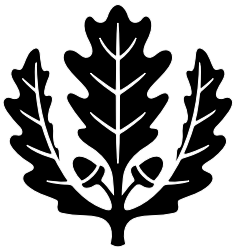

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Fundamental Determinants of Mexico's Exchange-Rate Crisis of 1994

Polly R. Allen
University of Connecticut

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341 Mansfield Road, Unit 1063
Storrs, CT 06269–1063
Phone: (860) 486–3022
Fax: (860) 486–4463
http://www.econ.uconn.edu/

FUNDAMENTAL DETERMINANTS OF MEXICO'S EXCHANGE-RATE CRISIS OF 1994

by
Polly Reynolds Allen
The University of Connecticut

In December 1994 Mexico's exchange-rate crisis sharply reversed seven years of slow growth. With hindsight and additional information, Mexico's large current-account deficit and excessive reliance on short-term dollar-denominated borrowing were clear signs of an overvalued peso. The suddenness and severity of the crisis are harder to explain. Economists have difficulty in modeling the precise timing of the crisis (Obstfeld and Rogoff 1995 and Flood, Garber, and Kramer 1995). In general, models of short-run movements in nominal exchange rates have not been supported empirically (Meese and Rogoff 1983 and De Grauwe 1989). More remarkable in the case of Mexico, economists could not agree in the months before the crisis on a fundamental diagnosis of Mexico's exchange-rate policy (Dornbusch and Werner 1994).

The crisis followed a seven-year period of widely praised reforms by the Mexican government. Aspe (1993) describes Mexico's program for bringing down inflation, which had peaked at almost 600 per cent per year in one month of 1987. Mexico rejected the standard neoclassical prescription of contractionary monetary and fiscal policies in favor of a program of structural reforms, including liberalization and reform of the financial markets, trade liberalization culminating with NAFTA, privatization of state-owned industries, and tax and fiscal reforms. At the core of the program was a series of Pacts among business, labor, agriculture and the government to control wages and prices and to stabilize the nominal exchange rate. Inflation fell from 160 per cent per year in 1987 to 45 per cent in 1988 and to less than 20 per cent in subsequent years.

A key factor in the Pacts was the promise of limited and controlled nominal depreciation of the peso against the dollar, cumulatively totalling 56 per cent from 1988 to November 1994, far short of Mexico's cumulative price increases of some 250 per cent. Dornbusch and Werner (1994), measuring Mexico's real exchange rate in several ways, show a real appreciation of the peso from 1987-1993 in the range of 60 to 80 per cent. This appreciation occurred in spite of a 14 per cent fall in Mexico's terms of trade, a large component of the real exchange rate. Mexico also ran overall balance-of-payments surpluses from 1990-93, accumulating over $7 b. of reserves in 1993 alone. Left to the markets, the real appreciation would have been even greater. Then, in 1994, increased concern about Mexico's political situation reduced capital inflows, leading to large reserve

losses. In December, the government devalued, stimulating further speculation that sent the peso into a free-fall.

Eight months before the crisis, Dornbusch and Werner summarized the opposing views of economists. On one side, the "equilibrium view" maintained that Mexico's investment opportunities, increased productivity, fiscal restraint, and newly liberalized trade and capital flows justified the continuing real appreciation. On the opposite side, Dornbusch and Werner argued that the rising current-account deficit, slow growth of output, and real appreciation relative to purchasing power parity showed an increasingly overvalued peso. As it turned out, they were correct about the overvaluation, and their model of an incomes policy provides insight into Mexico's growing disequilibrium.

But purchasing power parity is not an adequate measure of the equilibrium real exchange rate, which is influenced by real fundamentals. Yet fundamental changes of increased investment and government saving suggested to those holding the "equilibrium view" that Mexico's real appreciation was sustainable.

The fundamentals are crucial, but need to be analyzed in the context of a credible model describing the interrelated trajectories of the equilibrium real exchange rate and other variables, such as output, investment, consumption, and saving. For a country where capital moves freely, the model must incorporate fundamental determinants of long-term capital flows and the influence of the country's changing debt to foreigners. The simple, dynamic neoclassical model I describe here emphasizes the roles of investment, saving, and long-term capital flows in determining an economy's equilibrium trajectory. The resulting equilibrium real exchange rate is labeled the NATREX--the **NAT**ural **R**eal **EX**change rate.

If prices of goods are flexible and net capital flows largely reflect long-term investment and lending, market pressures will move the real exchange rate toward its equilibrium trajectory, regardless of nominal exchange rate policy. But when a country controls prices (as Mexico did, through the Pacts), the lack of price flexibility can prevent the real exchange rate from moving toward equilibrium. Equally important in Mexico's case, large short-term net capital flows can distort the balance of payments away from a sustainable equilibrium trajectory. Pressures can build, eventually leading to a crisis. Knowledge of the fundamentals and the corresponding equilibrium trajectory of the exchange rate become essential for sound policy.

Before the crisis, a comparison of the Mexican economy's trajectories with the equilibrium trajectories of the NATREX model would have provided a warning of the underlying disequilibrium and instability of Mexico's course. Since the crisis, many economists (e.g., Feldstein 1995 and Summers 1995) have noted Mexico's low saving rate and the implications for Mexico's growth of such low saving. More important in explaining Mexico's exhange-rate crisis were the dynamics of its national saving rate, which fell from 18 per cent of GDP in 1988 to only 15 per cent in 1992 and 1993. In addition to the positive fundamentals of Mexico's reforms, such as growing investment and increased government saving, Mexicans were borrowing to finance almost twice as much consumption as investment.

The NATREX model provides a theoretical foundation for describing an economy's *equilibrium* responses to changes in saving and in investment. For countries with fairly flexible prices, NATREX models have provided encouraging empirical support for movements of real exchange rates in response to changes in real fundamentals (Crouhy-Veyrac and Saint Marc 1995, Lim and Stein 1995, Stein 1995a and Stein 1995b, and Stein and Sauernheimer, 1995). But the changes in Mexico's investment, saving, current account, and real exchange rate are inconsistent with the equilibrium trajectories of the NATREX model. For Mexico, the NATREX model is useful, not as a picture of what actually happened, but to identify the fundamental problems--increased borrowing from foreigners in the face of declining national saving, exacerbated by an overvalued and appreciating real exchange rate. The dynamics of Mexico's rapidly falling saving, increasing borrowing, and appreciating real exchange rate--clear signs of an unstable trajectory--were the underlying cause of Mexico's exchange rate crisis.

A SIMPLE NATREX MODEL

The NATREX model is a real, medium-run to long-run model with high capital mobility, in which the goods market is cleared by the real exchange rate. Investment and capital flows lead to changes in the stocks of capital and net foreign debt, which in turn influence the demand and supply for goods. The equilibrium real exchange rate (the NATREX), continually clearing the market for goods in the medium run, gradually evolves until the economy reaches a steady state, where the stocks of capital and debt (per unit of effective labor) are constant. For simplicity, consider here the case of a stationary economy with zero growth.

The real exchange rate, R, is defined as the foreign-currency price of domestic currency, E, multiplied by the ratio of domestic to foreign price levels, P/P* (GDP deflators),

(1) $R = EP/P^*$,

a rise in R indicating real appreciation of the currency. The asterisk denotes foreign variables. Define the price levels as

(2) $P = P_n^a P_2^b P_1^{(1-a-b)}$ and (2') $P^* = P_n^{*a^*} P_1^{*b^*} P_2^{*(1-a^*-b^*)}$,

where good n is nontradeable, good 1 is exported and good 2 is imported by the home country. Assuming the law of one price for tradeable goods,

(3) $P_1 E = P_1^*$, and (3') $P_2 E = P_2^*$,

the real exchange rate for the home country can be written as a geometric average of the relative price of nontradeables to exportables in each country, R_n and R_n^*, and the home country's terms of trade, T:

(1a) $R = R_n^a R_n^{*a^*} T^{(1-b-b^*)} = z R_n^a$

where $R_n = P_n/P_1$, $R_n^* = P_n^*/P_2^*$, $T = P_1/P_2$, and $z = R_n^{*a^*} T^{(1-b-b^*)}$. This general formulation for the real exchange rate (Allen 1995) allows for the effects of changes in the relative prices of nontradeables to tradeables and in the terms of trade. It can be applied to a variety of models, and is empirically measurable.

The model describes a hypothetical medium-run equilibrium, where output is at its natural level and the basic balance of payments is in equilibrium. Cyclical, speculative, and short-run expectational factors are played out in the medium run and are ignored. Stocks of capital and net foreign debt are held constant in the adjustment to this medium-run equilibrium, but then begin to change as a result of investment and capital flows. Since changing stocks of capital and foreign debt continue to alter market equilibrium, the NATREX is a moving equilibrium real exchange--an equilibrium trajectory rather than level.

The basic NATREX model can be summarized in three equations --a medium-run market clearing equation (4) and dynamic equations for the stocks of capital and foreign debt, eqs. (5) and (6). [1] All stocks and flows are written in terms of the export good 1. Market equilibrium requires that national investment, I, minus national saving, S, plus the current account, CA, sum to zero.

(4) $I - S + CA = 0$.

The current account responds to changes in the real exchange rate, declining with real appreciation. Equilibrium is achieved through adjustments in the real exchange rate, which bring the current-account deficit (-CA) to equal the difference between national investment and national saving (I-S).

Assuming that the securities markets clear and that central banks do not intervene in the foreign-exchange market in the medium run, eq. (4) can be read either as zero excess demand for goods or as basic balance-of-payments equilibrium, where the current account is offset by non-speculative long-term net capital flows. National investment and national saving include both public and private flows, no distinction being made between public and private.

Perfect long-term capital mobility assures that the country can borrow freely at $r^* + \rho$--the world real long-term interest rate, r^*, plus an exogenous risk premium, ρ. Behaviors of both investors and consumers are derived from optimizing behavior based on all current information, but without perfect foresight. Given the uncertainty of future real disturbances, the trajectory of the real exchange rate cannot be predicted, even when the underlying structure of the model is known. Market participants know that the real exchange rate will change but cannot--and do not--predict its trajectory. As a consequence, long-term capital mobility equates the domestic with the foreign long-term real interest rate, adjusted for the risk premium.

The remaining two, dynamic equations describe the trajectories of the capital stock and net debt to foreigners. Desired national investment, I, leads to changes in the capital stock, k, while desired net capital inflows, I-S, lead to changes in the net debt to foreigners, F.

(5) = I, = 0 in the steady state, and

(6) = I-S , = 0 in the steady state.

In any medium run, the desired rates of saving, investment and the current account depend on the levels of k and F, given exogenous factors such as the level of productivity, the rate of time preference, the world rate of interest, the risk premium, and the terms of trade. Net long-term capital inflows (I-S>0), lead to increases in the foreign debt, F, which affects both saving and the current account. Positive investment (I>0) raises the capital stock, k, which influences all three flows--investment, saving and the current account. An exogenous

increase in productivity of capital, u, increases investment, while an exogenous increase in time preference, σ, increases consumption and reduces saving. A rise in $r^*+\rho$ reduces investment. The real exchange rate, R, affects only the current account, a rise in R (real appreciation) reducing a current-account surplus or increasing a deficit. [2] The model is described in more detail in the Appendix.

The three basic equations become

$$\underset{-\ +\ -}{I(k;u,r^*+\rho)} - \underset{?\ +\ -}{S(k,F;\sigma)} + \underset{-\ ?\ -\ -\ -}{CA(R,k,F;u,\sigma,T)} = 0, \quad (4a)$$ [3]

$$\underset{-\ +\ -}{= I(k;u,r^*+\rho)}, = 0 \text{ in the steady state,} \quad (5a)$$

$$\underset{-\ +\ -}{= I(k;u,r^*+\rho)} - \underset{?\ +\ -}{S(k,F;\sigma)}, = 0 \text{ in the steady state.} \quad (6a)$$

Saving equals GNP (output minus interest payments to foreigners) minus consumption,

$$S = \underset{+}{y(k)} - [r^*+\rho]F - \underset{+\ +}{C(k-F;\sigma)}, \quad S_F = -(r^*+\rho) + C_w, \quad (7)$$

where wealth w = k-F.

Stability requires that a rising capital stock gradually decrease investment ($I_k<0$) and that rising foreign debt gradually increase saving ($S_F>0$) and so reduce borrowing.

FUNDAMENTAL DISTURBANCES IN PRODUCTIVITY AND TIME PREFERENCE

The NATREX approach is designed to show (i) how fundamental changes in desired net capital flows influence the equilibrium real exchange rate and (ii) how an increase of borrowing leads to different trajectories for the equilibrium real exchange rate, depending whether the country borrows to finance new investment or new consumption. Borrowing for either purpose leads in the medium run to real appreciation and then to rising debt, but only investment increases the capital stock. Changes in both debt and the capital stock affect market equilibrium and the trajectory and long-run change of the equilibrium real exchange rate. Borrowing to finance consumption leads ultimately to lower consumption and real depreciation, whereas borrowing to finance

investment leads eventually to higher output, greater consumption and, likely, long-run real appreciation.

Figure 1a graphs desired long-term capital inflows, I-S, and the current-account deficit, -CA, in relation to the real exchange rate, R. The real exchange rate has no effect on either investment or saving, but positively affects the current-account deficit. In medium-run equilibrium, eq. (4a), long-term net capital inflows equal the current-account deficit, whereas long-run equilibrium (in an economy with no growth) requires zero capital flows and a balanced current account. Starting at point *a* (in long-run equilibrium where I-S = -CA = 0), increased borrowing for any purpose will raise I-S, shifting the I-S curve right to (I-S)'; use of the newly borrowed funds to purchase imports shifts -CA to the right as well, to -CA'. To the extent that the newly borrowed funds are used for domestic goods, I-S > -CA at R_0, and the economy moves to point *b*. The real exchange rate appreciates in the medium run to R_1.

[Figure 1 about here.]

This medium-run real appreciation occurs, regardless why the country borrows. Stocks of capital or debt then begin to grow, influencing I-S and -CA and changing the equilibrium exchange rate. The NATREX is a moving equilibrium.

Borrowing to finance consumption.

When the country is borrowing to finance consumption (caused by a rise in time preference, σ, which reduces saving in favor of consumption), foreign debt starts rising. With the capital stock unaffected, wealth (k-F) gradually falls, and interest payments to foreigners, r*F, rise.

The stability requirement of $S_F > 0$ requires that consumption respond strongly and positively to changes in wealth. Rising foreign debt reduces wealth and increases interest payments to foreigners. Saving will rise in response, only if consumption declines more rapidly than the rise of interest payments.

In figure 1a, with rising F, the I-S curve slowly shifts back to the left, until net capital inflows have ceased at I-S = 0. The rise in the foreign debt also increases the current-account deficit, moving the -CA curve right to -CA". With increased interest payments to foreigners, the current account will balance in the steady state only with a trade surplus,

requiring a real depreciation. The economy moves gradually from *b* to *c*, with depreciation from R_1 to R_2.

In the new steady state, wealth has declined and consumption has fallen below its pre-disturbance level. [4] Borrowing to finance consumption is truly a shift of time preference in a stable economy. Higher consumption today must be offset with lower consumption in the future. In summary,

borrowing to finance increased consumption first leads to real appreciation. In a stable economy, saving will then rise in response to the rising debt, leading to an eventual decline of consumption and real depreciation.

Borrowing to finance investment.

We see a different set of trajectories and long-run outcomes, when the country borrows to finance new investment (due to a rise in productivity, u, raising the marginal product of capital). This investment increases both the capital stock and foreign debt, eqs. (5) and (6), producing a more complex trajectory for the NATREX. Before predicting the trajectory of R, we need to know what goods are produced and traded, which goods are capital goods, and in which industry productivity increases.

For Mexico, let us take the case of a small country, producing two kinds of goods: tradeable goods, t = 1,2, sold at world prices, and nontradeable goods, n. The terms of trade, determined by world prices ($T = P_1^*/P_2^*$), are exogenous. Only the relative price of nontradeables, R_n, is endogenous, adjusting to medium-run equilibrium and providing the endogenous adjustment in the NATREX. In eq. (1a), percentage changes in R are proportional to percentage changes in R_n, assuming R_n^* and T to be constant.

With the tradeables markets always clearing at world prices, the trade balance, B, equals the country's excess supply of tradeables goods,

$$(7)\quad B = y_t - E_t,$$

where E_t = is expenditure for tradeables for either investment or consumption and y_t is output of tradeables. Any excess demand for goods must come from nontradeables. From the national-income-accounting definitions and eq. (7), eq. (4) can be rewritten as

$$(4b)\quad I - S + CA = E - y + B = E_t + E_n - y_t - y_n + (y_t - E_t)$$

$$? \; - \; - \quad + \; + \qquad + \; + \; -$$

$$= E_n - y_n = E_n(k,F,Rn;u_t,\sigma) - y_n(k,Rn;u_t) = 0,$$

where E denotes investment plus consumption expenditure for all goods, E_n, expenditure for good n, and y_n, output of good n; when describing only the tradeables industry, the productivity parameter is u_t. Fig. 1b shows the basic market equation, written as the excess demand for nontradeables. For a small country facing fixed world prices of tradeables, equations (4a) and (4b), or figures 1a and 1b, are two ways of looking at the same market-clearing condition.

In fig. 1a, the real exchange rate appreciates to R_1 because of increased demand for domestic goods (I-S > -CA); in fig. 1b, the same increased demand is shown as a rightward shift of E_n to E_n'. When capital inflows finance new investment, the initial rise in demand and shift of E_n ($\delta E_n/\delta u_t > 0$) reflects new demand for nontradeable capital goods, such as construction.

The subsequent trajectory of the NATREX depends in which industry productivity has increased. Let us assume for Mexico that the increase of productivity occurs only in the tradeables industries. New investment in tradeables leads to increased output of tradeables, y_t, and to increased demand for labor by the tradeables industry. As labor, and possibly capital, are shifted from production of nontradeables into production of tradeables, output of nontradeables declines ($\delta y_n/\delta u_t < 0$, gradually). In fig. 1b, the y_n curve gradually shifts left to y_n'. On the demand side, investment spending for nontradeables declines as the capital stock rises (until it eventually reaches zero in the steady state), while consumption of nontradeables begins to rise with rising wealth; the long-run effect on demand for nontradeables is shown as a shift from E_n' to $E_n"$. The economy gradually moves to point *d*, with a long-run appreciation of the NATREX to R_3. (Though not shown in fig. 1a, I-S returns to zero and the -CA curve gradually shifts left from -CA' to intersect with I-S at an exchange rate of R_3.)[5]

The increased productivity in tradeables has lead to long-run real appreciation. (The new steady-state NATREX, R_3, is probably lower than the medium-run R_1, and the move from R_1 to R_3 may not be monotonic.)

As long as the marginal product of capital is greater than the real interest rate ($y' > r^* + \rho$), the new investment will

raise the capital stock more than the debt, implying a rise in wealth and leading to increased consumption. (A sufficiently large marginal product of capital [$y' > C_w$] will cause output and saving to rise so much, that the country will not only increase consumption but also repay the debt and start lending [$dF/du < 0$].) In summary,

borrowing to finance investment first induces real appreciation. Investment in the tradeables industry leads to appreciation also in the long run. Gradually, output, wealth and consumption will rise.

Table 1 summarizes the medium-run and long-run effects of the two types of borrowing on the NATREX, output, wealth, consumption, and saving. Neither disturbance produces a continual decline of saving. In response to a rise in time preference, we see a decline of saving, rise of consumption and appreciation of the equilibrium real exchange occurring together in the medium run, but are only temporarily; with stable adjustment, all three are then reversed. An increase of investment leads to a positive cumulation of savings over time .[6]

[Table 1 about here.]

Comparing these trajectories of the NATREX model with those observed for Mexico from 1988-1993 highlights the real fundamentals that lead to Mexico's exchange-rate crisis in 1994.

EVIDENCE OF FUNDAMENTAL DISEQUILIBRIUM IN MEXICO

Table 2 shows Mexico's balance of payments from 1988 through the third quarter of 1994. The current-account deficit had grown to 8 per cent of GDP by 1992. Foreign direct investment remained fairly steady, at only one to two per cent of GDP, slightly less than the increase of reserves for 1990-93. Almost 90 per cent of the net foreign investment from 1988-1993 was in the form of portfolio investment, much of it short-term and indexed to the dollar. Reserve inflows turned negative in 1994, with capital inflows falling sharply in the second quarter.

[Table 2 about here.]

To see whether net foreign investment (NFI) in Mexico financed new investment or new consumption, we can look at the changes in national investment and national saving that accompanied the current-account deficit, keeping in mind that NFI = -CA = I-S. Table 3 shows the ratios to GDP of Mexico's

national investment (I/GDP), national saving (S/GDP), and current-account deficit (-CA/GDP), and the year-to-year changes in these three ratios, for the period 1988-1993. The sum of the decreases in S/GDP for 1988-1993 totaled .058, almost exactly equal to the changes in private consumption, while the sum of the increases of I/GDP totaled only .027. Year-to-year increases in national consumption total over twice the increases in investment. Cumulatively, from 1988-1993, about 60 per cent of the new borrowing (above 1987 levels) financed increased consumption.

[Table 3 about here.]

Comparing these Mexican trajectories with those of the NATREX model, we must keep in mind that Mexico's economy did not meet the medium-run assumptions of the NATREX model in several ways. Prices were largely regulated through the Pacts, leaving output to clear the goods market and requiring foreign-exchange intervention to maintain the nominal exchange rate. Net foreign lending included a large short-term component, reflecting excessive and risky intermediation by Mexico's newly privatized banks. And desired lending from abroad was not perfectly elastic at an exogenous $r^* + \rho$; foreigners' willingness to lend reflected a number of factors, which can be summarized in a fluctuating risk premium, ρ.

The real appreciation of the peso and inflows of reserves, simultaneous with a growing current-account deficit in Mexico, imply that disturbances came primarily from the capital account. The "equilibrium view" held that reform, liberalization, and rising productivity led to higher investment in Mexico and increased supplies of funds from foreigners.

By itself, an increase of funds from abroad would lead to a fall in the risk premium, real appreciation, and a greater current-account deficit. Investment should rise with the lower cost of borrowing, but there is no guarantee that the investment increases will equal the increase in the current-account deficit. To the extent that investment did not increase as much the desired new lending from foreigners, with prices rigid, the contractionary effects of the real appreciation would reduce output and lower saving. (This short-run response is not considered in the medium-run NATREX model; in this case, with a decline of saving due to falling income, the new borrowing would be financing existing consumption.) An exogenous increase of productivity in addition (a possible cause of foreigners' enthusiasm to lend) would further increase investment, shifting the use of funds away from consumption to investment.

But the Mexican figures do not support this "equilibrium" interpretation. Consumption (primarily private consumption) grew twice as fast as investment. The primary underlying cause of Mexico's increased borrowing, rising current-account deficit and real appreciation of the peso was the rapid rise in national consumption and corresponding fall in national saving. Compared with the stable trajectories described by the NATREX model, this continued steady decline of saving accompanied by increased borrowing indicates an economy on an unsustainable, fundamentally unstable path.

Figure 2 illustrates Mexico's move away from equilibrium. At point *b* in fig. 2 (as in fig. 1a), the country is shown with a current-account deficit and net capital inflow equal to 0A. (In a stable economy the I-S curve would gradually shift back to I-S, and if the country were borrowing to finance consumption, the exchange rate would gradually depreciate to a level, not shown in fig. 2, below R_0.) In Mexico, however, we see the opposite movements: saving continues to fall, moving the I-S curve from (I-S)' to (I-S)" and and the -CA curve to -CA". The NATREX appreciates further, from R_1 to R_2 at point *c*. Although market flows called for the real appreciation of the peso through 1993, these market flows reflected unstable consumption behavior and unsustainable short-term foreign lending. The economy was on an unstable trajectory.

[Figure 2 about here.]

In 1994, world markets became less willing to lend to Mexico, raising the risk premium. Figure 2 shows the results of this rise in ρ as a leftward shift of the I-S curve back to I-S = 0, and a depreciation of the real exchange rate to R_3, at point *d*. The reactions of market participants to the rising risk premium, depreciation of the peso, and new perceptions of Mexico's unstable trajectory contained a large destabilizing speculative element. Only the large loans and loan guarantees from the US and the IMF prevented net capital flows from foreigners from turning strongly negative.

Obstfeld and Rogoff (1995) discuss the credibility of the Mexican policies, as measured by the interest-rate differentials on dollar-denominated and peso-denominated Mexican bonds (proxies for the markets' expectations of depreciation). They do not discuss the necessary underlying basis for credibility. Credibility is not simply a matter of image manipulation but rather of assuring the underlying fundamentals. While the NATREX model does not explain the precise timing, it demonstrates the

inevitability of the crisis, given the fundamentally unstable trajectory of the Mexican economy.

CONCLUSION

The NATREX model shows how productivity, u_t, time preference, σ, and the terms of trade, T, influence the long-run equilibrium real exchange rate R^s.

$$(8)\quad R^s = R^s(u_t, \sigma, T), \qquad (+, -, +)$$

In Mexico from 1988-1994, cumulative declines of saving equaling almost twice the increases of investment, combined with slow growth of output, suggest that Mexico's borrowing was induced by increases more of time preference than of productivity. While both kinds of borrowing lead to initial real appreciation, borrowing to finance consumption quickly begins to depreciate the NATREX. Mexico's 70 per-cent real appreciation of the actual real exchange rate over the period indicates increasing misalignment from the equilibrium rate. Moreover, the 14 per-cent decline in the terms of trade directly depreciated the NATREX, making even greater the misalignment from the real appreciation.

Not only did Mexico have an overvalued exchange rate. The underlying fundamentals governing Mexico's national consumption and national saving were unstable. Mexico's slowly growing output barely covered the small increases in government consumption. The soaring private consumption was financed by borrowing from foreigners.

The NATREX model shows why a country cannot continue borrowing to finance consumption, even with perfect capital mobility. A stable economy requires that debt-financed new consumption must be followed by increased saving and lower consumption in the future. [7] This conclusion comes from an intertemporal budget constraint, not of zero present value for debt, but more practically, of movement to a sustainable level of debt to foreigners. Any country that continually borrows to finance consumption (at a rate exceeding the growth of output) is on an unstable trajectory that cannot be maintained indefinitely. If the markets for a time ignore this instability and continue to lend without raising the risk premium, the short-run market-clearing real exchange rate will appreciate ever farther from an equilibrium trajectory.

This unstable scenario of borrowing ever more to finance consumption describes Mexico's situation from 1988-1994. Not until 1994 did the markets begin to bet on a depreciation of the peso. The turn-around in capital flows was sparked by increased political uncertainties in Mexico and rising world interest rates, more than by any sudden perception from the markets of Mexico's unstable economic trajectory. But an increase of the risk premium, reduction of borrowing and real depreciation of the peso were consistent with the fundamentals for Mexico.

In the perfect world of the NATREX models, where the economy is always in medium-run equilibrium, unexpected real disturbances continually change the trajectory and steady-state level of the NATREX, so that it is always moving toward, but never reaches, its steady-state level. In the real world, where rigid prices, short-run speculative capital flows, and other market imperfections prevent the economy from reaching medium-run equilibrium, the actual real exchange rate deviates from the NATREX. But if prices are responsive to market pressures, the real exchange rate will continually be adjusting toward its moving equilibrium trajectory. The NATREX approach points up the basic fundamentals that determine this equilibrium trajectory and the inevitable pressures to move the real exchange rate toward the NATREX trajectory, regardless of nominal exchange-rate policy.

However, in countries where price rigidities prevent the economy from adjusting, the real exchange rate will not automatically move toward its NATREX trajectory. The nominal exchange rate becomes an increasingly important factor in determining the real exchange rate, and the choice of the nominal rate makes a real difference. Policy makers and participants in the markets need to know the equilibrium real exchange rate.

Knowing the equilibrium real exchange rate precisely is impossible, for it is a moving equilibrium determined by ever-changing fundamentals. Using purchasing power parity as a measure of equilibrium is inadequate. While purchasing power parity remains the benchmark around which exchange rates move over very long periods of time, within relevant time horizons the deviations of the equilibrium real exchange rate from PPP are much too large to ignore. Policy makers need to be aware of the interrelationship of the basic macroeconomic trajectories of saving, investment, output, consumption, and capital flows and to measure the effectiveness of their macroeconomic and exchange-rate policies against these equilibrium trajectories. The NATREX model provides a comprehensible picture of the equilibrium macroeconomic trajectories, against which policy makers can measure and evaluate the actual trajectories of the economy.

Such an evaluation in Mexico in the e arly 1990s would have shown the movements of all of the fundamentals, giving strong warnings of problems ahead for a country borrowing to finance so much new consumption. Increased borrowing to finance rising consumption had placed the Mexican economy on an unstable trajectory. That adjustment came only after several years of falling saving made the correction all the more severe.

ENDNOTES

1. A more detailed exposition of the NATREX approach can be found in Stein, Allen *et al*. (1995, Chs. 1-3). The NATREX approach encompasses several variations of the basic model, adapted to meet the specific characterstics of the economy described. Variations include alternative assumptions about what goods are produced; whether they are consumer, capital or intermediate goods; the degree of capital mobility; the rate of growth of the economy; and how large the country is in various markets, including the possibility of modeling interacting large economies. But basic shape of the simple model presented here and the major conclusions typify all NATREX models.

2. The assumption that I and S are independent of the real exchange rate is a simplification, though probably not a serious one. All flows are denominated here in terms of the export good, so that a rise in the relative price of nontradeables, R_n (a component of R), will increase the aggregate value of existing flows, to the extent that nontradeables are produced or purchased. In the case of aggregate output, a rise in R_n will increase production of nontradeables as well as their value in terms of the export good, so aggregate output is positively related to R_n. But substitutability between consumption goods would shift consumption away from nontradeables in the event of a rise in R_n, so the effect on overall consumption is ambiguous, depending on the elasticities of substitution. The effect of the real exchange rate on investment is thoroughly ambiguous, depending on which industry is the target of investment and which good is the capital good. On balance, the assumption that both I and I-S are independent of the real exchange rate is not unreasonable, unless one is modelling a specific country where it is possible to sign the direction of the influence.

3. $CA_F < 0$ assumes that when F rises, the increase of interest payments to foreigners exceeds the wealth effect on imports of consumption goods.

4. The requirement that investment and capital flows be zero in the steady state stems from the assumption, made purely for expositional simplicity, of a non-growing stationary economy. If the economy were growing at rate n, equal to the growth rate of effective labor, then $I = nk$ and $I-S = nF$ in the steady state. With sufficient growth, consumption might be higher in the steady state than before the disturbance, but will always be lower than if the rate of time preference had not increased.

5. The argument that increased productivity in the tradeables sector appreciates a country's real exchange rate has traditionally been based on rising wages in both sectors (Balassa 1964, Samuelson 1964, and Bhagwati 1984). While this argument is consistent with the response in the NATREX model, it does not consider investment, net capital flows, or the change in debt, leaves out the responses emphasized in the NATREX approach.

6. Feldstein and Horioka (1980) noted the correlation between saving and investment across countries and took this correlation as an indicator of low capital mobility, a point reasserted by Feldstein (1995) this year with respect to Mexico. Many economists have offered alternative explanations for the correlation. The NATREX model shows that a high correlation between national saving and national investment can be expected for a stable economy, even in the presence of perfect capital mobility.

7. Turner (1995) points out that, over the same period considered here for Mexico, capital inflows to Latin America as a whole financed increases of consumption rather than investment.

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1. A more detailed exposition of the NATREX approach can be found in Stein, Allen *et al*. (1995, Chs. 1-3). The NATREX approach encompasses several variations of the basic model, adapted to meet the specific characterstics of the economy described. Variations include alternative assumptions about what goods are produced; whether they are consumer, capital or intermediate goods; the degree of capital mobility; the rate of growth of the economy; and how large the country is in various markets, including the possibility of modeling interacting large economies. But basic shape of the simple model presented here and the major conclusions typify all NATREX models.

2. The assumption that I and S are independent of the real exchange rate is a simplification, though probably not a serious one. All flows are denominated here in terms of the export good, so that a rise in the relative price of nontradeables, R_n (a component of R), will increase the aggregate value of existing flows, to the extent that nontradeables are produced or purchased. In the case of aggregate output, a rise in R_n will increase production of nontradeables as well as their value in terms of the export good, so aggregate output is positively related to R_n. But substitutability between consumption goods would shift consumption away from nontradeables in the event of a rise in R_n, so the effect on overall consumption is ambiguous, depending on the elasticities of substitution. The effect of the real exchange rate on investment is thoroughly ambiguous, depending on which industry is the target of investment and which good is the capital good. On balance, the assumption that both I and I-S are independent of the real exchange rate is not unreasonable, unless one is modelling a specific country where it is possible to sign the direction of the influence.

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