and the potential effect on the parameter α.

Note also that domestic prices are assumed to be predetermined. In Masson and Agénor (1996), price formulation is explained in terms of overlapping contracts.

12. Equation (4) is derived from a level-form equation in which the domestic interest rate is assumed to depend on the logarithm of velocity, assuming for simplicity that the transactions variable is nominal output lagged by one period. Using the definition of the money stock as the sum of reserves and domestic credit, assuming a constant sterilization parameter linking changes in reserves and domestic credit, and assuming that the rate of growth of the "autonomous" component of domestic credit is constant up to a random term, yields (after taking logarithms) equation (4). With full sterilization, $\mu' = 0$. The implications of full sterilization for the functioning of the model are discussed below. Finally, note that changes in reserves are also defined as a proportion of nominal output in the previous period.

$$i_t = \Omega^{-1}\{-\mu_1 m_{t-1} + \alpha\mu(i_t^* + E_{t-1}\Delta e_t) - \gamma\mu(e_t + p_{t-1}^* - p_{t-1}) + \epsilon_t\}\,, \quad (5)$$

where $\mu_1 = \delta\mu_1'$, $\mu = \delta\mu'$, $\Omega = 1 + \alpha\mu$, and $\epsilon_t = \mu\epsilon_{1t} - \delta\epsilon_{2t}$.

By adjusting the nominal exchange rate, the policymaker can affect trade flows, reserve accumulation, and thus domestic interest rates. A nominal devaluation (an increase in e_t), for instance, improves price competitiveness and the trade balance, raises official reserves, and thereby lowers domestic interest rates. An increase in the U.S. interest rate (given the expected rate of depreciation of the exchange rate) induces capital outflows, lowers reserves and the money stock, and raises domestic interest rates—which tends to mitigate the effect of the initial shock on reserves. More complicated versions of this model could incorporate other channels and richer dynamics, though at the expense of tractability. For instance, the trade balance could depend on aggregate demand, which itself could be related to real interest rates and competitiveness. Also, these variables could operate with longer lags. However, such extensions would not add much to our basic hypothesis, that the authorities could limit the need for interest rate increases by devaluing, nor are they likely to affect our basic empirical test of the significance of U.S. interest rates and the real exchange rate as fundamental factors explaining exchange rate credibility and its evolution over time.

Expectations of exchange rate changes in this setup depend on the probability that the policymaker is weak or tough and the ex ante probability that a given type will decide to devalue in the light of a shock to official reserves. Private agents do not observe the shock to reserves, but only the lagged levels of reserves, the money stock, and prices, and whether the policymaker has devalued or not. The sequence of events is as follows: (a) the private sector forms exchange rate expectations, using an information set that includes variables known as of the end of $t - 1$—notably the lagged level of the money stock, and lagged domestic and foreign prices; (b) the authorities observe the shock to reserves, and choose whether or not to devalue, given the estimated effect on reserves and domestic interest rates; and (c) private agents decide capital flows and trade transactions, and the actual (end-of-period) levels of reserves and interest rates are obtained. Thus, the government devalues when, say, a negative shock to foreign reserves is large enough that the costs of maintaining the exchange rate fixed (resulting from lower reserves and higher interest rates) exceed those associated with the devaluation (in terms of, say, higher inflation). Formally, let L_t^F be the value of the loss function if the exchange rate is kept fixed, and L_t^D the value when the exchange rate is devalued. The government therefore devalues when $L_t^D - L_t^F < 0$.

To determine L_t^D and L_t^F, note first that from equation (5), if the authorities do not devalue (so that $e_t = e_{t-1}$), domestic interest rates are at the level:

$$i_t^F = \Omega^{-1}\{-\mu_1 m_{t-1} + \alpha\mu(i_t^* + \alpha\mu(i_t^* + E_{t-1}\Delta e_t) - \gamma\mu s_{t-1} + \epsilon_t\}\,,$$

where the real exchange rate s_t is defined as $e_t + p_t^* - p_t$.

13. In the model, d is not identified, but it would be straightforward to assume a fixed cost of devaluation, making a devaluation of a minimum size optimal.

If, on the contrary, the authorities opt to devalue, $e_t = e_{t-1} + d$, where the devaluation size d is assumed exogenous.[13] In that case, using the previous result, we have

$$i_t^D - \tilde{i} = (i_t^F - \tilde{i}) - \Omega^{-1}\gamma\mu d\,,$$

which shows that domestic interest rates are lower relative to their desired value when the authorities devalue (since the level of reserves, and thus the money stock, are higher), compared to a situation where they do not devalue. The second step is to substitute out the previous expression in equation (1), so that

$$L_t^D - L_t^F = \frac{\mu\gamma d}{\Omega}\,\frac{\{\mu\gamma d - 2\Omega(i_t^F - \tilde{i})\}}{\Omega} + \Theta d. \tag{6}$$

From the above expressions, it can be shown that $L_t^D - L_t^F < 0$ only when

$$\epsilon_t > \tilde{\epsilon}_t = \mu_1 m_{t-1} + k - \alpha\mu(i_t^* + E_{t-1}\Delta e_t) + \gamma\mu s_{t-1} \tag{7}$$

where $k = \Omega i + \mu\gamma d/2 + \Theta\Omega^2/2\gamma\mu$. Since Θ can take on one of two values Θ^W or Θ^T (indicating a weak or tough government, respectively), $\tilde{\epsilon}_t$ (through k) depends on the policymaker's type.

The expected devaluation rate is the product of the devaluation probability ρ_t and the devaluation size d. The private sector's assessment of the probability of devaluation ρ_t is equal to the probability of a weak government times the probability that a weak government will devalue ρ_t^w, plus a corresponding term for a tough government:

$$\rho_t = \pi_t\rho_t^W + (1 - \pi_t)\rho_t^T\,. \tag{8}$$

The expected devaluation rate is thus

$$\rho_t d \equiv E_{t-1}\Delta e_t = [\pi_t\rho_t^W + (1 - \pi_t)\rho_t^T]d\,. \tag{9}$$

Given knowledge of the authorities' objective function and of the distribution of shocks, the private sector can calculate the probabilities ρ_t^W and ρ_t^T. A negative shock ϵ_t which is large enough may lead to a devaluation because of its adverse effect (through movements in reserves and the money stock) on domestic interest rates; but the threshold level is lower for a weak government than for a tough government. From equation (7), ρ_t^h can be defined as follows, for $h = w, T$:

$$\rho_t^h = Pr(\epsilon_t > \tilde{\epsilon}_t^h)\,.$$

If ϵ_t is assumed, for tractability, to follow a uniform distribution in the interval $(-\nu, \nu)$, with $2\nu > \alpha\mu d$, then

$$\rho_t^h = (\nu - \tilde{\epsilon}_t^h)/2\nu\,. \tag{10}$$

Using equations (7) to (10), we can solve for $\rho_t d$:

$$\rho_t d = \frac{d}{1-\alpha\mu d/2\nu}\left\{\frac{\pi_t(k^T - k^W)}{2\nu} + \frac{1}{2\nu}[\nu - k^T - \mu_1 m_{t-1} + \alpha\mu i_t^* - \gamma\mu s_{t-1}]\right\} \quad (11)$$

where $k^T > k^W$.

The equation for the expected devaluation rate that is estimated below is thus given by

$$E_{t-1}\Delta e_t = a_0 + a_1\pi_t + a_2 i_t^* + a_3 s_{t-1} + a_4 m_{t-1} + u_t \quad (12)$$

where $a_1 > 0, a_2 > 0, a_3 < 0, a_4 < 0$, and u_t is an error term.

It can be seen that, given the assessment of a government's type π_t, a larger level for the beginning-of-period money stock or a depreciation of the real exchange rate lowers the expected devaluation rate, while a higher value for the foreign interest rate raises it.

The updating equation for the probability of a weak government π_t is derived as follows. Starting from a prior estimate π_{t-1} of the type of government, private agents observe the absence of a devaluation at time $t - 1$. Bayesian updating implies revision of π_{t-1} on the basis of the relative likelihoods that the two types would have chosen not to devalue:

$$\pi_t = \frac{1 - p_{t-1}^W}{(1-\rho_{t-1}^W)\pi_{t-1} + (1-\rho_{t-1}^T)(1-\pi_{t-1})}\,\pi_{t-1}. \quad (13)$$

Substitution of (10) for ρ_t^W and ρ_t^T in equation 13 results in a complicated nonlinear expression, which is not written here. As in Masson (1995), it is estimated in linearized form, with the addition of an error term z_t. This equation is given by

$$\pi_t = b_1\pi_{t-1} + b_2 i_{t-1}^* + b_3 s_{t-2} + b_4 m_{t-2} + b_5 Colosio + b_6 election + z_t, \quad (14)$$

where $0 < b_1 < 1, b_2 < 0, b_3 > 0, b_4 > 0, b_5 > 0$, and $b_6 < 0$. "*Colosio*" and "*election*" are temporary dummy variables taking values of unity in April and August 1994 respectively, and zero otherwise.[14] The updating equation for π_t has the opposite sign [compared to equation (12)] for the lagged values of the foreign interest rate, the real exchange rate, and the money stock, conditional on no devaluation having occurred. For instance, the willingness to accept a loss of competitiveness without devaluing is viewed as evidence that policymakers are less likely to be weak—and hence leads to a lower value of π_t.

Our analysis is based on the assumption of less than perfect sterilization. The evidence provided in some recent studies of the peso collapse suggests that sterilization

14. In addition, the *Colosio* dummy has a value of 0.25 in March, reflecting the fraction of the month subsequent to the assassination. Permanent dummies were also tried, but they were less significant. The temporary dummies have persistent effects, given the presence of π_{t-1} in equation (14).

in the years preceding the crisis had been very high. Calvo and Mendoza (1996), for instance, found, in a regression involving net domestic credit changes as the dependent variable, that the coefficient of official reserve changes was -0.96 over the period January 1992 to April 1995. With no feedback effect of reserves on the monetary base (that is, with $\mu = 0$), neither external shocks nor exchange rate changes would have any effect on domestic interest rates in our framework. Given that the model abstracts from the cost (and possible policy losses) associated with sterilization, it would never be optimal to devalue.[15] However, as long as sterilization is not perfect (that is, as long as μ is different from zero), it is always possible (in principle) for a sufficiently large shock to external reserves to ensure that $L_t^D - L_t^F < 0$—and thus trigger a devaluation. Our own estimate of the effect of a change in reserves on changes in net domestic assets of the central bank, based on monthly data over the period January 1992–October 1994 and using the lagged values of these variables as instruments—together with a constant term and seasonal dummies—yields a coefficient of -0.86. These results suggest that although the degree of sterilization was indeed very high over the estimation period, it was not complete.

3. ESTIMATION RESULTS

The measurement equation (12) together with the state equation (14) for the unobserved state variable π_t were estimated by a Kalman filter technique using monthly data for the period covering March 1991 through November 1994. The time period was dictated by data availability, and by the fact that the Mexican authorities devalued in December 1994. We used the Cetes-Tesobonos differential rather than the survey-based devaluation expectations as a measure of currency risk, because the former series provides a more comprehensive measure of expectations held by market participants.[16] The maximum likelihood procedure MAXLIK in Gauss 3.1 was used, starting from an initial value of π_0 equal to 0.5 (the path for the state variable was subsequently adjusted using the estimated constant term in the measurement equation, as described below). Means were removed from the right-hand-side variables: the real exchange rate, the base money stock divided by lagged nominal income, and the U.S. interest rate, after taking logs in the case of the first variable.[17]

Estimation results are presented in Table 1. The first regression includes all the ex-

15. A negative shock to domestic credit, for instance, would raise domestic interest rates and (assuming an initial situation where the interest rate is at its desired level) raise the value of the loss function. A devaluation would have no effect on the money stock with full sterilization (and thus no indirect, downward effect on interest rates) and would simply increase further the policy loss.

16. We nevertheless also attempted to estimate the model with the survey data on devaluation expectations. The results obtained were not very different from those reported below. In particular, they did not indicate a greater explanatory power of economic fundamentals.

17. Interest rates are at monthly rates. All data were taken from the Fund's *International Financial Statistics*—with nominal output proxied by multiplying the industrial production index by the consumer price index—except for the Cetes-Tesobonos differential. We used the differential for 91-day instruments from January 1991 to May 1993, and the differential for 28-day instruments from June 1993 to November 1994, since no uniform series was available for the complete period. Figure 1 shows that the two series move closely together during the May–June 1993 period of overlap.

TABLE 1

MEXICO: KALMAN FILTER ESTIMATES OF CETES-TESOBONOS DIFFERENTIAL AND PROBABILITY OF A "WEAK" GOVERNMENT, MARCH 1991–NOVEMBER 1994

Variables	Models 1		2		3	
	Cetes-Tesobonos interest differential					
Constant	0.0068	(5.5)	0.0065	(5.5)	0.0069	(3.3)
π_t	0.0069	(0.8)	0.0176	(4.0)	0.0180	2.6
i^*_t	0.9130	(0.9)	0.1200	(0.2)	—	—
s_{t-1}	0.0214	(1.5)	—	—	—	—
m_{t-1}	0.0015	(0.2)	0.0008	(0.3)	—	—
$\hat{C}_t$	0.0006	(0.2)	0.0003	(0.1)	—	—
	Probability of a "weak" government π_t					
π_{t-1}	0.8283	(11.0)	0.8547	(10.4)	0.8251	(1.3)
i^*_{t-1}	−96.74	(0.6)	—	—	—	—
s_{t-2}	0.6751	(0.4)	—	—	—	—
m_{t-2}	−0.3989	(0.4)	—	—	—	—
Colosio	0.4018	(0.8)	0.1329	(3.7)	0.0132	(1.7)
election	−0.2660	(0.7)	−0.1032	(2.8)	−0.1007	(14.3)
σ_z	0.1682		0.0696		0.0722	
ln$L$	6.2472		6.1916		6.1329	

NOTES: Coefficients in parentheses are absolute t-ratios. ln$L$ is the maximized value of the log likelihood function. σ_z is the estimated standard error of equation (14). Interest rates are on a monthly basis, and expressed as decimal fractions (rather than as percentages). The coefficients in the state equation as well as the coefficient of π_t in equation (12) reflect this. The instruments list used to calculate the predicted value of the Cetes-Tesobonos ratio $\hat{C}_t$ is the U.S. treasury bill rate at t, U.S. inflation at t, C_{t-1}, m_{t-1}, and the two dummy variables.

planatory variables appearing in equations (12) and (14). The second regression drops, in the measurement equation, all variables that appear with the wrong sign (namely, the real exchange rate) and, in the state equation, all variables that are not significant—except for the two dummy variables. The third regression drops all variables that are not statistically significant in both equations. In all three equations, we also added the predicted value of the ratio of the stock of Cetes to Tesobonos in the hands of the private sector and commercial banks, in order to control for the possible effects of changes in relative supplies of assets on the interest rate differential. In early 1994, the authorities began to substitute short-term indebtedness denominated in dollars for peso-denominated debt. Werner (1996) has argued that the increased relative supply of Tesobonos was a reason why the Cetes-Tesobonos interest differential did not widen in the latter part of 1994. To control for simultaneity bias, we use the predicted value of the ratio of the stock of Cetes to Tesobonos ($\hat{C}_t$ in the table), obtained from an auxiliary regression with a list of instruments defined at the bottom of Table 1, rather than the actual value.

The state variable is calculated in each case as follows: the path for π_t (starting from a value of 0.5) that results from estimation is adjusted using the formula

$$\pi'_t = \pi_t + a_0/a_1 \,. \tag{15}$$

This essentially attributes the constant term to concerns about the type of government, so that if $\pi_t = 0$ and the other right-hand-side variables were at their means (that is, were equal to zero), peso-denominated assets would pay the same rate as dollar-denominated assets, indicating complete credibility of a "tough" government.

Parameter estimates shown in Table 1 indicate that the calculated value of the Cetes-Tesobonos ratio, despite having the correct sign, does not have a significant effect on the interest rate differential. Likewise, the real exchange rate does not seem to be significant, either directly or through the updating of π_t. This is consistent with the fact that the real exchange rate did not continuously appreciate during the sample period. Indeed, although there was a worsening of price competitiveness in 1991–93, this was to some extent reversed in 1994, as the peso weakened within its fluctuation band [see, for instance, Masson and Agénor (1996)].[18] The lagged value of the money stock (measured in proportion of the previous period's estimate of nominal output) is not significant either, although it affects devaluation expectations and the unobserved state variable π_t with the correct sign. It is possible that a stronger effect would have emerged if official reserves and data on money supply had been consistently made public with short delays. One possible way of capturing this is to use higher-order lags on the money-to-output ratio. However, experiments along this line did not prove any more successful.[19] Finally, both dummy variables have the expected sign in all three regressions, and are statistically significant in the second and third regressions. Political events seem therefore to have played a role in agents' perceptions about the type of government.

The adjusted probability series for the restricted model displayed in the second column of Table 1 (which retains all variables with a correct sign in the measurement equation) is plotted in Figure 3, together with a one-standard error band.[20] It is important to note that in the absence of significant effects of economic fundamentals, π_t necessarily tracks the interest rate differential itself. Moreover, since it displays strong autoregressivity, even one-step-ahead estimates (as plotted here) resemble that differential. The figure shows clearly that this estimate of π_t implies an absence of increasing concerns about the "toughness" of the authorities in the months leading up to the December devaluation, although some concerns are apparent earlier in the year. Put differently, there appears to be no evidence that markets foresaw a shift in government policy concerning the exchange rate, or more specifically a change in the weight attached by the Zedillo administration to exchange rate stability. On the contrary, the likelihood that the government was weak shows a trend decline which continued (despite some increase in the spring and summer) throughout the period to November 1994.

18. The lack of significance of the world interest rate and the real exchange rate in the measurement equation may also result from the fact that μ may have remained relatively small during the sample period, as a result of sterilization operations.

19. We also considered the case where the interest rate target is not constant but exhibits some degree of persistence ($\tilde{i}_t = c_0 + c_1 i_{t-1}$ with $0 < c_1 < 1$). This assumption implies that i_{t-1} appears with a negative coefficient in equation (12), and a positive coefficient in equation (14). The lagged interest rate was not significant in any of our regressions.

20. The standard error rate is calculated as described in Hamilton (1994, pp. 397–99).

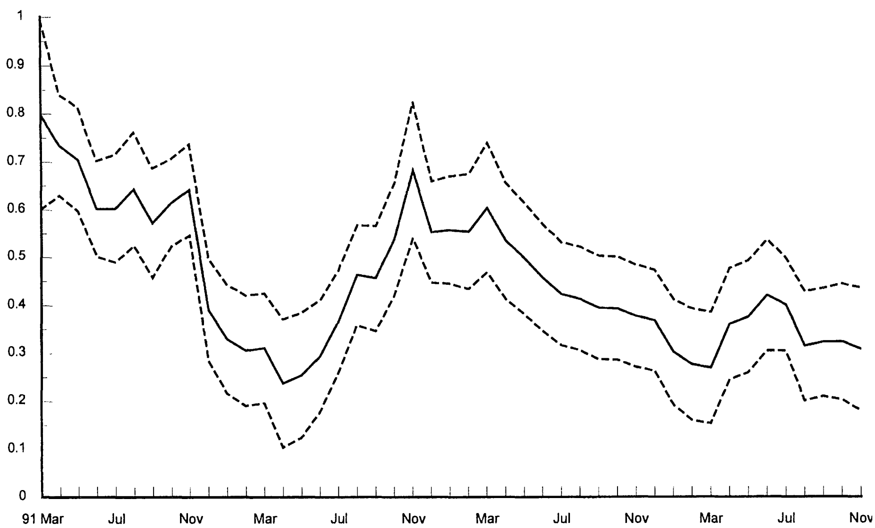

FIG. 3. Mexico: Probability of a "Weak" Government (plus and minus one standard error), March 1991 to November 1994. Source: Authors' calculations.

4. SUMMARY AND FINAL THOUGHTS

The purpose of this paper has been to examine the role of credibility and reputational factors in the lead up to the December 1994 crisis of the Mexican peso. As reviewed in the first part of the paper, available data suggest that there was no increase in the perceived risk of devaluation in the periods preceding the decision to devalue. We argue that this pattern may have resulted either because investors perceived economic fundamentals to be essentially appropriate—despite earlier signs of real exchange rate misalignment and the deteriorating current account balance—or because investors (following the presidential election in August) regained some degree of confidence in the policymakers' intentions.

Our estimation results show, first, that there is no evidence that prior to the peso collapse markets perceived a shift in government preferences and policy concerning the exchange rate. On the contrary, it appears that there was some decrease in the assessment that the government puts a low weight on exchange rate stability. Second, the real exchange rate and the lagged value of the money stock do not appear to have had a significant effect on the interest rate differential, nor do changes in relative stocks of Cetes and Tesobonos, in contrast to the results derived—in a different setting—by Werner (1996).

The model developed and estimated in this study is relatively simple and does not pretend to capture all aspects of the peso crisis. In Masson and Agénor (1996), we present a formally similar model of exchange rate credibility, but one emphasizing the conventional inflation-competitiveness trade-off. Estimation results gave similar implications as regards the lack of significance of fundamental factors and a trend decline in the estimated probability that the government put a low weight on price stability. Hence, we conclude that there is little empirical basis for attributing expectations of peso devaluation to fundamental economic factors affecting the evolution of credibility and reputation over time. On the contrary, markets appear to have seriously underestimated the risk of devaluation, despite early warning signals—such as the appreciation of the real exchange rate and, most importantly, the growing current account deficit.

An interesting further question is why confidence seems to have collapsed after the December devaluation of 15 percent. One possible explanation is that investors, having ignored the deteriorating fundamentals before the devaluation, finally woke up to fact that something was wrong—and may have gone too far in their pessimism. The new information included data on the low level of foreign exchange reserves, making investors aware that the authorities would be unable to defend the new exchange rate (see Sachs, Tornell, and Velasco 1995). It is hard to verify or disprove this hypothesis, but in some sense the fundamentals improved as a result of the devaluation, which could be expected to reduce the current account deficit over time. An interesting contrast can be made with the withdrawal of the United Kingdom from the exchange rate mechanism of the European Monetary System. Like Mexico, the United Kingdom faced a large current account deficit and an overvalued exchange rate; this led to a sudden loss of confidence in the sustainability of the exchange rate commitment (Masson 1995). The subsequent devaluation restored price competitiveness and allowed the U.K. authorities to lower interest rates—suggesting an *improvement* in credibility. The opposite was true for Mexico.

A second explanation for the loss of confidence in Mexican policies is that the devaluation signaled the real policy preferences of the authorities. In the context of our framework, they were actually not very committed to exchange rate stability. Figure 3 shows that just prior to the devaluation, the estimated probability π_t of a "weak" government (in the sense defined above) had declined to about 0.3. The devaluation can be seen as revealing the authorites' type (as being weak on exchange rate stability), on the assumption that they could have done something to prevent it (such as arranging for official or private credits well beforehand, or tightening monetary policy). If we suppose that after the devaluation π_t rose to unity, then the model would predict a widening of the Cetes-Tesobonos differential by about fifteen percentage points (at annual rates).[21] An effect of this magnitude is about what actually occurred immediately following the devaluation (as shown in Figure 2), and we are inclined to favor this second explanation.

Of course, this explanation raises further questions. Our model is not a multiperiod one, but if it were, it would imply that the authorities should have taken into account the subsequent loss in reputation into their decision to devalue [as in Drazen and Masson (1994)]. Why did they choose to go ahead anyway? It may be because the pressure of events forced them to act without adequate preparation—preparation that might

21. Taking the value $\pi_t = 0.3$, from the parameter estimates shown in the second column of Table 1, $12 \times (0.018) \times (1 - 0.3) \times 100 \sim 15$ percent.

have assuaged some of investors' concerns, and/or that the loss of reputation that ensued was much larger than they had anticipated.

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