Exchange Rate Policy Credibility in Mexico, 1991-1994

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Abstract: An econometric examination of interest rate differentials reveals the existence of a significant relationship between the level of exchange rate policy credibility in Mexico during 1991-1994, and the country's macroeconomic performance, the central bank international reserves and the NAFTA ratification. Interestingly, a steady fall in manufactures output growth tended to improve credibility, which suggests the existence of gains in the government's disinflationary reputation. Additionally, it is argued that downward pressure on the domestic peso-dollar interest differential came from the exchange rate debt indexation of 1994 and the opening of the domestic bond market to foreign investment in December 1990.

Resumen: Al analizar la credibilidad de la política cambiaria en México durante 1991-1994 se obtienen dos resultados básicos: *a)* que hay una relación estadísticamente significativa entre el grado de credibilidad y el desempeño macroeconómico del país, las reservas internacionales del banco central y la ratificación del TLC; y *b)* que la indexación cambiaria de la deuda interna durante 1994 presionó a la baja al diferencial de tasas de interés entre cetes y tesobonos, independientemente del comportamiento de las expectativas cambiarias. Se argumenta que la apertura del mercado de bonos a la inversión extranjera en diciembre de 1990 habría generado un efecto similar.

According to some interpretations, the speculative attack that preceded the currency crisis of December 1994 in Mexico, was ultimately the result of a process of cumulative real currency appreciation,

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rising trade deficits and declining output growth, which preannounced an eventual policy revision (see *e.g.* Dornbusch *et al.,* 1995). Yet, when dealing with expectations, it is analytically possible to think of two opposite effects from a government sustaining an exchange rate peg under conditions of relatively high domestic inflation: on one side, it may be that, as in the reasoning above, the negative output and balance of payments figures lead market participants to expect an offsetting devaluation, an insight critical to the most recent generation of currency crisis models (see *e.g.* Drazen and Masson 1993). The potentially important role of reputation, though, opens a second possibility: by assuming the output cost of the real appreciation, a government may eventually be able to convince market participants of its true intention to maintain the announced exchange rate policy (for a discussion, see Persson 1988); indeed, for a new administration engineering a recession may be a way to identify itself as "tough" (see Blackburn and Christensen 1989, section IV).

Policy decisions respond to this trade-off, and thus they can be altered by different types of shocks, notably those affecting macroeconomic performance (an exogenous fall in exports may turn the balance in favor of devaluation) or government preferences (a succession may bring less anti-inflationary authorities to office). Following this perspective, it has been argued that the timing of the peso devaluation and the currency attack that came before it were conditioned by the change of administration of late 1994 (see Ibarra 1998a). The important point is that, certainly within limits, expectations may improve in the face of adverse macroeconomic results induced by a process of currency appreciation, precisely because of a gain in reputation. This channel seems relevant for understanding the recent Mexican case, which featured a significant improvement in policy credibility between late 1992 and early 1994, under conditions of a steady decline in output growth.

A second basic question concerns the behavior of expectations during 1994, when the country experienced severe political shocks in the form of social and political violence, the celebration of presidential elections and finally the administration change of December. The observed evolution of expectations raises a puzzle: whereas interest rate differentials jumped immediately after the assassination of candidate Colosio in March, they stabilized quite rapidly afterwards and in fact showed some improvement as the year drew to a close (before the devaluation). As a first approximation, the observation could be

attributed to the political certainty brought about by the ruling party's electoral victory; yet, one suspects this cannot be the whole story in a country like Mexico, where presidential transitions tend to be turbulent periods.

An alternative explanation comes from the area of public debt management, and in particular from the steady rise in the share of dollar-indexed tesobonos in private portfolios after March 1994 (a supply shock). As is well known, the indexation has a positive signaling effect on expectations (by linking the debt's peso value to the exchange rate, it raises the fiscal cost of a devaluation); a second effect can also be important, however: by shifting the position of the marginal investor, the recomposition may result in a reduction in interest rate differentials independent of the overall behavior of expectations. This raises the possibility that the record of stable expectations in Mexico as 1994 drew to a close may have been to some extent spurious. As it turns out, a similar perspective is useful to show that the opening of the domestic bond market to foreign investment in December 1990 (a demand shock) tended as well to compress interest rate differentials.

Thus the purpose of this paper is to measure and explain the behavior of exchange rate expectations in Mexico during 1991-1994, trying to make sense in particular of the relatively high degree of policy credibility registered most of the time. The contents is as follows. The next section examines the behavior of an adjusted peso-dollar interest rate differential, as an indicator of the degree of exchange rate policy credibility. This is followed by a presentation in section 2 of some econometric evidence regarding credibility factors in our period. Section 3 then focuses on the effects of the supply and demand shocks mentioned above, with the help of a small analytical framework based on the postulate of dispersed market expectations: first we discuss the impact of the domestic debt indexation and update the econometric output from section 2; to gain further insight, we look at the comparative behavior of expectations in the bond and the exchange rate hedge markets. Second, in a more speculative mood, we analyze the transitional dynamics of the domestic interest rate and overall bond holdings after a country opens its domestic bond market to foreign investment. The pattern replicates some aspects of the Mexican episode, but formal econometric testing is left to future work.

1. Exchange Rate Policy Credibility in Mexico, 1991-1994

During our period, exchange rate policy in Mexico took the form of a sliding peso band against the U.S. dollar, with the band's floor fixed from November 1991 onward and the ceiling's crawl rate periodically revised within the formal renewals of the incomes policy agreements known as pacts. The daily crawl was 0.04 peso cents through 10 November 1991, 0.02 cents until 19 October 1992, and again 0.04 cents until the December 1994 devaluation. As is well known, under conditions of unregulated portfolio selection and perfect asset substitutability, depreciation expectations can be obtained from a domestic peso-dollar interest rate differential. However, given that we are interested in measuring policy credibility, instead of depreciation expectations per se, we have to adjust the differential for the peso depreciation *within* the band. Thus our procedure involves the following steps (see Svensson 1991): first, we estimate the expected peso depreciation from the arbitrage condition that the expected return on peso-denominated treasury bills (cetes) and dollar-indexed tesobonos be equal, *i.e.*,

$$ {}_td_\mu = ({}_tS_{t+\mu} / S_t) - 1 = \{(1+i_t) / (1+i^*_t)\}^m - 1, \qquad (1)$$

where ${}_td_\mu$ is the expected μ-day depreciation rate on t, S_t the spot exchange rate (peso price of the dollar), ${}_tS_{t+\mu}$ the μ-term expected exchange rate, i* and i the annualized μ-day tesobono and cete interest rates, respectively, and m = μ/365. Next, using the official crawl rate, we compute the *maximum* depreciation rate compatible with the band, defined as the difference between the announced ceiling and the current exchange rate,

$$ {}_td\sim_\mu = (S\sim_t + \alpha\mu)/S_t - 1, \qquad (2)$$

where ${}_td\sim_\mu$ is the maximum μ-day depreciation rate to be allowed within the band as of t, $S\sim_t$ is the current band ceiling, and α is the daily crawl rate (in pesos). Finally, to measure the degree of policy credibility, we subtract the maximum depreciation compatible with the band from the expected depreciation,

$$ \chi_\mu = {}_td_\mu - {}_td\sim_\mu; \qquad (3)$$

in this way, a positive χ value (which we call excess expected depreciation) is indicative of a less than fully credible exchange rate band.

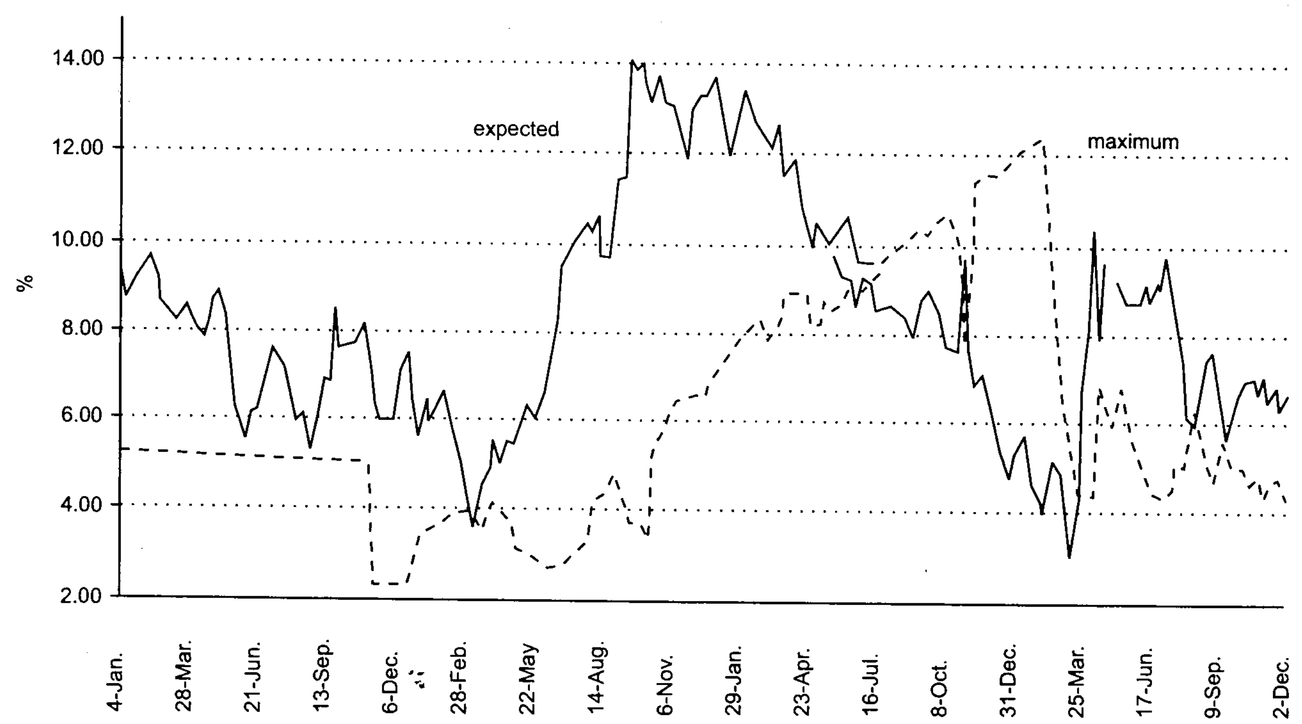
In the estimation of (1) we use the shortest interest rates available (28-day rates through mid 1992, and 91-day rates thereon) in order to minimize any possible distortions arising from expectations of capital gains. Figure 1 presents the weekly series for ${}_td_{365}$ and ${}_td\sim_{365}$. From the figure it is clear that strong changes in expectations took place over time. We may note, in particular, the rapid increase in the annual expected depreciation during most of 1992 (with expectations reaching a 14% peak by the end of the year), the subsequent fall down to 4% in early 1994, and finally the discrete increase in the interest differential that followed the assassination of Colosio in March 1994. Note as well the steady rise in the maximum depreciation rate, up to a 12.5% peak before the political shock. This gradual improvement in the band's strength came from two sources: *a)* the higher crawl rate introduced in October 1992, and *b)* the stabilization of the exchange rate, which resulted in an increasing gap between the actual rate and the band ceiling (see Figure 2). This latter factor can be explained, at least for the period before the November 1993 ratification of NAFTA, by the existence of a narrow band within which the Banco de México intervened on a daily basis (see Schwartz 1994).

Figure 3 presents the weekly series for χ_{365}, whose behavior reflects the joint effect of variations in the expected depreciation rate and in the position of the exchange rate within the band. We may note:

a) The steady erosion in credibility during most of 1992 (with χ_{365} peaking at 10% in October), followed by a sustained improvement between late 1992 and early 1994, with full credibility ($\chi_{365} < 0$) already evident by mid 1993. Taking into consideration the information in Figures 1 and 2, we see that full policy credibility in Mexico was the combined outcome of: *i)* a steady fall in the expected depreciation rate, *ii)* the October 1992 rise in the band's crawl rate, and *iii)* the stabilization of the actual exchange rate, which resulted in the rate shifting toward the strong (lower) half of the band.

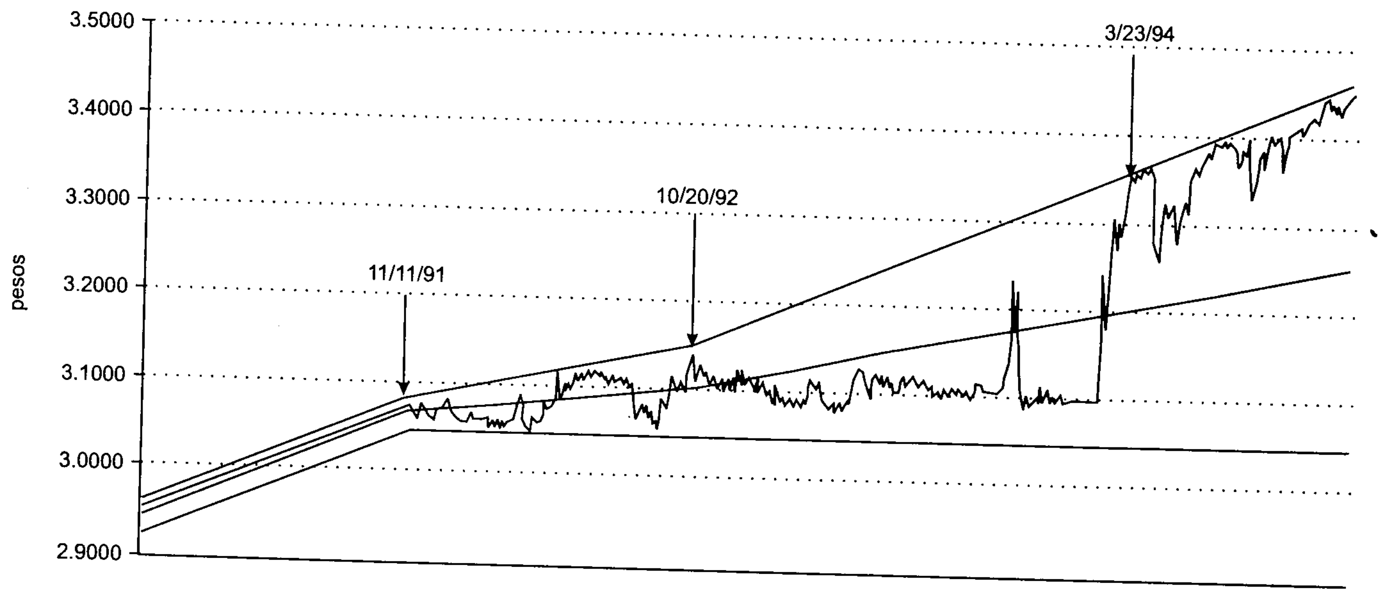
b) The 14 point upward jump after the political shock of March 1994, raising χ_{365} to 6% by early April. Expectations stabilized rapidly, though, and there was a relatively low χ_{365} value (2.5%) just before the December devaluation. This apparent recovery in credibility was notable for the conditions in which it took place, in particular a substantial cumulative currency appreciation and the uncertain political environment of 1994.

Figure 1. Expected and Maximum Depreciation Rates, 1991-1994



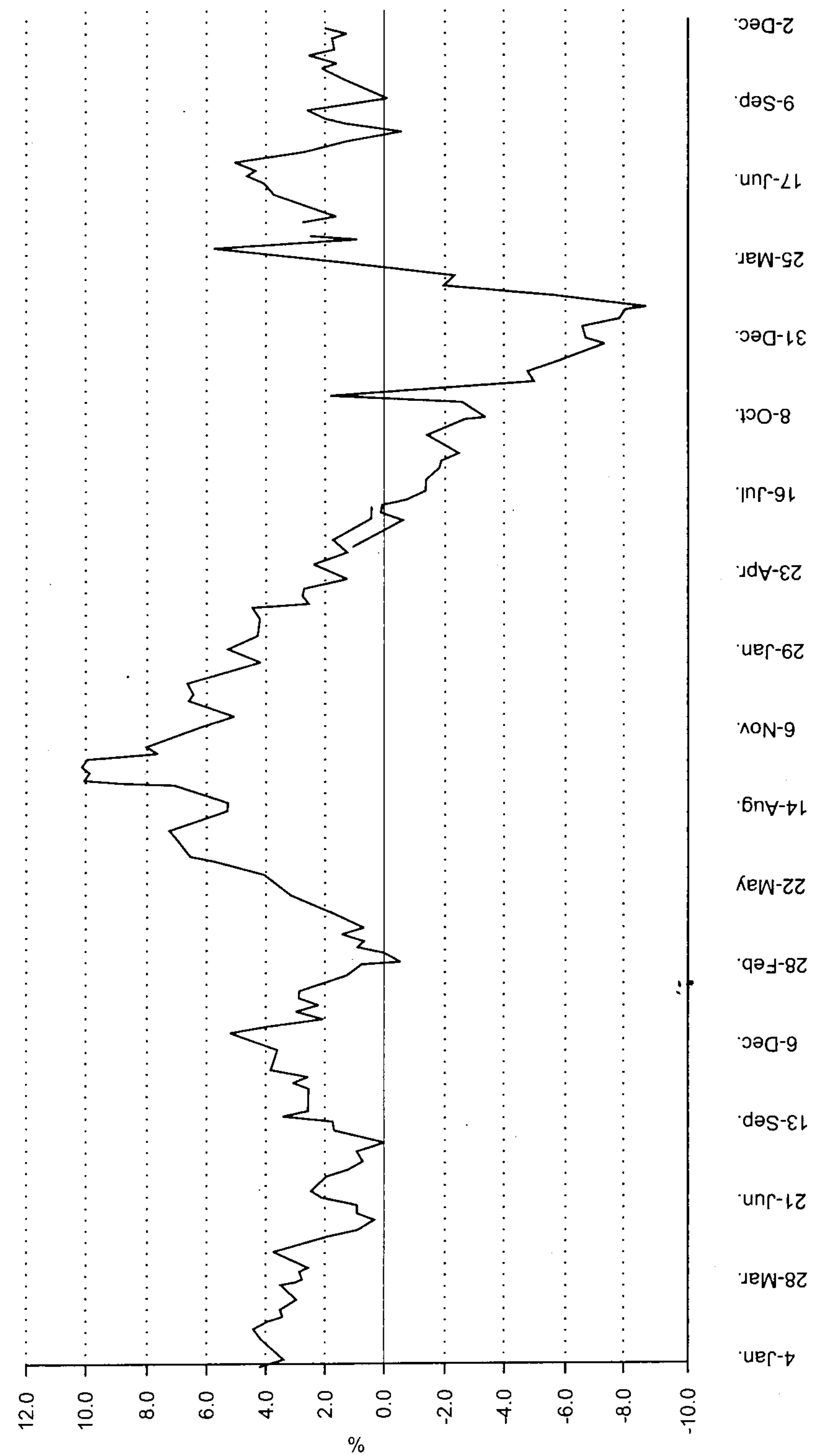
Weekly series; ends on 16 December 1994. Source: Banco de México.

Figure 2. Exchange Rate Band, 1991-1994



Daily series; ends on 16 December 1994: Source: Banco de México.

Figure 3. Excess Expected Depreciation Rate, 1991-1994



Weekly series; ends on 16 December 1994. Source: Banco de México.

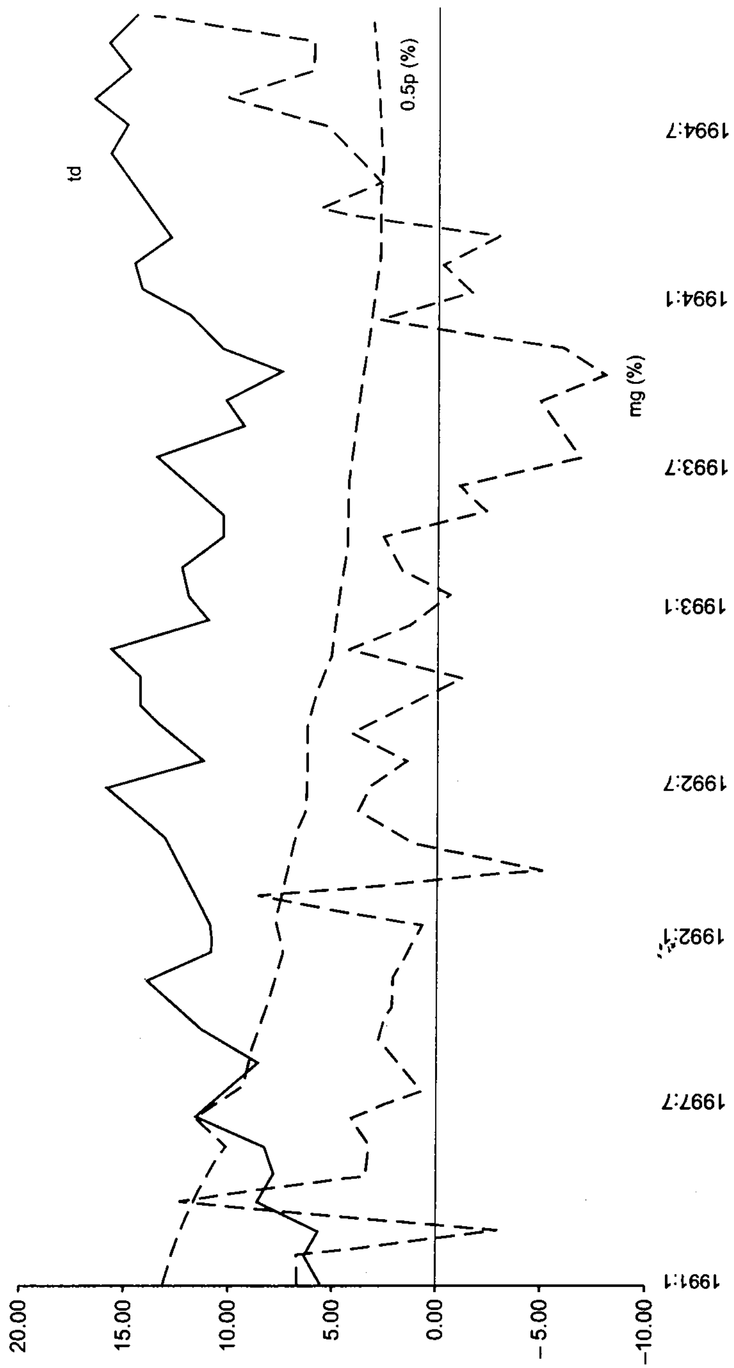
2. Credibility Factors

Starting in the late 1980s, the Mexican government's exchange rate policy assumed a predominantly disinflationary role, with the nominal rate consistently lagging behind the pace of domestic price rises. The stabilization program was clearly successful, with the annual inflation rate (12-month CPI variation) falling from 180% in February 1988 to 7% in November 1994. The macroeconomic cost of disinflation was evident as well: between 1989 and 1994, Mexican wholesale dollar prices increased about 30% against their U.S. counterparts; there was a steady decline in growth, in terms of both GDP (from more than 4% in 1990 to less than 1% in 1993) and manufactures output (with annual growth rates below minus 5% by late 1993); and meanwhile the trade deficit shifted from $1.8 billion in the first quarter of 1991 to $4.3 billion three years later (for some of the variables, see Figure 4a). In this section we examine the effect of these and other variables on the level of exchange rate policy credibility in the country.

As argued in the introduction, the effect of declining output growth on policy credibility is ambiguous *a priori*: on one side, falling growth resulting from the adoption of a disinflationary stance may create in the private sector the image of a "tough" administration, willing to stick with the announced policy; on the other, the cumulative cost in terms of growth deceleration together with the high trade deficits may eventually lead to a policy revision; within limits, any of the two effects may prevail. The impact from variations in the inflation rate is also uncertain: on one side, as domestic inflation approaches the international rate, there is a natural reduction in the scope for further disinflation, which could prompt a relaxation in exchange rate policy; on the other, the government may be unwilling to lose the disinflationary reputation it has accumulated over time. Moreover, as inflation falls, presumably the expected *size* of devaluation also declines. Thus it is an empirical question which of the possible effects predominates.

In addition to indicators of macroeconomic performance, basic economic logic suggests that expectations probably respond to the perceived ability of the central bank to defend the announced exchange band: other things equal, greater international reserves should lead to greater credibility. In our period, reserves rose steadily from about $10 billion in January 1991 to nearly $30 billion in February 1994, before falling to less than $18 billion in the wake of March's political

Figure 4a. Trade Deficit, Inflation and Manufactures Output Growth, 1991 (1)-1994(11)



Td in $100 million. Source: Banco de México and IMF IFS.

shock and to $10 billion before the devaluation. The position of the exchange rate within the band may as well be of importance, although the direction of the effect is again unclear on purely analytical grounds: with constant target zone credibility, a shift toward the band's upper limit will create expectations of future appreciation to central parity (see Svensson 1996 for a recent discussion, and Werner 1996 for the Mexican case); but the same shift could be interpreted as a sign of mounting pressure on the band and hence of a higher likelihood of realignment (it is mainly for this uncertain effect that we prefer not to use the so-called drift adjustment method; for a technical discussion, see Ibarra 1998b).

As we already showed, in Mexico there were three main stages in the evolution of the exchange rate within the band: during 1991, it remained close to central parity, without any significant fluctuation; in 1992 and 1993, it showed a narrow oscillatory pattern, staying most of the time in the strong half of the band; and finally, by the end of February 1994 it started to depreciate very rapidly, and in a matter of days it was practically hitting the band ceiling (see Figures 2 and 4b).

Finally, we need to make allowance for the possible influence of at least three different shocks. The first consists of variations in the crawl rate, whose direct effect on our measure of credibility is straightforward: for any given expected depreciation, a rise in the crawl rate increases the future value of the band ceiling, and hence reduces the *excess* expected depreciation. But there is a second, indirect effect: by altering the implicit path of the exchange rate's upper limit, changes in the crawl rate determine to some extent whether or not a major parity adjustment will take place in the future. For instance, the crawl rise of October 1992 was followed by a *fall* in the expected depreciation rate.

The second shock is the November 1993 ratification of NAFTA. A positive effect of NAFTA on expectations has at least two sources: first, the anticipation of a higher export volume, for any given real exchange rate, that would reduce the associated trade and current account deficits; and second, the improved access to the international capital market that would enable the country to sustain any given current account deficit. Finally, as the third shock we define a period of strong political uncertainty, beginning with Colosio's assassination and ending with the August 1994 presidential victory of the ruling party's new candidate.

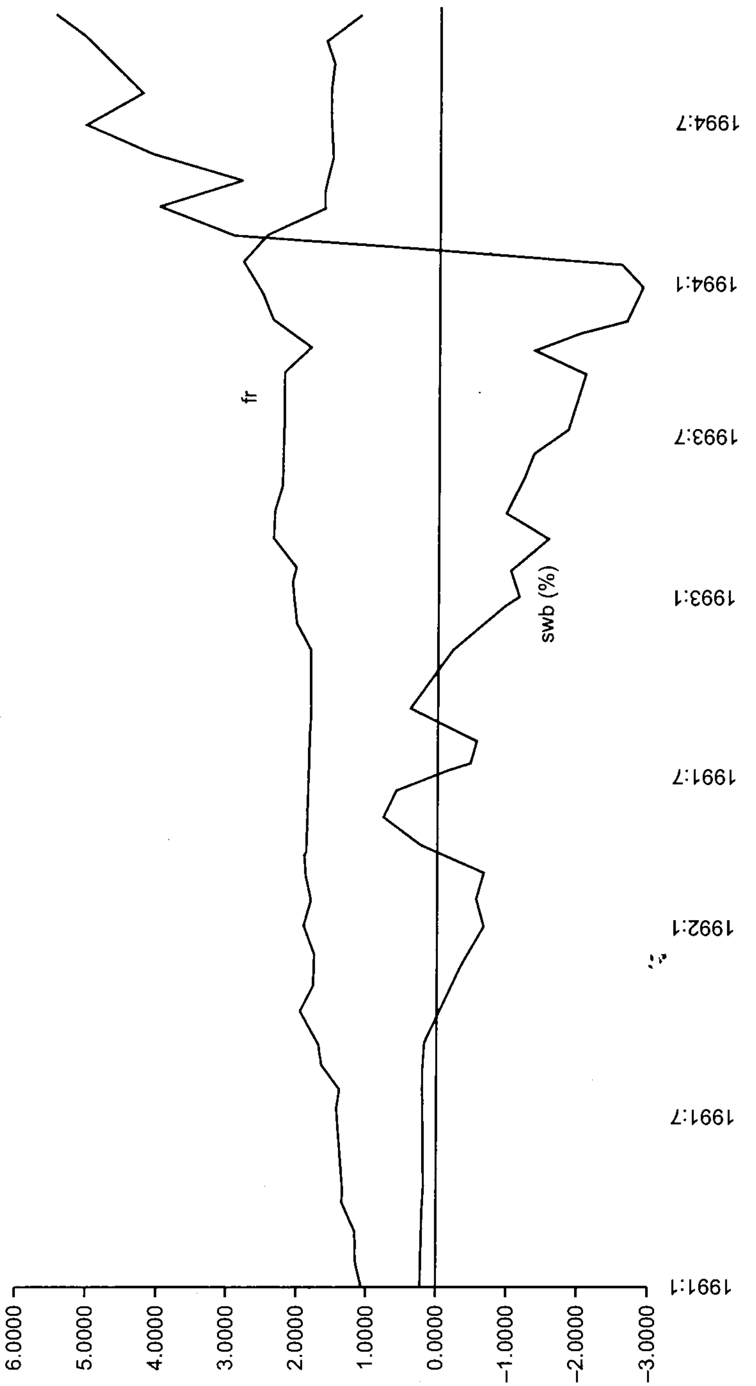


Figure 4b. Foreign Exchange Reserves and the Exchange Rate within the Band, 1991(1)-1994(11)

Reserves in $10 billion. Source: Banco de México.

Thus our credibility equation for regression analysis is,

$$\chi_{365} = f(td, rer, mg, p, swb, fr, nafta, pact, pi), \tag{4}$$

where td is the monthly trade deficit (in billions of dollars), rer a real exchange rate index, mg the manufactures output growth rate (12-month percentage variation in output), p the inflation rate (12-month CPI percentage variation), swb the percentage deviation of the exchange rate from its central parity (a positive value indicates the currency is in the band's weak half), and fr the central bank's stock of foreign reserves (in $10 billion; see Figures 4a, b).[1] The last three variables in equation (4) are representative of shocks: nafta starts at zero and takes a value of 1 from the November 1993 ratification onward; pact equals 1 in the months of high crawl rate (0.0004 pesos) and zero elsewhere; and finally pi, intended to capture the effect of political uncertainty in 1994, takes a value of 1 from March (Colosio's assassination) to July (the last month before the presidential elections).

In the estimation we use monthly observations and work with current and lagged (up to two months) values for the explanatory variables. The aim is not only to capture the protracted effect of information on expectations, but also to make allowance for any lags in the release of statistical data to the public. In order to avoid problems of collinearity between current and past values of each variable, though, we make the following transformation: instead of entering each variable x throughout in levels (*i.e.*, $a_1x_t + a_2x_{t-1} + a_3x_{t-2}$), we include the current level plus differences with respect to the last two periods: $b_1x_t + b_2dx_t + b_3d2x_t$, where $dx_t = x_t - x_{t-1}$ and $d2x_t = x_t - x_{t-2}$. It is easy to show that the following correspondence exactly holds for the parameters: $b_1 = a_1 + a_2 + a_3$, $b_2 = -a_2$, and $b_3 = -a_3$.[2] Thus b_1 represents the *protracted* effect of a change in the explanatory variable on the excess expected depreciation. In addition to OLS, we

[1] td is adjusted for the level of economic activity, by dividing the actual trade deficit by an index of manufactures output (set equal to 1 in January 1991), in order to reduce the possible collinearity between the trade deficit and output growth; the results remain basically the same if the raw trade figures are used instead. rer is computed as $(S_t/2.4615)(P^*/P)_t$, where 2.4615 is the average 1989 spot exchange rate and P* and P are the US and Mexican wholesale price indexes (1989 = 1), respectively. 1989 is a good reference year since: *a)* there was a small trade deficit ($0.6 billion) in a context of relatively high domestic output growth (3.3% per year), *b)* the bulk of the trade liberalization program had already taken place (mainly in 1985), and *c)* the manufactures share in exports had doubled from its 25% 1980 level.

[2] Note this is not a restriction needing testing, but a simple equation transformation intended to achieve higher efficiency in the estimation (see Hendry 1995).

estimate equation (4) by instrumental variables (IV) to correct for the possible endogeneity of reserves (variations in credibility are likely to have a significant effect on international capital flows and hence on the central bank's reserve position); as instruments we use the current and once lagged values of the 3-month U.S. treasury bill rate (tbill), with the transformation to differences explained above.[3]

Each equation is accompanied by a diagnostics battery: we test for (the absence of) second degree autoregressive and second degree ARCH errors, and for normality in distribution. There is also an F reset test for functional specification (it tests whether squared fitted values of the explained variable appear as a significant explanatory variable in a separate regression), and in the case of IV estimation, we present a χ^2 test for the validity of instruments. * (**) following a statistic means that the null hypothesis is rejected at 5% (1%) significance level, and thus that the model is not completely satisfactory (that is, errors are not well behaved, etc. See Hendry 1995 for a discussion of the tests; all results were obtained using the econometrics program PcGive).

Columns B and C in Table 1 present the OLS estimation output for the sample period 1991(3)-1994(11). The main results are as follows: the excess expected depreciation rate depends positively on the trade deficit and the manufactures growth rate, and negatively on the reserves stock; as it turns out, the level of credibility is positively affected by the inflation rate and the position of the exchange rate within the band (the latter, a mean reversion effect), and negatively by the real exchange rate (a bandwagon effect). In all cases, the protracted effect is statistically significant (column C). Also, the influence of each variable is consistent over time, in the sense that the coefficient size does not show dramatic variations between current and lagged values, whereas the coefficient sign does not change (in both respects, the exceptions are the once lagged trade deficit and twice lagged reserves). As to the rest of variables, the equation reveals a strong positive effect on credibility from the NAFTA ratification, but it fails to detect any significant effect from variations in the crawl rate and the emergence of political instability. Overall, the diagnostic set is satisfactory, although the model barely fails to reject the null hypothesis of no autoregressive errors.

IV estimation (column D) shows good diagnostics (including the test for the validity of instruments), and in particular there is a clear improvement in the test for autoregressive errors. Moreover, the direction of effects corresponds to that detected in column B, but in addition there is a general rise in the size of the coefficients, in some cases doubling the original value; on the other side, pact and pi remain statistically irrelevant.

As is well known, a potential source of difficulty in the interpretation of results in time series regression analysis is the possibility of nonstationarity in the variables; to address this issue, we perform Dickey-Fuller tests for the existence of unit roots in our model. The results are generally good: for td, rer and mg, the unit root null hypothesis is rejected at the 1% significance level; for p the null is rejected at 5%, while for excess expected depreciation, fr and tbill it is rejected at 10% (see Table 4; critical values for the test with a constant were obtained from Charemza and Deadman, 1992).

The unit root hypothesis cannot be rejected for swb, though.[4] It is of interest then to review our regression results after this variable is removed. OLS estimation of equation (4), with a zero restriction on the swb coefficient, is shown in Table 1, columns B' and C'. Note that there is an evident erosion in the goodness of fit of the model: each variable shows statistically insignificant coefficients (except for nafta, and now pi), there is an important increase in the residual sum of squares and a fall in the Durbin-Watson statistic, and now there is evidence of second degree autoregressive errors. This erosion advises against removing swb from the model. But in any case, it should be noted that in most cases the coefficient signs carry over from column B: in particular, the effect of td, mg and pi on the excess expected depreciation remains positive, while that of p, fr and nafta is still negative.

In summary, the results so far suggest that the credibility erosion from mid 1991 to late 1992 was primarily an outcome of the rapid rise in the country's trade deficit, whereas the dramatic recovery during 1993 and early 1994 came from the steady rise in reserves, the stabilization of the trade deficit, and the manufactures' slowdown, which more than offset the effect of the economy's gradual approach to international inflation rates. The influence of these factors was dramatically reinforced by the ratification of NAFTA. The credibility loss

[3] It would be desirable to make allowance for the possible endogeneity of swb as well, but we lack plausible instruments.

[4] This result probably reflects the change in the central bank's intervention rules occurred in November 1993, when the ceiling of the intervention band was brought to coincide with the official band's (thanks to an anonymous referee for this suggestion), and of course the discrete shift in the position of the exchange rate within the band in late March 1994.

Table 1. Excess Expected Depreciation, 1991(3)-1994(11)

A	*B*	*C*	*B'*	*C'*	*D*	*E*
	Method: OLS				*Method:* IV	
Variable	*Coefficient*	*t-prob*	*Coefficient*	*t-prob*	*Coefficient*	*t-prob*
constant	–49.250	0.1806	20.059	0.5441	–107.700	0.0744
td	6.500	0.0434	3.755	0.2963	10.093	0.0444
dtd	0.138	0.9454	0.926	0.6927	–1.666	0.5909
d2td	–2.033	0.3096	–1.427	0.5465	–1.899	0.5235
rer	154.890	0.0177	–7.214	0.8765	328.770	0.0071
drer	–79.458	0.5689	–46.361	0.5548	–0.448	0.9983
d2rer	–49.775	0.5853	42.080	0.4590	–173.600	0.2348
mg	0.825	0.0007	0.267	0.1659	1.377	0.0013
dmg	–0.386	0.0015	–0.118	0.2612	–0.662	0.0020
d2mg	–0.206	0.0335	–0.052	0.5904	–0.392	0.0173
p	–2.729	0.0012	–0.309	0.4999	–5.640	0.0013
dp	1.443	0.0112	–0.441	0.3868	2.878	0.0058
d2p	0.738	0.1549	–0.335	0.5190	1.843	0.0420
swb	–4.078	0.0011	—	—	–9.144	0.0012
dswb	2.275	0.0675	—	—	3.553	0.0656
d2swb	2.088	0.0415	—	—	5.108	0.0103
fr	–2.127	0.0000	–0.581	0.0216	–4.415	0.0004
dfr	0.935	0.0071	–0.019	0.9445	2.025	0.0035
d2fr	–0.016	0.9464	0.129	0.6528	0.137	0.7037
nafta	–8.543	0.0000	–7.519	0.0000	–9.924	0.0000
pact	0.082	0.9245	–0.942	0.3627	0.871	0.5151
pi	1.127	0.4812	3.382	0.0695	–0.304	0.9011
	R–sq = 0.8820		R–sq = 0.7918		Specification Chi–sq(1) = 0.0975 (0.7549)	
	RSS = 62.0016		RSS = 109.4146		RSS = 139.1747	
	DW = 1.21		DW = 0.756		DW = 1.74	
	AR 1–2 F(2, 21) = 3.1657 (0.0629)		AR 1–2 F(2, 24) = 17.1 (0.0000)**		AR 1–2 Chi–sq(2) = 1.5872 (0.4522)	
	ARCH 2 F(2, 19) = 1.1970 (0.3239)		ARCH 2 F(2, 22) = 0.9778 (0.3919)		ARCH 2 F(2, 19) = 0.6356 (0.5405)	
	N Chi–sq(2) = 0.7796 (0.6772)		N Chi–sq(2) = 0.7190 (0.6980)		N Chi–sq(2) = 0.9807 (0.6124)	
	RESET F(1, 22) = 0.5155 (0.4803)		RESET F(1, 25) = 9.2479 (0.0055)**		Instruments: tbill, dtbill.	

of 1994 was the result of a renewed rise in the trade deficit, higher dynamism in the manufactures and a loss of reserves. A somewhat counterintuitive result is that, when these effects are discounted, there is no evidence of a significant impact from political uncertainty (except in Table 1, columns B' and C').

The evidence of a negative effect of output growth on the level of policy credibility deserves particular attention. The finding could be attributed to the impact of current output growth on the *future* trade deficit, but the empirical evidence advises against this interpretation. First, because arguably the most important effect of growth on the trade balance is contemporaneous, and that effect is already captured by the td coefficient; second, because of the positive rer coefficient, when in fact a real currency appreciation is surely a sign of a future trade deficit rise; but most importantly, because the *lagged* mg coefficients are consistently (including the results in the next section) positive, even though the lagged effect of output growth on expectations via the current trade deficit is already captured by the td coefficient.

An alternative interpretation is that the positive effect of growth deceleration on exchange rate policy credibility came mainly from gains in reputation: in particular, the government's adherence to the disinflationary program in the face of economic deceleration may have been interpreted by market participants as evidence of the authorities' true intention to stick with the announced exchange rate policy. This interpretation, which postulates that there exists a connection between disinflationary intentions and exchange rate credibility, is supported by the statistically significant inflation coefficient: as domestic inflation and hence the scope for further disinflation fell, policy credibility tended to decline; in other words, agents did believe that the government was resorting to its exchange rate policy to reduce the domestic inflation rate.[5]

[5] The results concerning fr deserve a further comment. It has been frequently noted that, before the peso crisis, the Banco de México failed to announce with opportunity the level of the stock of foreign reserves. The presumption, of course, is that the central bank was trying to avoid further speculative pressure on the parity as reserves started falling. In this paper, however (as in several others that deal with the experience of different countries; for an influential study, see Rose and Svensson, 1994), we show that the international reserves come out with a positive, in most of the cases significant, effect on the level of policy credibility. A possible explanation is that the central bank purposefully began to retain relevant information only toward the end of 1994. Alternatively, given the fact that the central bank did not completely sterilize capital inflows in the period, the fall in the cete rate may reflect the resulting money supply shock. In fact, the analysis in section 3.2 below is based on the idea that a capital inflows shock tends to reduce the peso interest rate independently of the behavior of expectations.

3. Dispersed Expectations and Debt Shocks

So far we have assumed, following conventional practice, that changes in the interest rate differential reflect exclusively variations in the state of market expectations. Consider, however, that under the plausible assumption that expectations differ among market participants, the differential (*i.e.*, the excess return demanded to hold an asset) will reflect the expectations of the investor in the margin (for an early exposition, see Kahn 1954; for a recent discussion, Hartley 1996),[6] with the implication that the differential may change, irrespective of the overall behavior of expectations, by exogenous shifts in the position of the marginal investor. It may be possible to abstract from this factor in some cases, but not in that of Mexico during our period, when there were two major debt shocks, namely the dollar indexation of domestic debt in 1994 (a *protracted* supply shock) and the opening of the domestic bond market to foreign investment in December 1990 (a demand shock).

In this section we consider first the supply shock: a direct conclusion from a simple model is that the peso-dollar interest differential in Mexico tended to fall after March 1994 due to the rise in tesobono holdings in the private sector, irrespective of the evolution of expectations; we present some empirical evidence supporting this prediction. In the second part we take on the demand shock and analyze the behavior of the interest differential when the domestic bond market opens to foreign investment, assuming again expectations as given; although in this case the analysis is purely speculative, in that no formal statistical testing is presented, the basic results seem to reproduce important aspects of the Mexican experience in terms of interest rates and asset holdings.

3.1. Currency Debt Recomposition

Let us start by positing that there is disagreement among market participants regarding the level of the nominal exchange rate likely to prevail at the end of a given investment period, and construct a

[6] While mostly extraneous to recent macroeconomics, the assumption of dispersed expectations is central to the literature on the microstructure of foreign exchange markets; see, for instance, the introduction in Frankel *et al.* (1996).

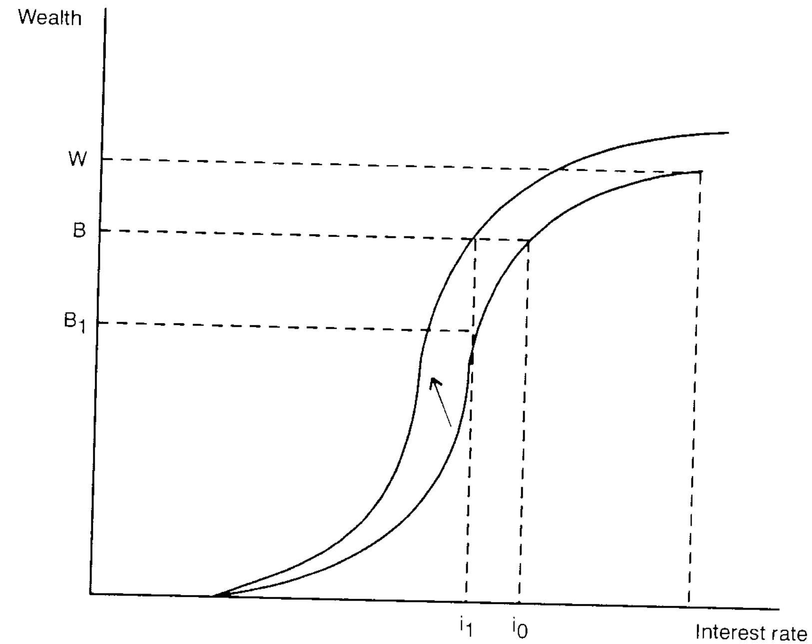
cumulative distribution of the total domestic wealth commanded by those market participants (which defines the aggregate portfolio size), ordered by the expected exchange rate (closest to the origin will be the investor expecting the lowest rate). Following Steindl (1990), we may allow any single market participant to entertain a variety of expectations, assuming individual wealth is distributed according to the relative strength with which each different expectation is held. Then, for any value of the exchange rate (S), the corresponding point in the cumulative distribution will show the amount of financial resources in the portfolios of market participants expecting a rate equal to or lower than S.

We assume there are only two types of short-dated financial assets: foreign bonds, denominated in dollars, and domestic, peso-denominated bonds (to keep the analysis simple, we assume there are no cash holdings). Given the interest rates at home and abroad, the desired portfolio composition will be a function of the expected currency depreciation; for example, if the differential between domestic and foreign rates is ${}_t d_\mu$, then the amount of wealth held in domestic bonds will represent those investments made under the expectation of a currency depreciation no greater than ${}_t d_\mu$; the remaining wealth will of course be invested in foreign bonds.[7]

The relationship between depreciation expectations and interest rate differentials as the basis for portfolio selection makes it possible to derive a cumulative distribution of total wealth ordered by the level of the domestic interest rate (since we are dealing with a small economy, we take the international interest rate, i*, as given); closest to the origin will be the investor expecting the lowest depreciation rate. For any interest rate level, the corresponding point in the cumulative distribution will show the amount of resources invested under the assumption of a currency depreciation no greater than i-i*. Thus there is a connection, governed by the distribution of exchange rate expectations, between the interest rate prevailing in each period and the amount of peso-denominated bonds issued by the authorities; in particular, the stock of bonds determines the interest rate that has to obtain in the market, reflecting the state of expectations behind the marginal investment. This is shown in Figure 5, where the quantity of bonds is B, the resulting interest rate i_0, and the amount of dollar-denominated bonds W-B.

[7] Note that we are simplifying the parity condition from which equation (1) is derived to $i = i^* + {}_t d_\mu$.

Figure 5. Interest Rate Determination



Within this framework, the effect of a recomposition of domestic debt toward dollar-indexed tesobonos is immediately seen. A reduction in the share of peso assets will result in a fall in the peso interest rate, even assuming unchanged expectations, because those investors with the highest expected depreciation rates will shift to dollar assets. The potential significance of this factor in the case of Mexico is easily illustrated: in the course of 1994, the end of period share of tesobonos in total domestic debt rose steadily from 5% in March to 40% in November (including central bank holdings; source: Mexican Treasury).

Empirically we examine the issue in two ways: first, we estimate again equation (4), after adding as a new explanatory variable the share of dollar-indexed bonds in total domestic debt, ids. Table 2 presents the results. Column B shows that the protracted effect of a rise in indexed debt has the expected negative sign: an increase in the share of tesobonos is associated with a statistically significant decline in the excess expected depreciation. In particular, the ids coefficient indicates that a 10 point rise in the share of dollar-indexed debt (a 0.1 rise in ids) tended to produce a 7 point gain in our indicator of policy credibility.

Table 2. Excess Expected Depreciation, 1991(3)-1994(11)

A	*B*	*C*	*D*	*E*
Method: OLS			*Method:* IV	
Variable	*Coefficient*	*t–prob*	*Coefficient*	*t–prob*
constant	3.652	0.9173	–118.120	0.2441
td	2.022	0.4914	10.668	0.1780
dtd	0.343	0.8415	–1.923	0.6097
d2td	–1.581	0.3759	–0.051	0.9892
rer	64.274	0.2932	369.490	0.0926
drer	–14.925	0.9039	–3.209	0.9900
d2rer	105.440	0.2066	–134.630	0.4305
mg	0.558	0.0094	1.316	0.0347
dmg	–0.253	0.0186	–0.619	0.0438
d2mg	–0.145	0.0831	–0.417	0.0757
p	–1.892	0.0137	–6.280	0.0382
dp	0.928	0.0690	3.284	0.0594
d2p	0.755	0.0916	1.967	0.0907
swb	0.878	0.6526	–11.021	0.1597
dswb	1.008	0.3692	3.065	0.2404
d2swb	1.417	0.1146	5.338	0.0715
fr	–1.425	0.0053	–5.100	0.0343
dfr	0.642	0.0349	2.188	0.0479
d2fr	0.225	0.3431	0.474	0.3525
ids	–69.792	0.0051	33.744	0.6507
dids	75.185	0.0326	–51.359	0.6038
d2ids	5.924	0.7162	–45.989	0.3073
nafta	–3.588	0.0678	–12.327	0.0599
pact	0.327	0.6785	–0.018	0.9913
pi	–10.005	0.0417	9.957	0.5024

OLS	IV
	Specification Chi–sq(1) = 0.0602 (0.8062)
R–sq = 0.9268	
RSS = 38.4972	RSS = 163.5876
DW = 1.30	DW = 1.97
AR 1–2 F(2, 18) = 2.0553 (0.1571)	AR 1–2 Chi–sq(2) = 0.4688 (0.7911)
ARCH 2 F(2, 16) = 0.5576 (0.5833)	ARCH 2 F(2, 16) = 0.0974 (0.9077)
N Chi–sq(2) = 3.4924 (0.1744)	N Chi–sq(2) = 2.1949 (0.3337)
RESET F(1, 19) = 1.1809 (0.2908)	Instruments: tbill, dtbill.

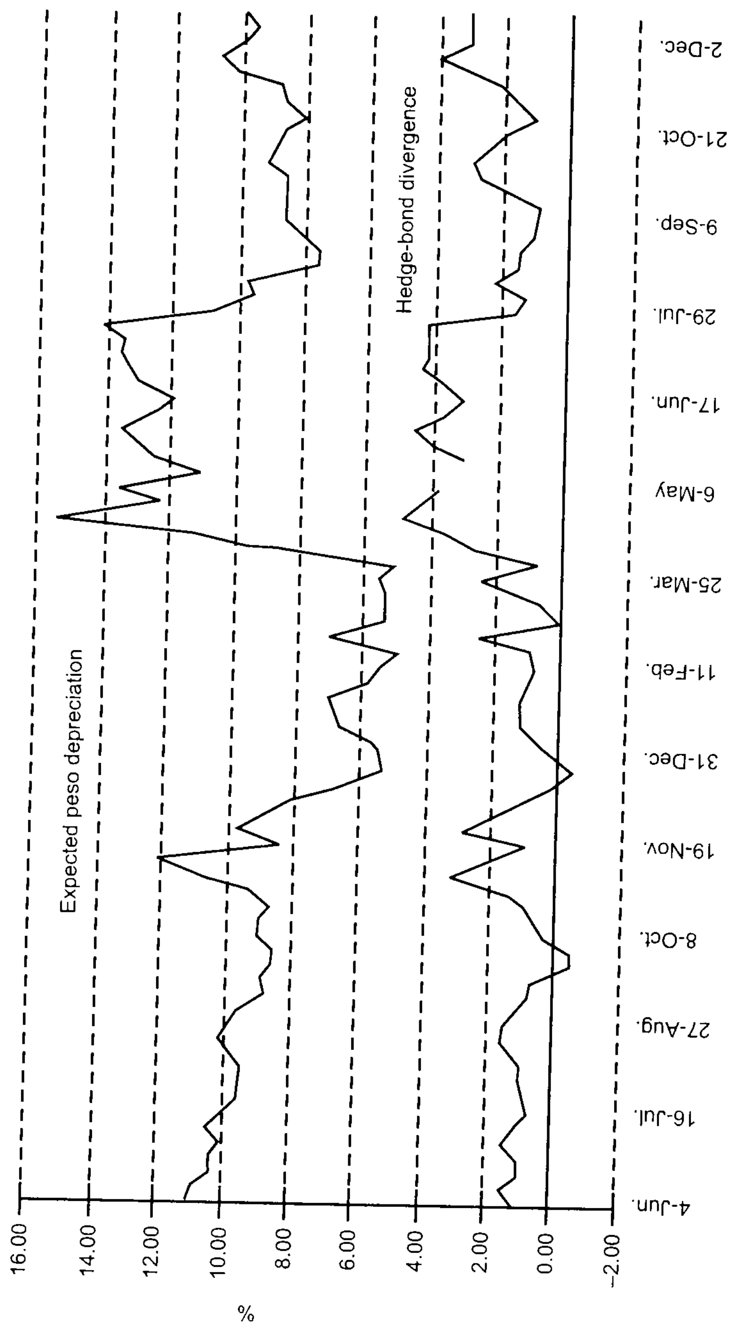
Note that introducing the new variable has some effects on the other variable's coefficients: in particular, those corresponding to td, rer and swb lose statistical significance, while that of pi becomes negative; on the other side, although the absolute size of the mg, p, fr and nafta coefficients falls, the signs carry over from Table 1 and remain statistically significant. In other words, the influence from macroeconomic fundamentals remains significant (except for td) and the evidence of gains in reputation survives. When we estimate the equation by IV (column D), the same conclusions concerning fundamentals apply, but the ids coefficient changes to positive and becomes statistically irrelevant.

Thus the results shown in Table 2 lend some mixed support to the idea that the dollarization of domestic debt of 1994 tended to lower the value of our indicator of (excess) expected depreciation. A second source of evidence comes from data generated in the foreign-exchange hedge market, created by the Banco de México in the aftermath of the 1982 debt crisis (Mansell 1992). The reason for looking at these data, in particular the depreciation rates implicit in the hedge contracts, is straightforward: the introduction of tesobonos had a direct effect on the position of the marginal investor in the bond market, but only an indirect one in the hedge market (for example, greater tesobono holdings may have reduced the forward demand for dollars, pulling down the future price of dollar and probably the spot rate as well). Hence we can expect to find a divergence of expectations, measured in the margin, between participants in these two markets, as the share of tesobonos rose.[8]

Figure 6 presents the weekly series for the annualized expected depreciation rate from 90-day hedge contracts from mid 1993 to the end of 1994 (before the devaluation). The broad pattern is similar to that of the bond market, consisting basically of a downward trend during 1993 and early 1994, a discrete upward shift in late March, and then a stabilization and eventual improvement as the year drew to a close. But note the series corresponding to the difference between expected depreciation rates in these two markets: from mid 1993 until the end of the first quarter of 1994, the difference in expectations was moderate, most of the time below 2 percentage points. For the rest of

[8] The following results are particularly important, given that the regression results in Table 2 have the drawback that we are not able to reject the null hypothesis of unit root for ids, even at a 10% significance level (see Table 4).

Figure 6. Hedge-Market Expectations, 1993-1994



Weekly series; ends on 16 December 1994, source: Banco de México and *El Financiero.*

the year, however, there appears to be a distinctive rise, particularly in the weeks immediately following the March shock, and then again during the final weeks of the year. Casual empiricism at least suggests that the rise is significant: taking quarterly averages, the difference shifted from 1.09 to 3.23, 2.15 and 2.54 points in the course of the year.

To examine more formally these data, we estimate a regression equation of the hedge market's expected depreciation rate on the bond market's counterpart and a dummy starting at zero and taking a value of 1 from the last week of March onward (when the debt recomposition started). The results in Table 3, based on weekly observations for the period 1993(23) to 1994(49), show as expected a statistically significant, positive dummy coefficient: during the period of indexation, the expected depreciation rate in the hedge market rose in relation to that in the bond market. Since the result is not entirely satisfactory in that there is evidence of autocorrelated errors and misspecification, we re-estimate the equation using as additional independent variables the hedge market's lagged expected depreciation rate and the first difference of the bond market's expected depreciation rate. With this modification, the error autocorrelation is eliminated, while the positive, statistically significant dummy coefficient persists.

Finally, to gain further insight, we perform unit root tests on the regression residuals as a simple way of determining whether there is a basis for suspecting cointegration between expectations in both markets (see Charemza and Deadman, 1992). Ideally we would like to see signs of cointegration appear only after the dummy for debt recomposition has been introduced. First, we verify that the null hypothesis of a unit root is rejected, at a 5% significance level, for expectations in both the hedge and bond markets (see Table 4); thus in practice we can disregard the risk of spurious regression results in Table 3. Next we perform Dickey-Fuller tests on (a) the difference in expectations between the two markets, (b) the residuals from a regression of hedge market expectations on bond market expectations alone, (c) the residuals from the first regression in Table 3, and (d) the residuals from the second regression in Table 3.

The test results are as follows: the unit root null hypothesis cannot be rejected for case (a), even at a 10% significance level, whereas for cases (b) to (d), rejection occurs at a 1% level (using again the critical values supplied by Charemza and Deadman, 1992). Thus there is evidence suggesting the existence of cointegration, starting with case (b). Although this does not provide direct support for the

Table 3. Hedge-Market Expected Depreciation, 1992(23)-1994(49)

A	B	C	D	E	F
Variable	*Coefficient*	*t-prob*	*Variable*	*Coefficient*	*t-prob*
constant	–0.1324	0.8019	constant	0.2708	0.5389
ed–bond	1.1629	0.0000	ed–hedge (–1)	0.6337	0.0000
dummy	1.6323	0.0000	ed–bond	0.3865	0.0040
			ded–bond	0.7127	0.0000
			dummy	0.5869	0.0182
	R–sq = 0.8326			R–sq = 0.8948	
	s = 1.0051			s = 0.8074	
	DW = 0.885			DW = 1.91	
	AR 1–2 F(2, 74) = 17.258 (0.0000)**			AR 1–2 F(2, 72) = 0.8978 (0.4120)	
	ARCH 2 F (2, 72) = 4.7233 (0.0118)*			ARCH 2 F (2, 70) = 0.9108 (0.4069)	
	N Chi–sq(2) = 0.3533 (0.8381)			N Chi–sq(2) = 3.5061 (0.1732)	
	RESET F(1, 75) = 16.466 (0.0001)**			RESET F(1, 75) = 5.3478 (0.0236)*	

Table 4. Unit Root Tests

eed	−1.8137 (c)	eed = excess expected depreciation
td	−3.2898 (a)	
rer	−3.4549 (a)	
swb	−0.5886	
fr	−2.1118 (c, d)	
mg	−4.1505 (a)	
p	−3.0836 (b, e)	
tbill	−2.0444 (c, d)	
ids	3.2311	
ed–hedge	−2.38 (b)	
ed–bond	−2.507 (b)	
diff	−0.9249	diff= ed–hedge minus ed–bond
res1	−3.131 (a)	res1 = residuals from regression of ed–hedge on ed–bond
res2	−4.638 (a)	res2 = residuals from first regression in table 3
res3	−8.351 (a)	res3 = residuals from second regression in table 3

Unit root null hypothesis:
(a) rejected at 1%
(b) rejected at 5%
(c) rejected at 10%
(d) inconclusive at 5%
(e) inconclusive at 1%
Based on critical test values supplied in Charemza and Deadman (1992).

postulated effect of the introduction of tesobonos, consider that there is indeed an important rise in the t-values when we introduce the dummy for debt recomposition: in particular, they rise in absolute value from 3.131 in case (b), up to 4.638 and 8.351 in cases (c) and (d) (see Table 4).

In brief, there is evidence that the peso-dollar interest rate differential in the domestic bond market tended to decline as the share of tesobonos rose, after taking into account the effect of other macroeconomic variables on expectations. This effect would help to explain why, despite the political uncertainty of 1994, the interest differential eventually returned to relatively low levels before the devaluation. This negative relationship could in principle be attributed to the signaling effect of the government's decision to index, and not to a change in the marginal investor's position in the bond market: the logic would be that, by linking the peso value of debt to the nominal exchange rate and thus raising the fiscal cost of a devaluation, the authorities showed their genuine commitment to a no-devaluation policy (see Dornbusch 1996 for a recent discussion). This represents a powerful incentive and thus it is probably one factor behind the regression results in Table 2. Yet this signaling effect cannot account for the whole story, in particular the hedge-bond market divergence, given that there is no reason to assume that participants in the hedge market were less receptive to the government's signals than those in the bond market, at least with regard to such major decisions as the currency composition of public debt.

It could also be argued that, since foreign investors were not allowed to trade in the hedge market, the observed hedge-bond market divergence reflected a sudden differentiation of expectations between domestic and foreign residents. But this explanation implies an implausible segmentation of expectations: it would have to be assumed that foreigners were in the margin in the bond market throughout the entire period (so that the interest rate differential reflected in every moment their expectations), a sign that they were more pessimistic than domestic investors in that market, and yet that they suddenly turned less pessimistic than domestic residents in the hedge market.[9]

[9] Frankel and Schmukler (1996) present evidence from three Mexican closed-end country funds, indicative of a divergence in expectations between foreign and domestic investors, with the latter turning suddenly more pessimistic at the onset of crisis. Their results, based on the behavior of fund discounts, show, however, that such divergence appeared only at about the time of devaluation; in fact, the evolution of discounts in two of the funds reveals that during most of

It seems safe then to conclude that the relatively good behavior of the cete-tesobono interest rate differential in the final months of 1994 should be partly attributed to a change in the position of the marginal investor in the cete market, resulting from the exchange rate indexation of domestic debt; in this way, the cete rate would have tended to decline because those investors expecting the highest depreciation rates were shifting to domestic dollar assets.[10]

3.2. Financial Liberalization and Capital Inflows

To conclude this section, we formally analyze the dynamics of interest rate and asset holdings after a small country's bond market opens to foreign investment, focusing in particular on the transition period of portfolio adjustment. We do this to reflect upon the likely effects of the opening that took place in Mexico in December 1990, although as we mentioned before the approach is highly speculative in that we postpone for future work the revision of econometric evidence.

Thus for our present purposes, we start by noting that it is possible to draw a cumulative distribution of the wealth of market participants according to their exchange rate expectations, similar to that in Figure 5, but for the rest of the world (not shown). At the interest rate differential i_0–i^*, desired holdings of domestic bonds are equal to B^*, but since foreigners are not allowed to participate in the domestic market, B^* also corresponds to the initial gap between actual (zero) and desired holdings. Assume next that the legal barriers to foreign investment are removed. There will be then a gradual reduction in the gap between actual and desired stocks, which will yield a capital inflow as long as the portfolio adjustment is under way; but since the quantity of domestic bonds in the private sector is fixed, there has to be a transference of bonds from domestic residents to foreigners, which to happen requires a reduction in the domestic interest rate.

1994 foreign investors were more pessimistic than their domestic counterparts. In any event, it should be noted that the existence of discounts reflects disparities in profit (not exchange-rate) expectations; this two types of expectations may even be inversely related, if, as seems plausible to assume for an international fund, the constituting firms are located mainly in the tradable goods sector and their profitability is affected positively by a devaluation.

[10] This effect is reinforced if we assume that *a)* investors are risk-averse, and *b)* those with the greatest degree of aversion shifted from cetes to tesobonos. This would have reduced the cete-tesobono interest differential if one assumes there is a statistically significant currency-risk premium (thanks to an anonymous referee for this comment).

The transference will produce a capital outflow exactly matching the inflow (abstracting for the moment from wealth effects; see below).

Naturally, as i declines, the foreigners' desired stock also falls, which contributes to eliminating the gap between actual and desired portfolio shares. The cumulative fall in the domestic interest rate eventually needed to re-establish world portfolio equilibrium (in the absence of wealth changes) can be obtained by adding the rest of the world to the domestic cumulative distribution; in Figure 5, this results in the new interest rate i_1. At this rate, home holdings of domestic bonds have declined to B_1 and those of foreign bonds increased to W–B_1; naturally, foreigners hold the remaining B–B_1 domestic bonds.

The interest rate adjustment will be gradual if, as seems plausible to assume, the shift from foreign to domestic securities takes time; this would reflect the varying speeds at which different foreign investors acquire the necessary information to enter the domestic market, the maturity structure of portfolios, etc. We can represent this process by the following equation,

$$di/dt = f(g - \alpha)W^*, \quad f< 0, \quad g'(i) > 0 \tag{5}$$

where W^* is foreign wealth, and g and α stand for the desired and actual shares of domestic bonds in foreign portfolios. This equation defines a horizontal i line in i,W^* space, along which the domestic interest rate is constant. Above the line there is excess demand for domestic securities and the interest rate falls; its position depends on α: as α rises during portfolio adjustment, the line moves upward.

We consider now wealth dynamics. We take world wealth (Ω) as given, so that domestic wealth is simply Ω–W^*, and changes in domestic and foreign wealth cancel each other out. Variations in private wealth arise from discrepancies between income and expenditure in the private sector; under fiscal equilibrium, any excess expenditure will appear as a deficit in the current account of the balance of payments. The change in foreign wealth will thus be equal to the home current account deficit, Q:

$$dW^*/dt = Q = T - i^*F + iB^* = T - i^*m(\Omega - W^*) + i\alpha W^*,$$

$$T_{W^*},\ T_i,\ m'(i) < 0 \tag{6}$$

where T is the home trade deficit (a negative function of foreign wealth and the interest rate because of expenditure effects), F denotes domestic holdings of foreign bonds, and m is the share of foreign securities in domestic portfolios (for simplicity, throughout the analysis we retain the assumption of no cash holdings and keep the nominal exchange rate fixed at 1).

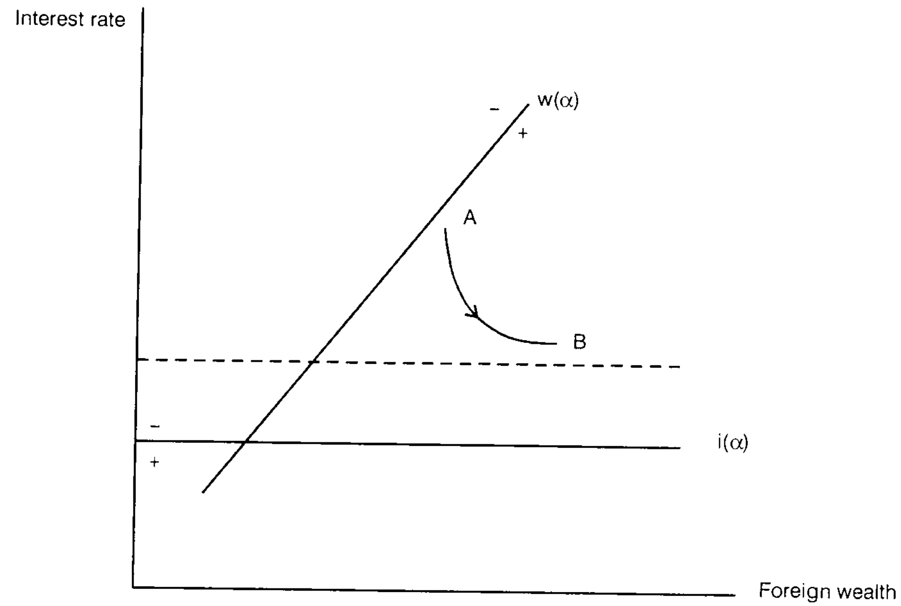
After imposing the $Q = 0$ condition, equation (6) defines a w line of stationary wealth. Interest rate and wealth variations have both portfolio and expenditure effects which make it difficult to establish on purely analytical grounds the line's slope. An interest rate rise, on the expenditure side, improves the trade balance, which could be offset by a domestic wealth rise; on the portfolio side, it raises the interest payments on foreign holdings of home securities and reduces desired home holdings of foreign securities, both increasing the current account deficit — this could be offset by a fall in foreign wealth. It seems in accord with economic experience that a rise in the domestic interest rate will reduce the current account deficit because of a relatively strong expenditure effect on trade. In such case, the w schedule's slope and the system's dynamic characteristics will depend on the strength of the wealth effect on expenditure.

With a relatively weak effect, correcting an interest rate rise's effect on the current account will require a rise in foreign wealth so as to increase the non trade part of the current account deficit. In i,W* space, the w line will be upward sloping and there will be a positive current account deficit to its right, where foreign wealth will hence be rising. With a strong wealth effect, on the contrary, the line will be downward sloping, with falling foreign wealth to its right. In the first case, an initial current account deficit will rise over time, whereas in the latter it will converge toward zero. Since the rising deficit better conforms to the characteristics of our period, we will focus on the former case, but it should be noted that a similar analysis could be carried out with a downward sloping w line, gradually shifting to the right because of a real currency appreciation.

The position of the w line changes with α. Again, assuming a weak expenditure effect of wealth variations and a strong effect from changes in the interest rate, the line will shift upwards as alpha rises: the increasing non trade deficit will be offset by some combination of higher i and lower W* values.

Figure 7 presents the i and w lines in i,W* space. It can be shown that, starting with a balanced current account, after the opening of

Figure 7. Trajectory During Portfolio Adjustment



the domestic bond market the economy will move to the region of falling interest rate and growing foreign wealth. The reason why i falls was already discussed. As to W*, consider that after the opening of the domestic market there will be initially a capital outflow exactly matching the inflow, as a result of the exchange of securities explained before, *i.e.*, $dF/dt = dB^*/dt$. Thus the *immediate* variation in the current account deficit (*i.e.*, before taking into account the deficit's wealth effects) is given by

$$dQ/dt = (i - i^*)dB^*/dt, \tag{7}$$

which shows that there will be an erosion as long as $i > i^*$. Thus, when the domestic bond market opens to foreign investment, we shift to the right of the w line, to a point such as A: over time there will be a fall in the domestic interest rate together with a rise in foreign wealth.

Assume the portfolio adjustment to the financial opening has been completed, so that $B^* = gW^*$. Then we will have

$$dW^*/dt = Q = T - i^*m(\Omega - W^*) + igW^*, \tag{6a}$$

where now there is an additional portfolio effect of interest rate variations via g. If international reserves are to remain constant, the domestic interest rate has to adjust to produce a net capital surplus equal to the current account deficit. The demand for domestic securities can be specified, in the standard way, as

$$B = h\Omega + (g - h)W^*, \quad h'(i) > 0 \tag{8}$$

where h is the desired share of domestic bonds in domestic portfolios as a function of the interest rate differential. In general, we can assume that $g - h < 0$, as a reflection of home bias in private portfolios (see Obstfeld 1995). If domestic authorities refrain from financing the current account deficit, which would in fact require an exchange of reserves for domestic bonds with the domestic private sector, B will remain constant. Moreover, if we recall that $Q = -dW/dt = dW^*/dt$, then time differentiation of (8), and solving for di/dt yields,

$$di/dt = Q(h - g)/[h'\Omega + (g' - h')W^*], \tag{9}$$

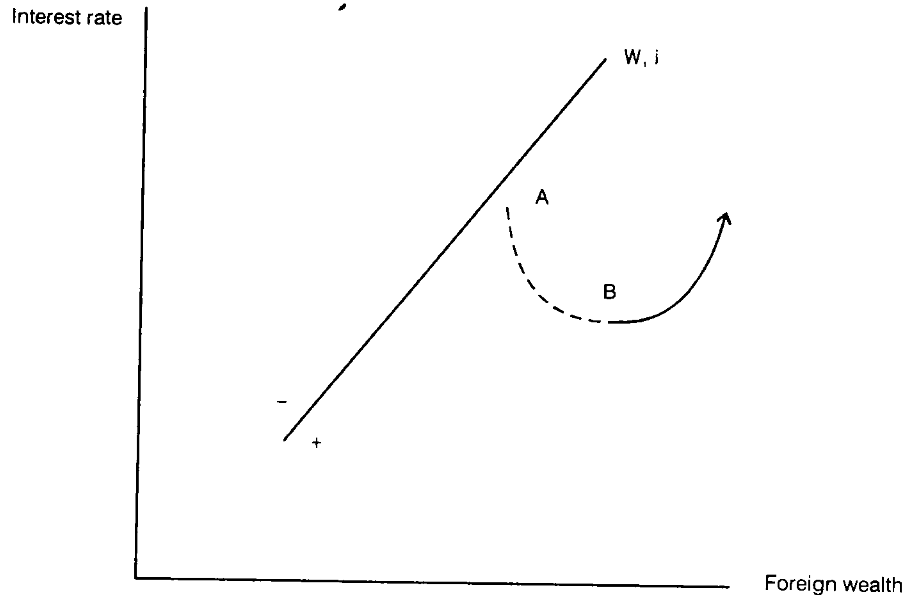
which shows that, after the portfolio adjustment is over, the interest rate rises in proportion to the current account deficit (given that the country's current account deficit is a extremely small fraction of world wealth, both the portfolio shares and foreign wealth will change very slowly).

A comparison of (6a) and (9) shows that the w and i lines are identical after the portfolio adjustment is over, representing the combinations of interest rate and foreign wealth that yield a zero current account (see Figure 8). Thus the complete trajectory is as follows: after the opening of the domestic bond market, the interest rate starts falling, moving from A to B; once the portfolio adjustment is over (point B in Figures 7 and 8), the movement is reversed and the interest rate begins rising.[11] Throughout the process, there is a home current account deficit and domestic wealth is falling.

The interest rate follows a u-shaped path, which is independent of the behavior of exchange rate expectations. The pattern is a result of a change in the dynamics of the phase space, in particular in the way

[11] In terms of Figure 5, the redistribution of world wealth keeps changing the shape of the cumulative distribution (because of home bias), thus raising continuously the domestic interest rate.

Figure 8. Complete Trajectory



the interest rate behaves in relation to the i line. During portfolio adjustment, there is an excess demand for home securities, which is what makes it possible to finance a current account deficit — *i.e.*, to transfer domestic assets to the rest of the world — with a falling interest rate. After the excess demand is removed, the only way to continue the transfer is by offering a rising interest rate to foreign investors. Left to itself, the economy would show ever increasing i and W* values; to avoid this unsustainable path, the real exchange rate eventually has to depreciate and in that way shift the w line to the economy's current position. Note though that how much time passes before the exchange rate adjustment takes place is important: the longer the delay, the further northeast the economy's stable position will be, as a reflection of the accumulation of foreign debt (see Artis and Taylor 1995).

The interest rate and wealth variations that take place during portfolio adjustment and afterwards have implications for the evolution of asset holdings. During the adjustment, the interest rate fall results in a lower desired share of domestic securities at home (and an equal rise in the share of foreign securities). Of course, this is what makes possible the portfolio recomposition after the market is opened.

But there is simultaneously a wealth effect from the current account deficit: for any given interest rate, the fall in domestic wealth tends to depress home holdings of both domestic and foreign securities. Taking the two effects into account, the implication is that during the adjustment home holdings of home securities will fall (due to lower wealth and interest rate), whereas home holdings of foreign securities will not rise as much as suggested by the interest rate effect.

After the adjustment, both the interest rate and foreign wealth rise. The interest rate effect tends to raise the overall (home and foreign) demand for home securities, and the opposite for foreign securities, whereas the wealth effect reduces the home demand for both types of securities, and increases it abroad. As a result, foreign portfolios will show rising holdings of home securities, induced by both effects, which means that home holdings of home securities will have to fall (since the overall supply of domestic securities is constant). Home holdings of foreign securities will also fall, with both effects acting in the same direction (that is, domestic residents will sell both home and foreign securities to finance their excess expenditure).

In summary, the importance of this analysis for our present purposes is its suggestion that, besides the influence of macroeconomic fundamentals such as studied in section 2, the opening of the Mexican bond market to foreign investment in late 1990 was a reinforcing factor of the downward trend in the cete-tesobono interest rate differential seen from late 1992 to early 1994. Clearly, a lag in portfolio adjustment needs to be assumed for the story to make sense. In this regard, it is significative that the net capital inflow into the peso bond market jumped, according to balance of payments data, from only $3.4 billion in 1991 (*i.e.*, the year following the liberalization) to $8.3 billion in 1992 and $7.5 billion in 1993. Also supportive in relation to the implied changes in asset holdings, is the estimate that, by the end of 1994, about 70% of tesobonos and 50% of cetes were in foreign hands (see Folkerts-Landau *et al.,* 1996).

4. Summary

The level of exchange rate policy credibility in Mexico, as measured by an adjusted cete-tesobono interest rate differential, varied widely in the period 1991-1994. Most notably, the market moved from high skepticism in late 1992, with excess expected depreciation peaking at

10% per year, to full credibility in the second half of 1993 and early 1994, when in fact the adjusted differential turned negative. Following a 14 point discrete jump in the first quarter of 1994 and a partial reversal later on, excess expected depreciation stood at about 2.5% just before the December 1994 devaluation. These movements in policy credibility appear to be significantly associated with changes in macroeconomic fundamentals, such as the domestic inflation rate and the central bank's international reserve position — positively —, and output growth and the trade deficit — negatively —, and policy shocks such as the ratification of NAFTA. In particular, the shift toward high levels of credibility in the course of 1993 and early 1994 can be explained by a build-up of government disinflationary reputation, ever increasing reserve holdings at the central bank, the stabilization (although at a high level) of the trade deficit, and the NAFTA factor.

We argued that the stability of the interest differential in the final months of 1994 was supported by a process of increasing indexation of domestic debt to the dollar, both indirectly (by raising the fiscal cost of a devaluation), and directly (by removing the group of investors with the highest depreciation expectations from the cete market). This helps in explaining the puzzling observation of an apparent improvement in expectations in the midst of strong political uncertainty. More generally, we can conclude that the relatively low cete-tesobono interest rate differential registered before the devaluation was the combined outcome of the notably high level of policy credibility already achieved by the time of Colosio's assassination, and the steady exchange rate indexation of domestic debt. Finally, we speculated that the opening of the domestic bond market to foreign investment in December 1990, which was followed with some lag by massive capital inflows, was also a factor behind the reduction in the cete-tesobono differential.

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Price and Rate Regulations for the Mexican Natural Gas Industry: Comments on Policy Decisions

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Abstract: After the regulatory reform experienced in the Mexican gas sector, three areas with market power remained. Production is a legal monopoly of Pemex. Transportation and distribution are natural monopolies. Distributor's gas sales to (mainly residential) customers are potentially monopolistic in case of lack of competition from marketers or substitute fuels. This paper presents the theoretical concepts and international lessons considered during the design of the price and rate regulations to limit these areas of market power. Benchmarking is used to control Pemex gas prices, while a sophisticated revenue cap methodology is employed to regulate transportation and distribution rates. All of these mechanisms provide incentives for productive efficiency, take care of allocative efficiency, and minimize the cost of regulation. The paper also points out lessons from the policy design process and some of the potential pitfalls of regulations as well.

Resumen: Después de la reforma reguladora en el sector del gas mexicano la producción es aún un monopolio legal. El transporte y la distribución son monopolios naturales. Las ventas de gas de los distribuidores a los consumidores (principalmente residenciales) son potencialmente monopolísticas cuando no existe competencia de comercializadores o de combustibles sustitutos. Este documento presenta conceptos teóricos y lecciones internacionales considerados durante el diseño de la regulación de precios y tarifas. Para regular los precios del gas nacional se usa una referencia internacional, mientras que para regular las tarifas de transporte y distribución se emplea una metodología de ingreso máximo. Estos mecanismos promueven la eficiencia en la producción y en la asignación, y minimizan los costos de la regulación. También se destacan las lecciones del proceso de diseño de política así como algunos problemas potenciales de las regulaciones.

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