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Real Effects of Exchange-Rate-Based Stabilization: An Analysis of Competing Theories

1. *Introduction*

According to conventional wisdom, inflation can only be reduced at the cost of a short-term contraction in economic activity. Available evidence for industrial countries has been taken to support the notion that disinflation is contractionary (Gordon, 1982). The costs of disinflation are generally attributed to the presence of nominal contracts (Fischer, 1977; Taylor, 1980) and are thus expected to hold for open economies (Fischer, 1986). The last 15 years, however, have witnessed the emergence of a large body of evidence on the real effects of stabilization in high-inflation countries which clearly defies this conventional view.

The first clear indication that there was something missing in the traditional understanding of disinflation came from the stabilization programs in the Southern Cone of Latin America (Argentina, Chile, and Uruguay) in the late 1970s. In spite of a very large real exchange-rate appreciation, economic activity expanded rapidly in the first years after stabilization. The contraction typically associated with inflation stabilization came only later in the programs. An examination of similar episodes in chronic inflation countries clearly suggests a common pattern (Kiguel

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and Liviatan, 1992; Végh 1992): countries that use the exchange rate as the nominal anchor in inflation stabilization programs experience a boom in economic activity (consumption, investment, and GDP expand), a large real exchange-rate appreciation, a rise in the real wage rate, and a deterioration in the external accounts. Later in the programs, these effects are often reversed, with the economy contracting sharply and the real exchange rate depreciating.

A large literature has sought to explain these intriguing phenomena. Early work by Rodriguez (1982) and Dornbusch (1982) on the Southern Cone programs of the late 1970s emphasized the presence of sticky inflation. According to this hypothesis, under high capital mobility a reduction in the rate of devaluation leads to a fall in nominal interest rates and, given sticky inflation, to a lower real interest rate. This fall in the real interest rate causes an economic boom. An alternative explanation is the "temporariness hypothesis" (Calvo, 1986; Calvo and Végh, 1993), which focuses on the effects of lack of credibility. This hypothesis considers the case in which agents expect the inflation stabilization program to be reversed in the future. If money is needed to carry out transactions, a temporary reduction in nominal interest rates lowers the effective price of consumption today relative to the future and induces an initial consumption and output boom accompanied by an appreciated real exchange rate. Several authors have emphasized the role of fiscal policy. In Helpman and Razin (1987), the reduction in the inflation tax generates a wealth effect, and thus a boom, due to the lack of Ricardian equivalence. In Drazen and Helpman (1988), the wealth effect comes through the expectation of a future reduction in government spending. Rebelo (1994) considers a scenario in which, in the absence of reforms, government expenditure increases, thus raising the present value of the resources that the government eventually needs to extract from the private sector through taxation or other means (nationalizations, forced lending, etc.). By bringing the fiscal situation under control, a stabilization produces a wealth effect that can generate a boom, even though taxes increase in the short run. The role of durable-goods consumption has been stressed by De Gregorio, Guidotti, and Végh (1994). In their model, consumers follow (S,s) rules for the purchases of durable goods. Since transacting is costly, a fall in inflation frees resources for other uses. The resulting wealth effect induces consumers to bring forward purchases of durables, thus generating an initial boom and a later slowdown. Finally, the more recent literature has focused on the supply-side effects that may result from removing the inflationary distortion on labor supply (Roldos, 1993) or capital accumulation (Roldos, 1995; Uribe, 1995).

While this large theoretical literature has provided useful insights into

different aspects of exchange-rate-based stabilization, there has been no attempt at tackling the different hypotheses within a single analytical framework to assess their relative importance. Furthermore, a comparison of the quantitative relevance of the various theoretical mechanisms in light of the orders of magnitude observed in practice is also lacking. The purpose of this paper is thus to assess—both qualitatively and quantitatively—the different hypotheses using a unified framework. To this end, we develop a small open economy model characterized by two sectors of activity (tradables and nontradables), physical capital accumulation, a transactions-based demand for money, and an endogenous supply of labor.

At a qualitative level, we find that several hypotheses perform fairly well in a number of dimensions, although no single hypothesis seems capable of accounting for all empirical regularities. The supply-side effects of disinflation proved to be an essential component of any scenario that comes close to mimicking actual stabilization dynamics. At a quantitative level we find it very difficult to explain the magnitudes of the observed real appreciations and consumption booms. Hence, improving the quantitative performance of this class of models remains an important challenge for future research in this area.

The paper proceeds as follows. Section 2 reviews the stylized facts of exchange-rate-based stabilization in chronic-inflation countries and illustrates these facts with data for four major stabilization episodes: the 1978 Uruguayan *tablita*, the 1985 Israeli stabilization, the 1987 Mexican stabilization, and the 1991 Argentine convertibility plan. Section 3 uses a model with exogenous labor supply, which abstracts from money, to isolate four basic mechanisms: the wealth effect, the labor-supply effect, the effective-price-of-consumption effect, and the investment effect. Section 4 extends this model to incorporate endogenous labor supply, a transactions-based demand for money, and physical capital accumulation subject to adjustment costs. We calibrate the model using data for Argentina and solve it numerically. Section 5 proceeds to examine four hypotheses: credible disinflation, temporariness, fiscal effects, and nominal rigidities (sticky wages and sticky inflation). Section 6 evaluates the performance of the different hypotheses and discusses the implications of several extensions and modifications of our baseline model. Section 7 concludes.

2. *Stylized Facts of Exchange-Rate-Based Stabilizations*

Since the late 1940s, many developing countries have endured long periods of chronic inflation. Chronic inflation is characterized by high

(relative to industrial countries) and persistent inflation.[1] Unlike hyperinflation—whose duration is measured in months and exhibits an explosive nature—chronic inflation is relatively stable and may last for decades. Countries adapt to living with high inflation by creating various indexation mechanisms in financial, labor, and goods markets which, by reducing the costs of inflation, tend to perpetuate the inflationary process. Thus, as stressed by Bruno (1993), while large fiscal deficits typically constitute the "original sin" behind chronic inflation, accommodative monetary and exchange rate policies and widespread indexation explain the adaptation to "living in sin."

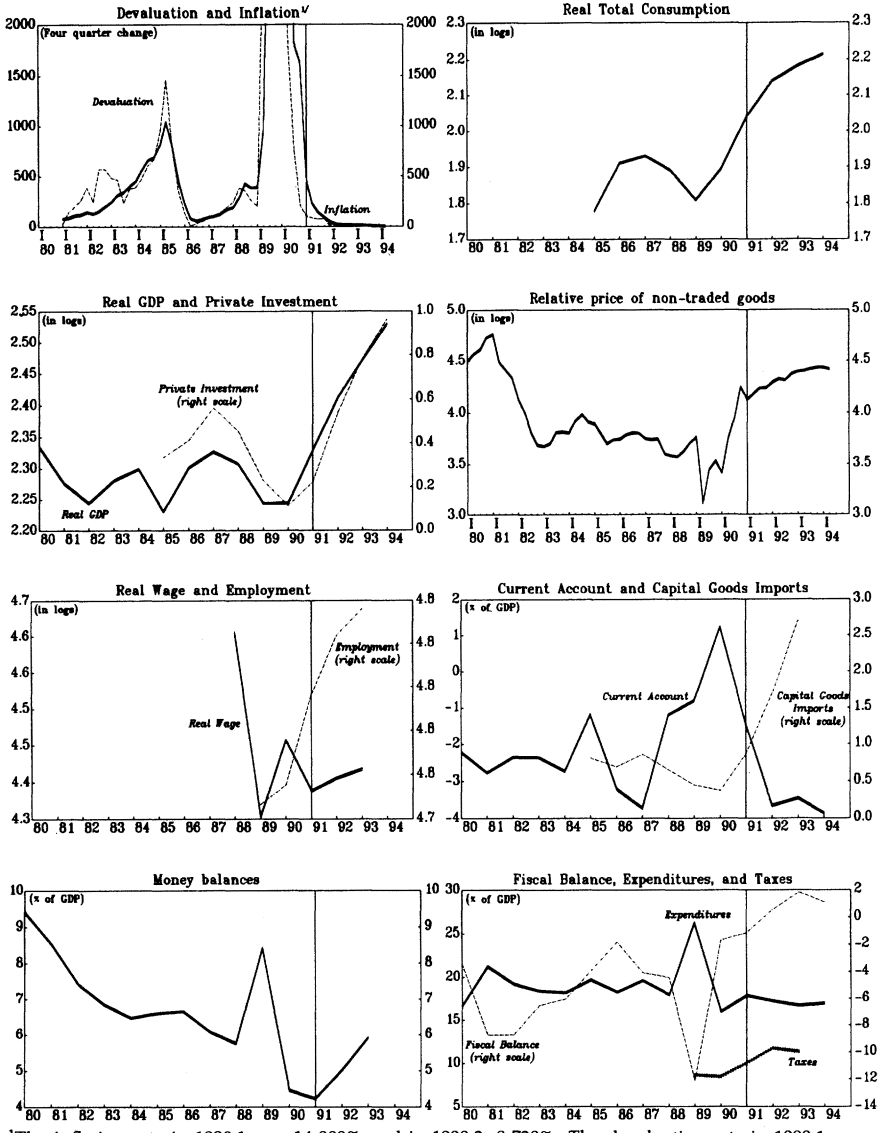
Getting rid of chronic inflation has proved to be a long and arduous process. More often than not, stabilization attempts have failed and inflation has come back with a vengeance. During the 1980s, however, some countries—most notably, Chile, Israel, Mexico, and, more recently, Argentina—have succeeded in drastically reducing their rates of inflation.

With a few exceptions, most major stabilization programs in chronic high-inflation countries have used the exchange rate as the main nominal anchor. The choice of the exchange rate over a monetary aggregate reflects the fact that in high-inflation countries velocity is likely to be subject to unpredictable shifts—often exacerbated by a high degree of dollarization—which makes it difficult to assess the rate of monetary growth consistent with a targeted inflation rate. Moreover, a pegged exchange rate has the advantage of allowing for an endogenous increase in the nominal money stock.

During the past 30 years there have been 13 major exchange-rate-based stabilizations in Argentina, Brazil, Chile, Israel, Mexico, and Uruguay. Roughly half of these programs were "heterodox" in the sense that they supplemented the fixing of the exchange rate with price and wage controls. The remaining stabilization plans were "orthodox," that is, they used the exchange rate as the sole nominal anchor. Whether successful or not, exchange-rate-based stabilizations in chronic-inflation countries have been characterized by a series of empirical regularities documented in Kiguel and Liviatan (1992), Végh (1992), and Reinhart and Végh (1994). These regularities, listed below, can be easily detected in Figures 1–4, which describe four major stabilization episodes: the 1978 Uruguayan *tablita*, the 1985 Israeli stabilization, the 1987 Mexican stabilization, and the 1991 Argentine convertibility plan.

1. The important distinction between chronic inflation and hyperinflation goes back to Pazos (1972). For recent analyses, see Bruno (1993), Sachs (1987a), and Végh (1992).

Figure 1 ARGENTINA: 1991 CONVERTIBILITY PLAN

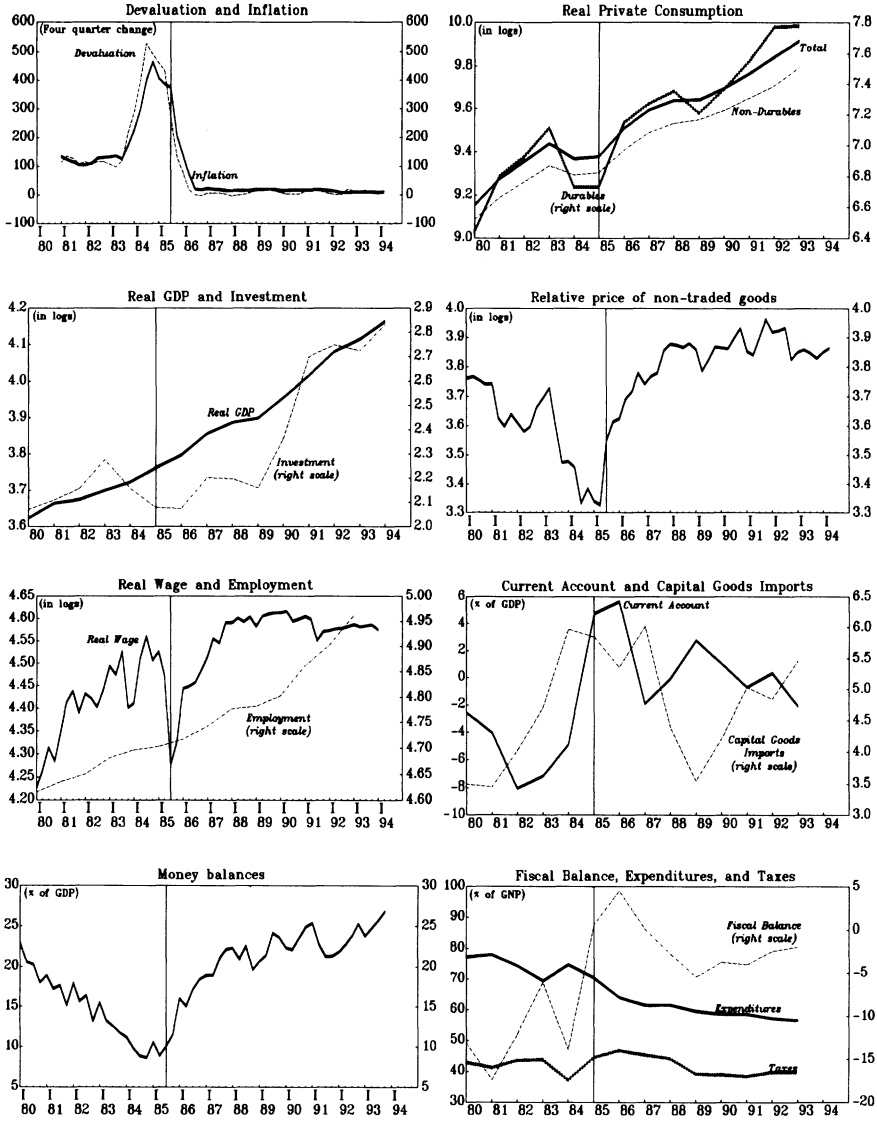


[1]The inflation rate in 1990:1 was 14,000% and in 1990:2, 8,720%. The devaluation rate in 1990:1 was 29,325%.

Note: The vertical bar indicates the beginning of the stabilization plan.

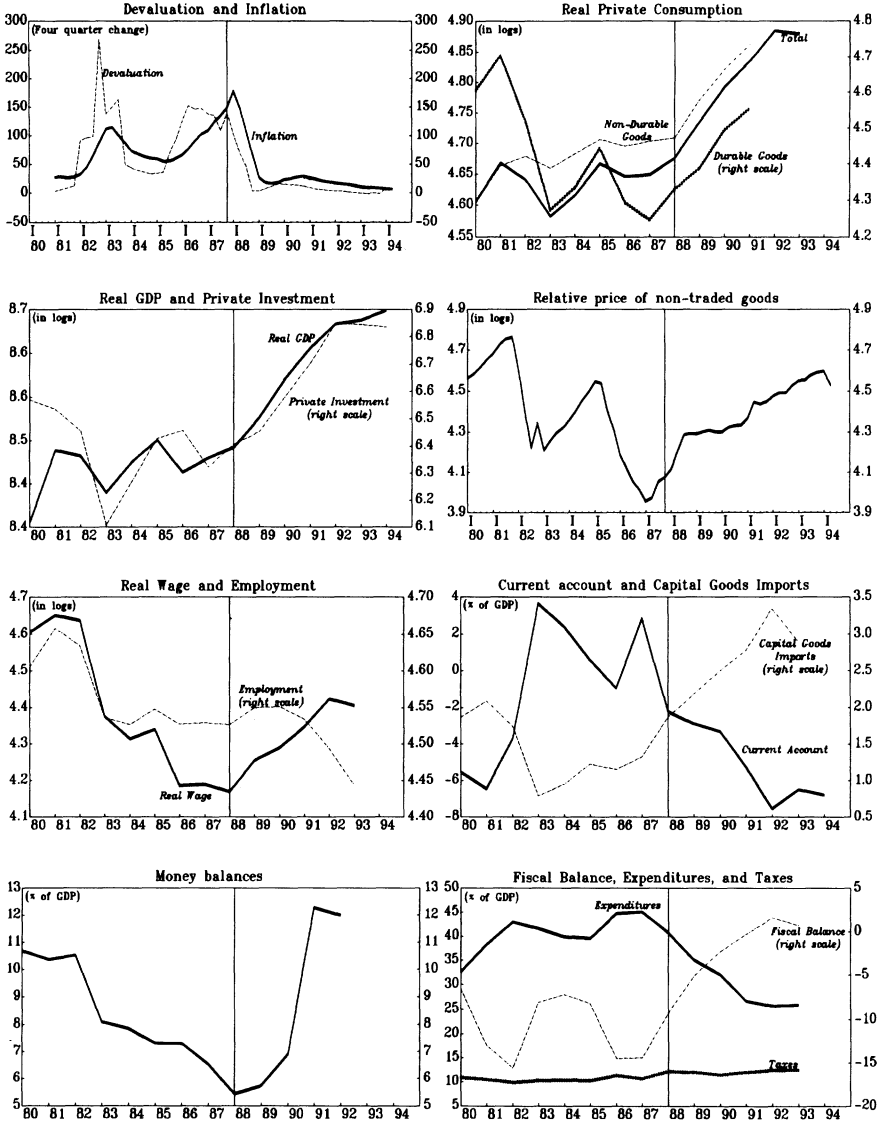
Sources: IFS and national authorities.

Figure 2 ISRAEL: JULY 1985 STABILIZATION PLAN



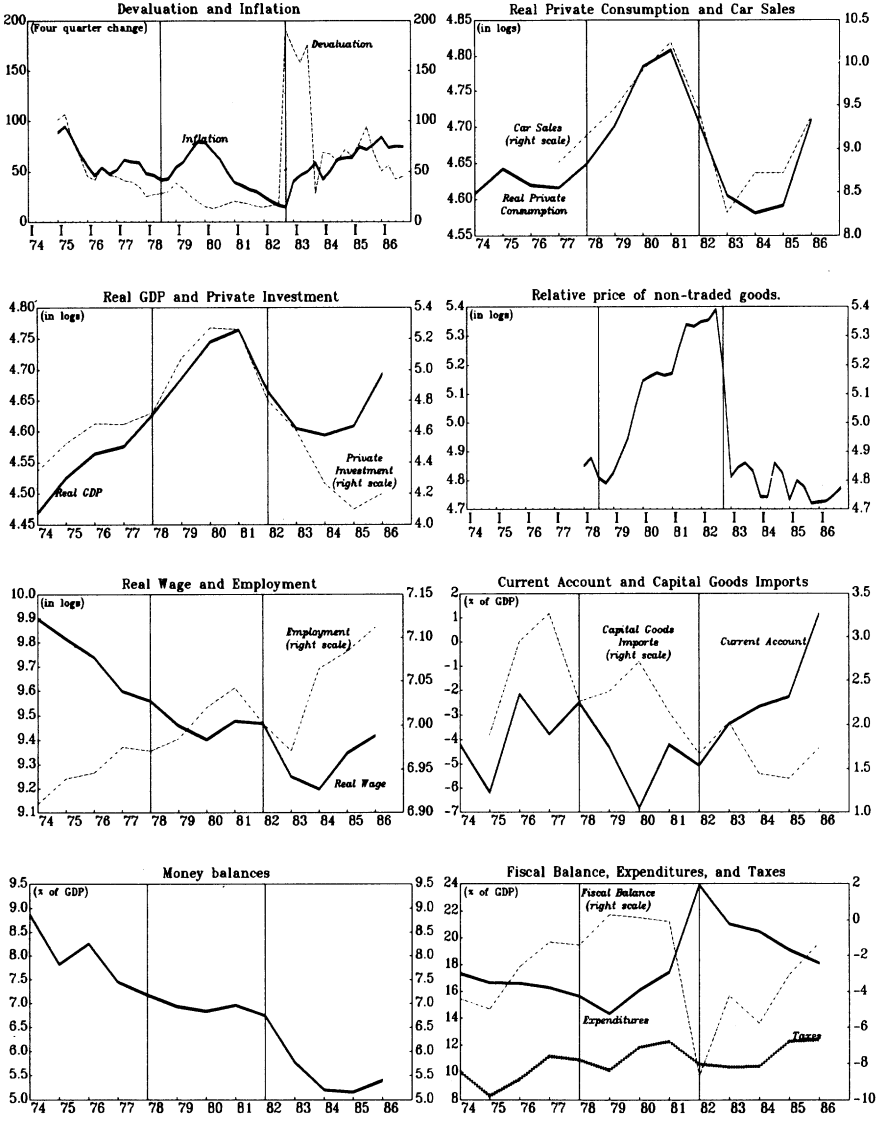
Note: The vertical bar indicates the beginning of the stabilization plan.
Sources: IFS, Bank of Israel, and national authories.

Figure 3 MEXICO: 1987 STABILIZATION PLAN



Note: The vertical bar indicates the beginning of the stabilization plan.
Sources: IFS and Banco de Mexico.

Figure 4 URUGUAY: OCTOBER 1978 STABILIZATION PLAN



Note: The vertical bars indicate the beginning and end of the stabilization plan.
Sources: IFS and Central Bank of Uruguay.

1. *Slow convergence of the inflation rate to the devaluation rate.* An exchange-rate anchor is often advocated on the basis that, through its immediate effect on inflation of traded goods, overall inflation will quickly converge to the rate of devaluation. However, a comparison of four-quarter changes in the exchange rate and prices suggests that inflation has normally converged slowly, particularly in orthodox programs (with the Southern Cone *tablitas* being the most prominent example, as illustrated for the Uruguayan 1978 program in Figure 4).
2. *An initial expansion in economic activity followed by a later slowdown.* Contrary to what traditional Phillips-curve-type relationships would predict, economic activity (GDP, employment, private consumption, and private investment) has typically expanded in the first stages of the programs. The increase in the private consumption of durable good has been particularly dramatic, as illustrated in Figures 2–4 for Israel, Mexico, and Uruguay (car sales). In all the plans that failed, the initial boom was later followed by a severe recession, as illustrated in Figure 4 for the Uruguayan 1978 stabilization. This late recession has also been observed in some successful programs, such as the Israeli stabilization.[2] Although not well documented, it also appears that output in the nontradables sector typically expanded by more than output in the tradables sector, which has even fallen relative to trend.[3]
3. *A rise in the relative price of nontraded goods (real exchange-rate appreciation).* As Figures 1–4 illustrate, the increase in the relative price of nontraded goods has generally been substantial. In failed programs, the relative price of nontraded goods has typically followed an inverted-U-shaped path, as illustrated in Figure 4 for the Uruguayan 1978 program.[4]
4. *An increase in real wages measured in units of tradable goods.* Real wages

2. Using panel data for seven high-inflation countries for the period 1964–1993, Reinhart and Végh (1994) show that GDP growth is significantly above the mean growth rate (by 2.3%) in the early stages of exchange-rate-based stabilizations and significantly lower (by 5.4%) in the late stages.
3. In Israel, for example, the tradable sector grew at the same rate as before the program, while the nontradable sector grew considerably more (at an annual rate of 7.5% in 1986–1987, compared to 2% per year growth in 1981–1986 (Bufman and Leiderman, 1995)). In Uruguay, nontradables sectors like construction and retail grew by 20 and 22%, respectively, in the first three years of the stabilization plan, while manufacturing (a tradable sector) grew by only 4.7% (Central Bank data). In the first two years of the Mexican program, some tradable sectors contracted, while nontradable sectors typically expanded.
4. The relative price of nontradable goods is a trade-weighted index using CPIs computed by the IMF. For Israel the relative price of nontradables was computed using the U.S. and the Israeli CPI indexes reported in IFS.

have typically increased in the initial stages. The Uruguayan experience seems to be an exception in this respect.[5]

5. *An ambiguous response of real interest rates.* The behavior of (ex post) real interest rates appears to depend on whether the plans have been orthodox or heterodox. In orthodox plans realized real interest rates have typically declined, while in heterodox plans they have typically increased.
6. *A remonetization of the economy.* The ratio of M1 to GDP has typically increased rapidly in the aftermath of stabilization plans (Uruguay is an exception in this respect).
7. *A deterioration of the trade and current account.* The external accounts have generally deteriorated sharply, reflecting a large increase in imports of durable goods and capital goods.
8. *A large fiscal adjustment (in successful or temporarily successful programs).* The elimination of large public-sector deficits is clearly a necessary condition for an enduring disinflation. Programs where the fiscal adjustment has been either partial or absent (as in the Argentine 1978 *tablita,* in the 1985 austral plan, and in the 1986 Brazilian cruzado plan) have quickly gotten off track. In successful programs (or programs that have lasted for several years, like the Uruguayan tablita), the public-sector accounts have been balanced upon or shortly after implementation of the program, with the 1985 Israeli plan (Figure 2) and 1991 Argentine convertibility plan (Figure 1) being dramatic examples. Large fiscal adjustments have taken place either through major cuts in public expenditures (as in Israel) or through increases in taxes.
9. *A boom in the real estate market.* The price of residential and commercial property tends to rise significantly in exchange-rate-based stabilization episodes. In the first two years following the implementation of the Uruguayan 1978 stabilization plan, the prices of housing and land (in dollar terms) rose by 181 and 212%, respectively (Roldos, 1991). Prices of housing and land fell sharply in 1982 when the program ended and returned to their prestabilization levels. During the Chilean 1978 *tablita,* real housing prices increased by 135% in the first three years of the program and then fell precipitously in 1982 to prestabilization levels when the program was abandoned (Morande and Soto, 1992).

3. *The Basic Mechanisms*

Before proceeding with a model that contains all the elements we want to study, we use a simpler model to isolate the key economic mecha-

5. Due to data limitations, the real-wage series reported in Figures 1–4 were deflated using the CPI.

nisms that will be present in most of the hypotheses that we will discuss. This section describes an optimizing small open economy with perfect international capital mobility. In this economy the supply of labor is exogenous, there is no physical capital accumulation, and money plays no role.[6]

3.1 THE MODEL

3.1.1 Preferences The economy is populated by a large number of identical households. The representative household seeks to maximize its lifetime utility defined over sequences of consumption of tradable goods (C_t^T) and nontradable goods (C_t^{NT}):

$$U = \sum_{t=0}^{\infty} \beta^t \frac{1}{1 - 1/\sigma} \{[(C_t^T)^{\gamma}(C_t^{NT})^{1-\gamma}]^{1-1/\sigma} - 1\}, \qquad 0 < \gamma < 1, \tag{1}$$

where $0 < \beta < 1$ is the discount factor and $\sigma > 0$ is the intertemporal elasticity of substitution. Each agent supplies inelastically N units of time per period, which he allocates to working in the tradables (N_t^T) and nontradables (N_t^{NT}) sector:

$$N_t^T + N_t^{NT} = N. \tag{2}$$

3.1.2 Production Technology This economy has the production structure of a specific-factors model (Jones, 1971; Mussa, 1974). Labor is the mobile factor, and the specific factors are capital (K) and land (T). Production of tradables (Y_t^T) and of nontradables (Y_t^{NT}) is described by the following Cobb–Douglas production functions, where Z^T and Z^{NT} are time-invariant level parameters:

$$Y_t^T = Z^T(N_t^T)^{\alpha}K^{1-\alpha}, \qquad 0 < \alpha < 1, \tag{3}$$

$$Y_t^{NT} = Z^{NT}(N_t^{NT})^{\eta}T^{1-\eta}, \qquad 0 < \eta < 1. \tag{4}$$

The stock of land is fixed, and, for the purposes of this section, the stock of capital is also taken as constant. Since nontradables are labor-intensive, we assume that $\alpha < \eta$.

6. See Frenkel and Razin (1987) and the references therein for a discussion of optimization-based open-economy models. For the recent simulation-based literature, see the surveys by Backus, Kehoe, and Kydland (1995) and Baxter (1995). The small open-economy framework that we employ is most similar to the models of Mendoza (1991), Lundvik (1992), Correia, Neves, and Rebelo (1995), and Roldos (1995).

3.1.3 The Household's Problem To economize on notation, we assume that households directly operate the economy's technology and sell their production in the goods market. Hence, they face the following budget constraint:

$$Y_t^T + p_t Y_t^{NT} + \Omega_t + b_{t-1}(1 + r^*) = (1 + \tau_t^c)C_t^T + (1 + \tau_t^c)p_t C_t^{NT} + b_t, \tag{5}$$

where p_t is the relative price of nontradables in terms of tradables. Households can borrow and lend in the international capital market at the exogenous real interest rate r^*. The variable b_t represents private net foreign asset holdings. The government levies taxes on the consumption of both goods at a rate τ_t^c. To isolate the distorting effects of taxation, we assume in this section that the tax revenue is rebated to the households in the form of lump-sum transfers (Ω_t). The no-Ponzi-game condition for the representative household is

$$\lim_{t\to\infty} \frac{b_t}{(1 + r^*)^t} = 0. \tag{6}$$

To abstract from the presence of trends in the current account, we assume that $\beta = (1 + r^*)^{-1}$. The household's problem then consists in maximizing lifetime utility, defined in (1), subject to the constraints (2)–(6). This formulation is equivalent to one in which there are domestic factor markets for capital, labor, and land. Firms in both sectors hire factors of production in order to maximize profits. Households choose their consumption path in order to maximize lifetime utility.

3.1.4 The Government Budget Constraint The government collects taxes on the consumption of both goods and rebates this revenue to the households through lump-sum transfers. Government net foreign asset holdings (f_t) evolve according to

$$f_t = f_{t-1}(1 + r^*) + \tau_t^c C_t^T + \tau_t^c p_t C_t^{NT} - \Omega_t. \tag{7}$$

The no-Ponzi-game condition for the government is

$$\lim_{t\to\infty} \frac{f_t}{(1 + r^*)^t} = 0. \tag{8}$$

3.1.5 Equilibrium in the Goods Markets We assume that nontradables are only used for consumption, so in equilibrium the sequence of relative prices $\{p_t\}_{t=0}^{\infty}$ has to be such that

$$Y_t^{NT} = C_t^{NT}. \tag{9}$$

Using this equation and aggregating the private and public budget constraints, we obtain the equilibrium conditions for the tradable goods market:

$$Y_t^T = C_t^T + TB_t, \tag{10}$$

$$a_t = (1 + r^*)a_{t-1} + TB_t, \tag{11}$$

where $a_t = b_t + f_t$ represents the consolidated net asset holdings of the government and the private sector, while TB_t is the economy's trade balance. The current account is given by $CA_t = r^*a_{t-1} + TB_t$. In the absence of shocks, this economy is always at a steady state where $TB = -r^*a$. Any level of a is consistent with the steady state. Positive levels of net foreign asset holdings allow the economy to finance a trade deficit that makes it possible to enjoy higher levels of consumption of both goods.

3.2 FOUR BASIC EFFECTS

Consider now the economic mechanisms at work in this model. Understanding these mechanisms will make clear which are the key elements that need to be combined to reproduce the stylized facts described in Section 2. The qualitative implications of the first three effects on the main variables of interest are summarized in Table 1.

3.2.1 The Wealth Effect The stabilization literature often refers to "wealth effects" as being important in understanding the outcomes of stabilizations. The wealth effect in the Hicksian sense comprises the responses of the different choice variables to an increase in lifetime utility at unchanged prices.[7] In this economy, a wealth effect takes the form of a proportional increase in the consumption of both goods with no change in the labor allocation across the two sectors, as follows from the optimality conditions:

$$\frac{1-\gamma}{\gamma}\frac{C_t^T}{C_t^{NT}} = p_t, \tag{12}$$

$$p_t \eta Z^{NT} (N_t^{NT})^{\eta-1} T^{1-\eta} = \alpha Z^T (N_t^T)^{\alpha-1} K^{1-\alpha}. \tag{13}$$

Equation (12) dictates the optimal proportions in which tradables and nontradables are consumed. Equation (13) determines the optimal alloca-

7. For a discussion of wealth and substitution effects in dynamic models, see King (1991).

Table 1 BASIC EFFECTS

Shock	*Effect in Period:*[a]	Y^T	Y^{NT}	C^T	C^{NT}	N^T	N^{NT}	p	w	a
Increase	1	↓	↑	↑	↑	↓	↑	↑	↑	↑
in a	∞	↓	↑	↑	↑	↓	↑	↑	↑	↑
Increase	1	↑	↑	↑	↑	↑	↑	↓	↓	—[b]
in N	∞	↑	↑	↑	↑	↑	↑	↓	↓	—[b]
Temporary	1	↓	↑	↑	↑	↓	↑	↑	↑	—[b]
decline in τ^c	$t > 10$	↑	↓	↓	↓	↑	↓	↓	↓	↓

[a]Period 1 is the period in which the shock takes place.
[b]The symbol "—" indicates that the variable remains unchanged.

tion of labor across the two sectors. These equations show that a proportional increase in the two productivity parameters Z^T and Z^{NT} in an economy where $a = 0$ generates a pure wealth effect: the consumption of both goods rises in the same proportion, leaving their relative price unchanged.

To illustrate the effects of a shock that generates a wealth effect, suppose that there is an increase in the stock of net foreign assets in period 0. By increasing a we obtain a combination of the Hicksian wealth effect and the substitution effects that take place in equilibrium as a result of the increase in p. All these effects take place immediately, since the model displays no transition dynamics. An increase in a leads households to expand their consumption of both goods. Notice that if p were unchanged, households would maintain the same ratio C^T/C^{NT}. This is, however, infeasible. Equation (13) shows that when p does not change, the values of N^{NT} and Y^{NT} remain the same. In order for C^{NT} to expand, p has to rise to induce a reallocation of labor toward the nontradable sector. In equilibrium, therefore, p always rises and the consumption of tradable goods always expands by more than the consumption of nontradables.[8] The reallocation of labor toward the non-tradable sector leads to a fall in the production of tradable goods. The trade balance deteriorates as a result of the fall in Y^T and the rise in C^T. This fall in the trade balance is compensated by the increase in returns to net foreign assets (r^*a).

The consistency of these various effects with prominent features of exchange-rate-based stabilizations explains why wealth effects are con-

8. It is obvious that the same increase in demand that generates a real appreciation raises the rental price of land, which in equilibrium is $p_t(1 - \eta)Z^{NT}(N_t^{NT})^{\eta}T^{-\eta}$. This is consistent, at least at a qualitative level, with the boom observed in real estate markets.

sidered important in understanding these episodes. A key issue is thus what may be the source of wealth effects in stabilization programs.

3.2.2 The Labor-Supply Effect In a model with an endogenous labor supply the total amount of time devoted to market activities will generally respond to the stabilization shocks. The effects of these labor-supply movements can be illustrated in this simple model by considering an exogenous, permanent increase in the total supply of labor, N. This triggers both a positive wealth effect and substitution effects associated with changes in the relative price of nontradables. To understand the effects of an increase in N, suppose for a moment that the relative price of nontradables remains unchanged. Given the assumption that $\alpha < \eta$, N^{NT} will increase by more than N^{T}. For this to be an equilibrium, the consumption of nontradables would have to increase by more than the consumption of tradables. However, if p remains constant, households will want to increase the consumption of both goods in the same proportion. Thus, in equilibrium the relative price of nontradables will have to fall. This implies that C^{NT} will increase by more than C^{T}. The current account remains unchanged because the increase in N is permanent. We conclude that an increase in the labor supply will help explain the consumption booms but will make it more difficult to rationalize the observed increase in the relative price of nontradables.

3.2.3 The Effective-Price-of-Consumption Effect Macroeconomic stabilizations are generally characterized by a decline in the rate of inflation. To the extent that money is used to purchase consumption goods, the fall in inflation lowers the effective price of consumption. This effect can be illustrated in this real model by considering a reduction in the consumption tax rate, since it produces similar effects to a fall in the rate of inflation. Given that labor supply is exogenous and that the tax revenue is rebated to the households in a lump-sum manner, a permanent change in τ^c has no effects. However, *temporary* changes in τ^c are not neutral, because they distort the relative price of consumption today vis-a-vis consumption in the future. This effect is the crux of the "temporariness" hypothesis discussed in Section 5.

Denote the current period by t, and suppose that τ^c takes on a lower value between now and period $t + T$, after which it returns to its initial level. Consumption of both goods will be higher during the low-tax periods and lower afterwards. These higher levels of consumption are financed by depleting the stock of net-foreign assets, i.e. by running a current account deficit. A rise in consumption leads to an increase in p for the reasons discussed before: the relative price of home goods has to

increase in order to elicit the increase in N^{NT} that makes the rise in C^{NT} feasible.[9] For T periods we will observe a consumption boom and a higher level of p. The magnitude of the consumption boom depends on the elasticity of intertemporal substitution, σ, and on the production parameters α and η.

What happens from period $t + T + 1$ onward? The economy looks just as it did before period t, but it has a lower level of net foreign assets. Thus both consumption and p will be lower than before time t.

It is worth noting that this experiment does not isolate the pure substitution effect associated with the temporary decline in τ^c. The results reflect a mixture of this substitution effect with a *negative* Hicksian wealth effect. To see this, recall that the tax revenue is rebated to the household, so a constant consumption tax rate has no effects on the level of welfare. By distorting the intertemporal price of consumption, the temporary decline in τ^c actually lowers the utility of the representative household.

3.2.4 The Investment Effect Before we move on to a more complex formulation, it is worthwhile to incorporate investment in physical capital in this model to discuss the determinants of the domestic capital stock. To accomplish this we only need to introduce three changes into the model: include investment expenditures (I_t) in the right-hand side of equation (5) and in the market clearing condition (10), and append the standard capital accumulation equation, where δ denotes the rate of depreciation:

$$K_t = I_t + (1 - \delta)K_{t-1}. \tag{14}$$

This assumes that investment in physical capital requires only tradable goods. Since investment does not involve adjustment costs, the stock of capital adjusts immediately to equate the world real interest rate to the domestic marginal productivity of capital, net of depreciation:

$$r^* = (1 - \alpha)Z^T(N^T_{t+1})^{\alpha}K_t^{-\alpha} - \delta. \tag{15}$$

This equation shows that investment in physical capital is affected by both direct and indirect forces. An increase in the productivity parameter Z^T is the simplest example of a direct force that increases investment. A decline in taxes on output or investment, as well as a decline in inflation when investment transactions require the use of money, has

9. The relative price p remains unchanged only when the two goods are perfect substitutes (in this case C^{NT} does not change) or when both production functions are linear in labor (in this case the technology dictates a constant relative price).

effects similar to those of an increase in Z^T. However, investment is also affected by changes in the demand for nontradables, which, through their effects on N^T, alter the desired stock of capital.

We have seen that both a temporary decline in the effective price of consumption and an increase in net foreign assets generate consumption booms and real appreciations. In both cases the amount of labor employed in the tradables sector declines. This will lead to a fall in investment that restores the parity between the domestic net productivity of capital and the international real interest rate. In order for investment to rise, this indirect effect has to be compensated by a shock that raises domestic capital productivity.

4. *A Monetary Model with Capital Accumulation*

This section extends our simple model to include physical capital accumulation with costs of adjustment, a transactions-based demand for money, and an endogenous labor supply.

4.1 PREFERENCES

To make the supply of labor endogenous, we adopt a two-good version of the momentary utility used in Greenwood, Hercowitz, and Huffman (1988):

$$U = \sum_{t=0}^{\infty} \beta^t \frac{1}{1 - 1/\sigma}\left\{\left[(C_t^T)^{\gamma}(C_t^{NT})^{1-\gamma} - \psi(N_t^T + N_t^{NT})^{\nu}\right]^{1-1/\sigma} - 1\right\},$$
$$\sigma > 0, \quad \nu > 1, \quad \psi > 0. \tag{16}$$

In small open economy models, such as those of Mendoza (1991), Lundvik (1992), and Correia, Neves, and Rebelo (1995), this form of preferences produces more realistic behavior for consumption and for the trade balance than instantaneous utility functions that are Cobb–Douglas in consumption and leisure.

4.2 PRODUCTION TECHNOLOGY

We maintain the same specific factors structure of Section 3, described by (3) and (4), but we no longer treat K as fixed.

4.3 CAPITAL ACCUMULATION TECHNOLOGY

Tradable goods can be used for consumption or investment (I_t). The law of motion for the capital stock features adjustment costs to investment (without which investment flows are implausibly volatile):

$$K_t = \phi(I_t/K_{t-1})K_{t-1} + (1 - \delta)K_{t-1}. \tag{17}$$

The parameter $0 < \delta < 1$ denotes the rate of depreciation, and the function $\phi(\cdot)$ is an increasing, concave, twice continuously differentiable function with two properties that guarantee the absence of adjustment costs in the steady state: $\phi(\delta) = \delta$, $\phi'(\delta) = 1$. This formulation implies that Tobin's q, the ratio of the value of capital to its replacement cost, is $q_t = 1/\phi'(I_t/K_{t-1})$, and is thus equal to one in the steady state.

4.4 TRANSACTIONS TECHNOLOGY

Money is used for transactions according to a specification in which holdings of real money balances expressed in terms of traded goods allow the agent to economize on the amount of resources devoted to transactions. We denote these resources by S_t and assume that they are denominated in terms of tradable goods:[10]

$$S_t = Z^S(C_t + I_t)v\left(\frac{M_t/P_t^T}{C_t + I_t}\right) \tag{18}$$

where P_t^T is the nominal price of traded goods, M_t/P_t^T represents real money balances, and Z^S is a level parameter. Total consumption defined in units of the tradable good is given by $C_t = C_t^T + p_t C_t^{NT}$. We assume that the function $v(\cdot)$ has the following quadratic form:

$$v(X) = X^2 - X + 1/4, \tag{19}$$

where $X_t = M_t/[P_t^T(C_t + I_t)]$ is the reciprocal of the velocity of circulation with respect to total expenditure. As will become clear below, this particular quadratic form insures that transactions costs are zero when the nominal interest rate is zero.

4.5 THE HOUSEHOLD'S PROBLEM

Households maximize their utility described by (16) subject to the specification of the technology (3),(4),(18),(19) and to the following constraint:

10. This type of transaction technology has been widely used in monetary macro models; see, e.g., Kimbrough (1986) and Marshall (1992). The properties of a monetary economy in which $v(\cdot)$ has the quadratic form used in (19) below and S represents time devoted to transactions activities were analyzed in Végh (1989).

$$b_t + C_t^{\mathrm{T}} + p_t C_t^{\mathrm{NT}} + I_t + S_t + \frac{M_t}{P_t^{\mathrm{T}}}$$
$$= b_{t-1}(1 + r^*) + \frac{P_{t-1}^{\mathrm{T}}}{P_t^{\mathrm{T}}}\frac{M_{t-1}}{P_{t-1}^{\mathrm{T}}} + (1 - \tau_t)Y_t^{\mathrm{T}} + p_t(1 - \tau_t)Y_t^{\mathrm{NT}} + \Omega_t, \tag{20}$$

where τ_t is the tax levied on the output of both sectors, while Ω_t is a lump-sum transfer from the government. The borrowing and lending opportunities in the international capital market remain the same as in Section 3. The no-Ponzi-game condition described in (6) continues to apply here. We will also continue to assume that $\beta = (1 + r^*)^{-1}$.

4.6 MONEY DEMAND

The optimal conditions for the household problem, together with the quadratic form assumed for $\upsilon(\cdot)$, imply that the demand for real balances is homogeneous of degree one in total expenditures, which accords with the estimates of Reinhart and Végh (1995):

$$\frac{M_t}{P_t^{\mathrm{T}}} = (C_t + I_t)\frac{1}{2}\left[1 - \frac{R_t}{Z^S(1 + R_t)}\right], \tag{21}$$

where R_t denotes the nominal interest rate. For simplicity we assume that tradables inflation in the country to which the currency is pegged (typically the United States) is zero. The nominal interest rate is then given by

$$R_t = (1 + \epsilon_t)(1 + r^*) - 1, \tag{22}$$

where ϵ_t is the rate of devaluation. One useful property of the quadratic transactions technology is that it implies a finite demand for real balances when the nominal interest rate is zero. In this case the optimal value of X is ½, and transactions costs are nil [$\upsilon(X) = 0$]. Thus, when $R_t = 0$ the equilibrium of our economy coincides with that of a model in which all goods are "credit goods," so that money plays no role.

4.7 LABOR SUPPLY

The supply of labor at each point in time is given by

$$N_t^{\mathrm{T}} + N_t^{\mathrm{NT}} = \left\{\frac{\gamma^{\gamma}(1 - \gamma)^{1-\gamma}p^{\gamma-1}(1 - \tau)w_t}{\nu\psi[1 + Z^S(\tfrac{1}{4} - X_t^2)]}\right\}^{1/(\nu-1)}, \tag{23}$$

where w denotes the before-tax real wage rate defined in units of tradables:

$$w_t = \alpha Z^T K_{t-1}^{1-\alpha} (N_t^T)^{\alpha-1}. \tag{24}$$

As a result of our preference specification, the supply of labor behaves in a simple, intuitive fashion. The labor supply at time t is solely a function of the after-tax real wage rate deflated by the consumer price index ($(1 - \tau)\, w_t\, p_t^{\gamma-1}$) and the expected rate of inflation at time t (which determines X_t). Thus there is no income effect or intertemporal substitution effect driving the supply of labor. The elasticity of labor supply with respect to the real wage is $1/(\nu - 1)$.

4.8 THE GOVERNMENT BUDGET CONSTRAINT

The government collects taxes on the production of both goods, buys tradables (G_t^T) and nontradables (G_t^{NT}), and makes a lump-sum transfer to the households. Government net foreign-asset holdings (f_t) evolve according to:

$$f_t = f_{t-1}(1 + r^*) + \frac{M_t}{P_t^T} - \frac{P_{t-1}^T}{P_t^T}\frac{M_{t-1}}{P_{t-1}^T} + \tau_t Y_t^T + \tau_t p_t Y_t^{NT} - \Omega_t - G_t^T - p_t G_t^{NT}. \tag{25}$$

The path for f_t has to satisfy the government no-Ponzi-game condition (8). In all the experiments that we will study we compensate changes in seignorage, tax revenue, or government expenditures by adjusting lump-sum taxes or transfers.

4.9 MONETARY POLICY

Since we are interested in fixed-exchange-rate regimes, we will model the rate of devaluation ϵ_t as the exogenous policy parameter that the government controls. The level of M_t will be endogenously determined by the money demand equation (21) and by the requirement that the price of tradable goods be the same in the two countries: $P_t^T = e_t P^{T*}$, where P^{T*} is the foreign price of tradable goods and e_t is the exchange rate.

4.10 EQUILIBRIUM IN THE GOODS MARKET

Equilibrium in the nontradable goods market requires

$$Y_t^{NT} = C_t^{NT} + G_t^{NT}. \tag{26}$$

Using this equation and aggregating the private and public budget constraints, we obtain the equilibrium conditions for the tradable goods market:

$$Y_t^T = C_t^T + I_t + S_t + G_t^T + TB_t, \tag{27}$$
$$a_t = (1 + r^*)a_{t-1} + TB_t. \tag{28}$$

Here $a_t = b_t + f_t$ represents, as before, the consolidated net asset holdings of the government and of the private sector. TB_t is the economy's trade balance.

4.11 THE STEADY STATE

Given that we abstracted from technological progress, all the variables defined above will be constant in the steady state. The steady state for this economy is defined by a set of conditions that include the resource constraints and equations (12), (13), (21), (23), and (24). Conditions (12) and (13) relate p to the labor allocations across the two sectors and to the consumption mix. Conditions (21), (23), and (24) are, respectively, the equations that describe money demand, labor supply, and the real wage rate.

Since there are no adjustment costs in the steady state, the net marginal product of capital (adjusted for the transactions costs associated with the investment process) is equated to the international real interest rate:

$$r^* = \frac{(1 - \alpha)(1 - \tau)Z^T(K^T)^{-\alpha}(N^T)^{\alpha}}{1 + Z^S(\frac{1}{4} - X^2)} - \delta. \tag{29}$$

Notice that we recover the usual expression that equates the domestic marginal product of capital net of depreciation to the world real interest rate when the nominal interest rate is zero, since in this case X is equal to $\frac{1}{2}$ [see equation (21)].

The steady-state level of investment is given by $I = \delta K$. The steady-state trade balance is determined by the condition

$$TB = -r^*a. \tag{30}$$

As in Section 3, the steady state is consistent with any level of net foreign assets.[11] Economies with higher levels of a have higher steady-state levels of consumption of tradables and nontradables, as well as lower levels of investment and production of tradable goods.

4.12 CALIBRATING THE MODEL

Our model has no known closed-form solution, so we employ the numerical linearization methods of King, Plosser, and Rebelo (1988) to explore its

11. For high enough values of a, the steady state can be characterized by a corner solution in which N^T is zero. Since in all the scenarios that we consider a is negative, this possibility is never relevant.

Table 2 PARAMETER VALUES

Parameter	*Baseline Value*
International real interest rate (r^*)	0.01
Discount factor (β)	0.99
Rate of devaluation (ϵ)	0.46
Depreciation rate (δ)	0.025
Labor share, tradables sector (α)	0.48
Labor share, nontradables sector (η)	0.63
Elasticity of intertemporal substitution (σ)	0.20
Elasticity parameter, momentary utility (ν)	3.00
Level parameter, momentary utility (ψ)	22.75
Share parameter, momentary utility (γ)	0.50
Level parameter, tradables production (Z^T)	1.00
Level parameter, nontradables production (Z^{NT})	4.76
Level parameter, shopping technology (Z^S)	1.00
Level of net foreign assets (a)	− 6.81
Adjustment costs elasticity (ζ)	0.067
Government expenditures in tradables (G^T)	0.25
Government expenditures in nontradables (G^{NT})	0.51
Tax rate on output (τ)	0.10

Note: Each period is meant to represent one quarter.

properties.[12] Our baseline parameters are described in Table 2. Each period is meant to represent a quarter. These parameters were chosen to try to replicate the average values of some key ratios for the Argentine economy in the decade prior to the 1991 convertibility plan. This is a difficult task, given the instability of the Argentine economy during the 1980s. We nevertheless chose Argentina as the reference country because the convertibility plan was orthodox, i.e., it did not rely on price and wage controls.

We employed the point estimates of the elasticity of intertemporal substitution obtained by Reinhart and Végh (1995) for Argentina (σ = 0.2). We followed Uribe (1995) in setting the rate of inflation to its average value in the period 1970–1990: 10% per month. We also employed his estimates for the labor shares in the tradable and in the nontradable sector (α = 0.48 and η = 0.63). The share parameter in the utility function was set equal to 0.5; together with our choices for Z^T and Z^{NT}, this implies that approximately half of total consumption expenditures are devoted to nontradables. We chose ν = 3, which implies an elasticity of labor supply of 0.5, so as to obtain realistic labor-supply responses (increases in labor supply on the order of 3%) in the experiments that we

12. This method involves linearizing the model around the steady state. The fact that this model displays a unit root (associated with the ability to borrow and lend at a fixed interest rate) may lower the accuracy of the numerical approximations, since we linearize around a steady state to which the economy never returns.

considered. We chose $\psi = 22.75$, which implies that in the steady state agents devote 20% of their time to working in both sectors.

We chose the transactions technology parameter Z^s to match the 7% ratio of seignorage to GDP estimated by Kiguel (1989) for the period 1984–87.[13] The level of net foreign assets (a) was chosen so as to generate a steady-state trade balance relative to the GDP that coincides with the long-run average for this variable in the period 1970–1990 (0.0267). Tax revenue during the period 1985–1987 was 10% of GDP, while government expenditures for the nonfinancial public sector (excluding real interest payments) represented roughly 30% of GDP.[14] We chose $\tau = 0.10$ and set the overall level of government expenditures consistent with these figures. We assumed that 70% of government expenditures were devoted to nontradable goods, with the remainder spent on tradables.

The model was parametrized with standard values for the real interest rate (1% per quarter) and for the rate of depreciation (2.5% per quarter). We chose adjustment costs so that the elasticity of Tobin's q with respect to the investment-capital ratio $[-\phi''(\delta)\delta/\phi'(\delta)]$ is equal to 1/15, which is Baxter and Crucini's (1993) baseline parameter.

In all the experiments described in the next section, we follow the literature in treating stabilizations as unanticipated events. We start the economy in period 0 at the steady state and assume that the stabilization was until then unanticipated, but is perfectly foreseen from that point on. Throughout the paper the results we report are expressed in terms of percentage deviations from initial steady-state values.

4.13 MONEY-BASED VERSUS EXCHANGE-RATE-BASED STABILIZATION

Before we proceed, it is important to notice that in our model there is no difference between an exchange-rate-based stabilization and a money-based stabilization (where the government controls the money supply and the exchange rate is endogenous). Fixing the exchange rate implies a certain path for M_t. Any money-based stabilization in which the government adopts the same path for M_t will produce the same outcome.

In practice, however, exchange-rate-based programs are preferred to money-based programs for two reasons.[15] First, the velocity of circula-

13. Kiguel's (1989) seignorage estimates were computed as the change in M1 because in Argentina reserve requirements on time deposits and other interest-bearing deposits were remunerated by the Central Bank. These estimates are broadly consistent with the money demand function estimated by Rodriguez (1994), which implies that a 10% monthly inflation is consistent with a ratio of seignorage to GDP of 6%.
14. The source for these figures is the Argentine Ministry of Economy and Fund staff estimates.
15. In Reinhart and Végh's (1994) data set, which comprises 7 countries and 17 stabilization plans from 1964 to the present, there are 12 exchange-rate-based stabilizations but only 5 money-based programs.

tion shifts so much at the onset of a stabilization episode that it is difficult for policymakers to determine what the appropriate growth rate of M_t should be. Fixing the exchange rate makes M_t endogenous and avoids this problem. A second problem with money-based stabilizations is that, if the government wants, for some reason, to avoid a period of deflation, it has to announce a permanent decline in the growth rate of money, at the same time it engineers a one-time increase in M_t. This rise in M_t, which is necessary to accommodate the rise in money demand produced by the decline in expected inflation without a price fall, might undermine the credibility of the disinflation program.

5. *The Alternative Theories*

The stylized facts reviewed in Section 2 have given rise to a large theoretical literature. In this section we use the model of Section 4 to examine the implications of the different theories for all the relevant macroeconomic variables. This is an indispensable task. The stabilization literature generally focuses on a few variables at a time, either to insure analytical tractability or to isolate particular mechanisms of interest. To facilitate the comparison between the different hypotheses, we summarize their qualitative implications in Table 3, which reports the direction of change for the different variables at the end of the first year after the implementation of the stabilization for our benchmark parametrization.

5.1 CREDIBLE DISINFLATION: SUPPLY-SIDE EFFECTS

A natural starting point to study exchange-rate-based stabilizations is to isolate the effect of a credible, permanent reduction in the devaluation rate ϵ. The resulting supply-side effects have recently been emphasized by Roldos (1993, 1995) and Uribe (1995). In all the experiments that we consider, we reduce the rate of devaluation by 100%. This is consistent with the convertibility plan, where the exchange rate was fixed.

The effects of a decline in the rate of devaluation are depicted in Figure 5.[16] The decline in the rate of inflation generates the type of investment effect discussed in Section 3. The fall in the nominal interest rate reduces the transactions costs associated with investment, which increases the marginal productivity of capital net of these costs [equation (29) shows the steady-state version of this effect]. As a result, the steady-state capital/labor ratio in the tradable-goods sector will be higher, implying higher values of w and p and a lower ratio C^{NT}/C^{T}. There is also a wealth

16. Roldos (1995) derives similar results in a cash-in-advance model with exogenous labor supply.

Table 3 QUALITATIVE EFFECTS

	Y^T	Y^{NT}	C	I	TB	N	w	p	M/P^T
Stylized facts	↓	↑	↑	↑	↓	↑	↑	↑	↑
Five hypotheses:									
Permanent disinflation	↑	↑	↑	↑	↓	↑	↑	↑	↑
Temporariness	↑	↑	↑	↑	↓	↑	↑	↑	↑
Fiscal contraction:									
Fall in tradables expenditures	↓	↑	↑	↓	↑	↑	↑	↑	↑
Fall in nontradables expenditures	↑	↑	↑	↑	↓	↓	↓	↓	↑
Rise in taxes	↓	↓	↓	↓	↑	↓	↓	↓	↓
Sticky wages with supply-side effects of disinflation	↓	↑	↑	↑	↓	↓	↑	↑	↑
Sticky inflation with supply-side effects of disinflation	↑	↑	↑	↑	↓	↑	↑	↑	↑

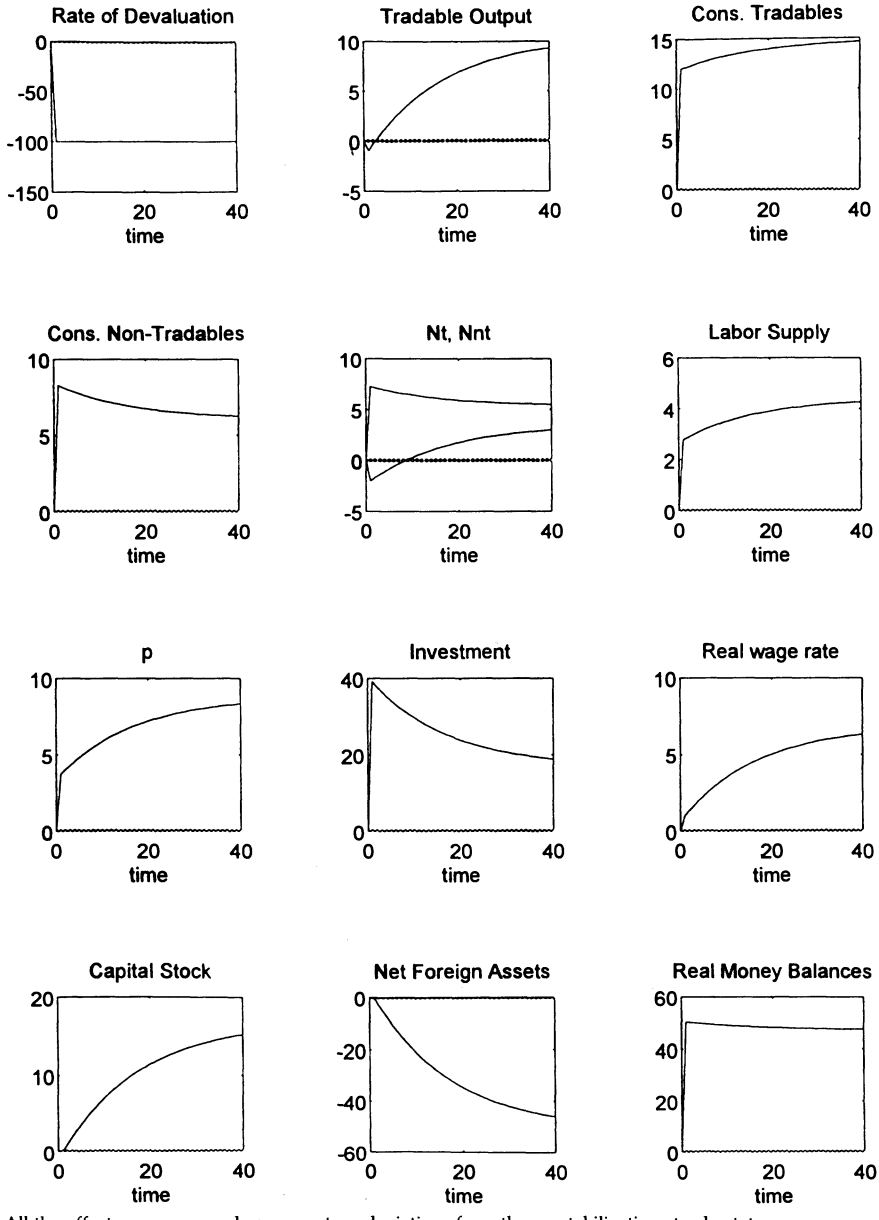
Note: This table summarizes the results observed in the fourth quarter after the beginning of the stabilization. These would be the effects that one would observe with annual data.

effect produced by the reduction in resources spent transacting (S). On impact, the consumption of both goods increases. Given the magnitudes involved, the increase in labor supply is not enough to accommodate the increase in demand for nontraded goods. Hence, N^T falls and N^{NT} rises on impact. The rise in the stock of capital that takes place during the transition is associated with a fall in N^{NT} and a rise in N^T.

5.2 THE TEMPORARINESS HYPOTHESIS

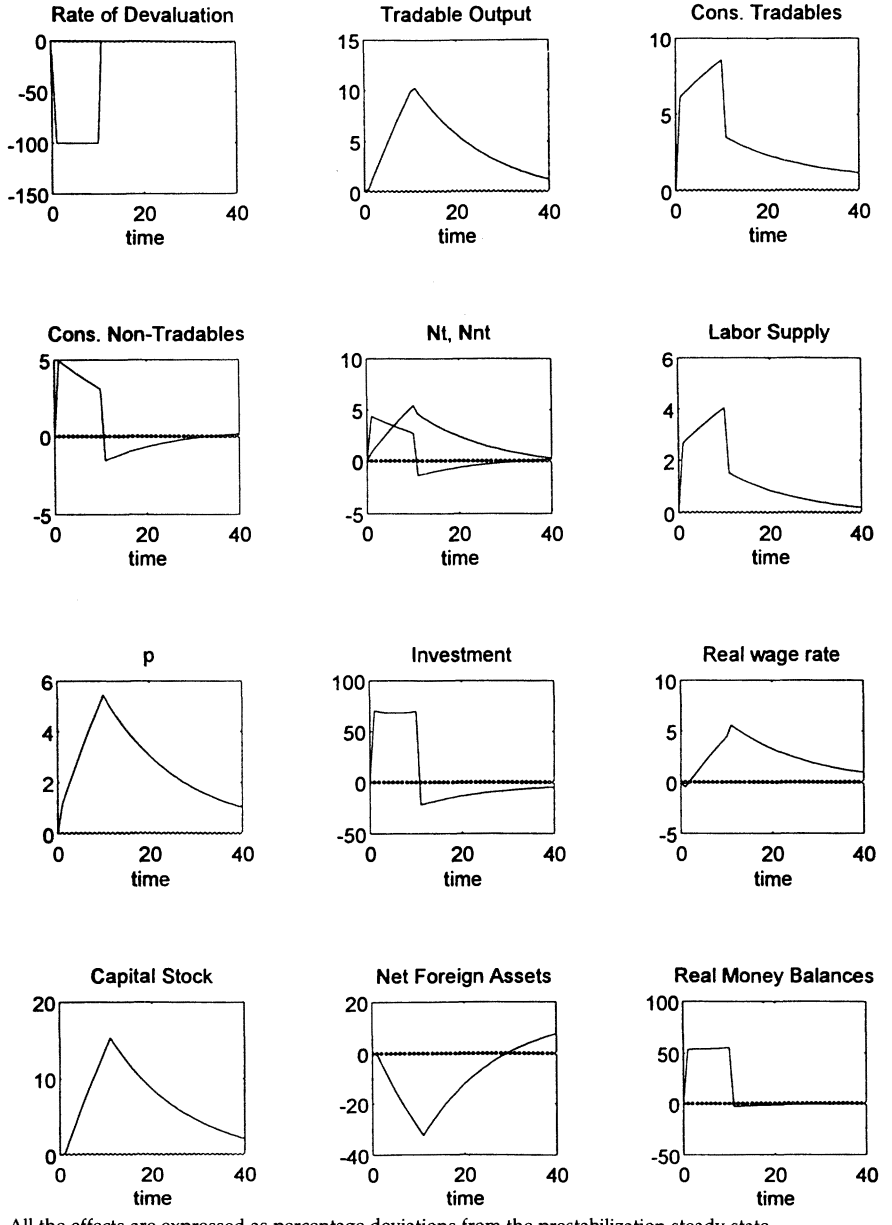
A rich history of failed stabilization attempts in chronic-inflation countries typically leads the private sector to view with skepticism any new attempt to bring down inflation to international levels. This has been the motivation underlying the temporariness hypothesis explored by Calvo (1986) and Calvo and Végh (1993). This hypothesis considers the case in which the stabilization plan is not credible, and hence the reduction in the rate of inflation is viewed as strictly temporary. Figure 6, which shows the effects of a 100% decline in the rate of devaluation that only lasts for 10 periods, illustrates the implications of the temporariness hypothesis.

Figure 5 PERMANENT 100% DECLINE IN THE RATE OF DEVALUATION



All the effects are expressed as percentage deviations from the prestabilization steady state.

Figure 6 TEMPORARY 100% DECLINE IN THE RATE OF DEVALUATION



All the effects are expressed as percentage deviations from the prestabilization steady state.

Since money must be used to purchase goods, a temporary fall in the interest rate lowers the effective price of consumption today relative to the future—along the lines discussed in Section 3—leading to a consumption and output boom followed by a later contraction. The temporarily lower effective price of consumption induces the household to increase consumption today (i.e., between period 1 and period 10) relative to the future (i.e., after period 10). Thus, on impact both C^T and C^{NT} rise. The higher levels of consumption observed between period 1 and period 10 are financed in part by a higher level of the labor supply and in part by a depletion of net foreign assets. Absent the increase in labor supply, we would observe (1) an increase in w due to the reallocation of labor from the tradables to the nontradables sector, and (2) a rise in p reflecting the higher demand for nontradables. These effects continue to be present, but the expansion in the labor supply is associated with an initial fall in the real wage rate. The increase in N is primarily a result of the fall in inflation, which lowers the price of consumption in terms of leisure [recall from (23) that inflation affects labor supply through changes in X]. The fall in inflation makes investment temporarily cheaper. This causes a large investment boom during the stabilization and a fall in investment below its initial level after period 10.

5.3 THE EFFECTS OF FISCAL POLICY

The idea that some of the effects of stabilization plans are a result of the fiscal reforms that tend to accompany the decision to fix the exchange rate has been stressed in the work of Drazen and Helpman (1988, 1990) and Agenor (1994). One puzzling feature of stabilization experiences is that they seem to be associated with an economic boom, despite the fact that there is often an immediate increase in taxes and a reduction in government expenditures. The possibility that fiscal contractions may be expansionary has been explored empirically by Giavazzi and Pagano (1990) in their analysis of the fiscal contractions observed in Ireland and Denmark in the 1980s. Recently, Rebelo (1994) has shown that an expansion can occur in the presence of an increase in taxes in situations where the present value of the resources that the government needs to extract from the private sector declines as a result of the stabilization plan.

5.3.1 Fiscal Adjustment during Stabilization Most successful (or temporarily successful) stabilization programs typically include a drastic fiscal adjustment that features a combination of higher taxes and lower expenditures (see, for example, Sachs, 1987b). As an illustration, Table 4 documents the nature of the fiscal adjustment that took place in the four stabilization episodes depicted in Figures 1 through 4. In Argentina, the

Table 4 FISCAL ADJUSTMENTS DURING STABILIZATION

Argentina (Public Sector Excluding Provinces)[a]

		% of GDP				
		1989	1990	1991[b]	1992	1993
1	Total revenues	13.7	13.8	15.8	17.1	17.4
	1.1 Tax revenue	8.6	8.4	10.0	11.7	11.3
2	Expenditures[c]	30.7	16.6	18.3	17.3	16.7
	2.1 Interest[d]	11.8	3.3	2.6	1.5	1.1
	2.2 Wages	4.6	3.9	4.3	3.9	3.2
3	Balance (1-2)	− 17.0	− 2.8	− 2.5	− 0.2	0.7

Israel (General Government)[e]

		% of GDP					
		1984	1985[b]	1986	1987	1988	1989
1	Total revenues	61.0	71.1	68.7	61.6	58.9	54.2
	1.1 Tax Revenue	37.1	44.4	46.8	45.3	44.1	39.1
2	Expenditures	74.8	70.4	64.1	61.5	61.6	59.6
	2.1 Subsidies	6.3	4.8	3.1	3.1	3.4	3.0
	2.2 Defense	14.3	12.7	11.0	11.0	10.7	10.3
3	Balance (1-2)	−13.8	0.7	4.6	0.1	−2.7	−5.4

Mexico (Public Sector)[f]

		% of GDP					
		1986	1987[b]	1988	1989	1990	1991
1	Total revenues	28.8	29.5	29.0	27.9	27.3	25.9
	1.1 Tax revenue	9.1	8.7	10.9	12.0	10.4	10.7
2	Expenditures	43.7	43.9	39.9	32.9	30.1	26.5
	2.1 Interest	16.4	19.8	18.0	13.2	10.3	5.6
	2.2 Wages	5.8	5.6	6.1	5.8	5.7	6.3
3	Balance (1-2)	−14.9	−14.4	−10.9	−5.0	−2.8	−0.6

Uruguay (Central Government)[g]

		% of GDP					
		1977	1978[b]	1979	1980	1981	1982
1	Total revenues	15.0	14.2	14.6	16.2	17.4	15.2
	1.1 Tax revenue	11.2	10.9	10.1	11.8	12.3	10.6
2	Expenditures	16.3	15.6	14.3	16.1	17.5	23.9
	2.1 Interest	1.0	0.8	0.6	0.4	0.3	0.6
	2.2 Wages	6.8	6.1	5.2	5.7	6.4	7.4
	2.3 Soc. Secur.	3.0	2.9	2.9	5.0	5.6	9.4
3.	Balance (1-2)	− 1.3	− 1.4	0.3	0.1	− 0.1	− 8.7

[a]*Source:* Argentine Ministry of Finance and Fund staff estimates.
[b]Year in which the stabilization plan began.
[c]Excluding expenditures for arrears clearance to pensioners, suppliers, and provincial governments.
[d]On an accrual basis.
[e]*Source:* Bank of Israel.
[f]*Source:* Banco de Mexico.
[g]*Source:* Central Bank of Uruguay.

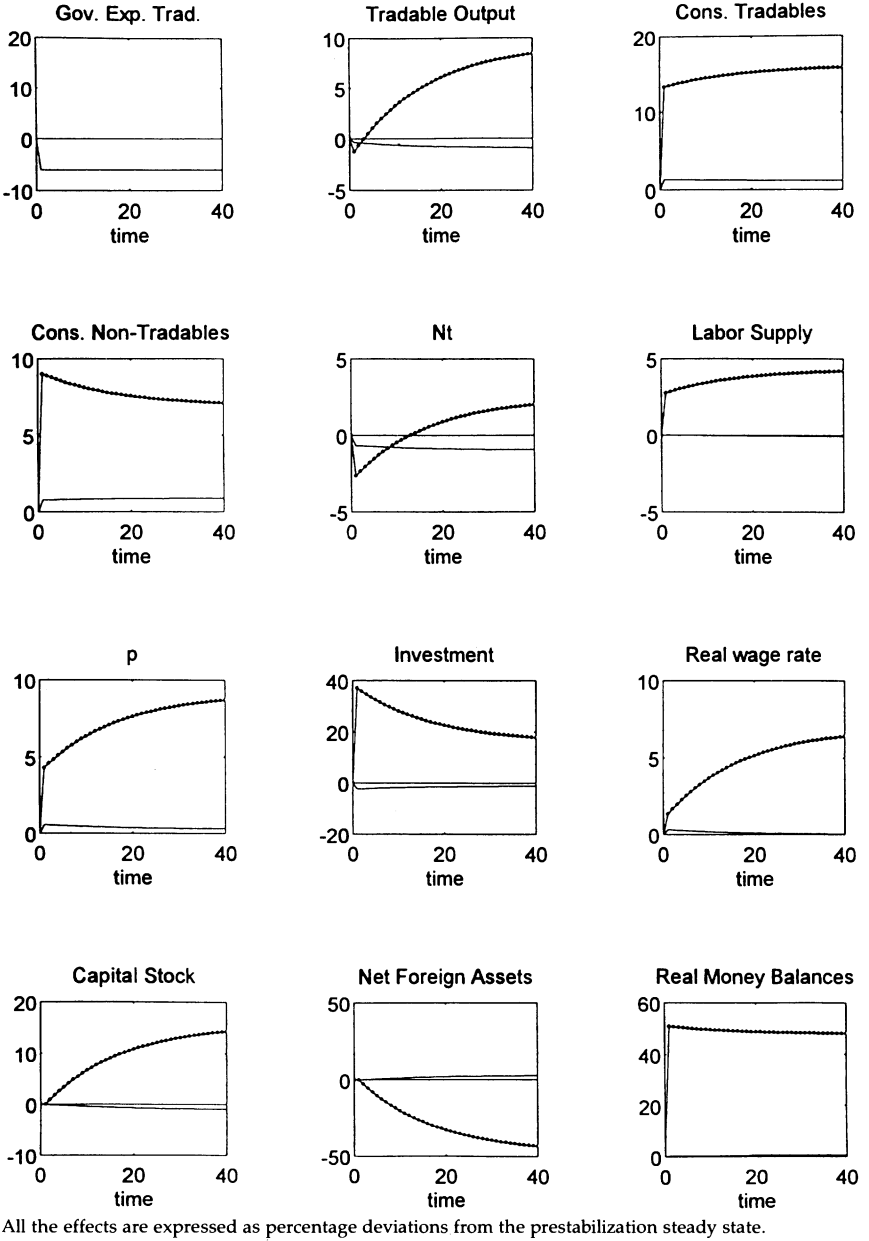
fiscal improvement from 1990 to 1993 took the form of higher revenues (including taxes). In Israel, the drastic fiscal improvement of 18.4 percentage points in the general government deficit as a percentage of GDP from 1984 to 1986 reflected a decline of roughly 10 percentage points in public expenditure (primarily in defense and subsidies) and an increase in revenues. Part of the increase in revenues, however, seems to have been an endogenous response to the initial boom, as evidenced by the fact that revenues as proportion of GDP fell sharply with the 1988–1989 recession.[17] Mexico already had a large primary surplus (close to 10% of GDP) by the time the stabilization plan was implemented at the end of 1987. The large overall deficits in the first years of the program shown in Table 4 are explained by the large interest payments that resulted from high interest rates. In Uruguay, the fiscal adjustment had also taken place before the program was implemented. In 1982, the fiscal situation deteriorated sharply due to a large increase in expenditures (related to social security and government salaries).

5.3.2 Simple Fiscal Experiments We will focus on three simple experiments that highlight permanent changes in fiscal policy that are common components of stabilization packages: (1) a reduction in government expenditures on tradables: (2) a reduction in government expenditures on nontradables; and (3) an increase in taxes. The outcomes of these experiments are reported in Figures 7 through 9. In these figures the solid lines correspond to the effects of fiscal policy in isolation, while the dotted lines display the fiscal effects combined with the permanent disinflation featured in Figure 5.

Since the economy can borrow and lend at a fixed rate, a reduction in government expenditures on tradables is equivalent to the expansion in a discussed in Section 3. The timing of government expenditures on tradable goods is irrelevant from the standpoint of the private sector; only the present value of these expenditures matters. The solid line in Figure 7 shows the effect of a 6% reduction in G^T. This implies a fall in total government expenditures on the order of 2%. This corresponds roughly to the contraction in expenditures for the consolidated public sector observed in Argentina. The model predicts a consumption boom, an expansion in the nontradable sector and a contraction in the tradable sector, a real appreciation, and an increase in the real wage. Investment falls, and the current account improves. It is clear that, in isolation, this type of fiscal contraction cannot explain the stylized facts of Section 2.

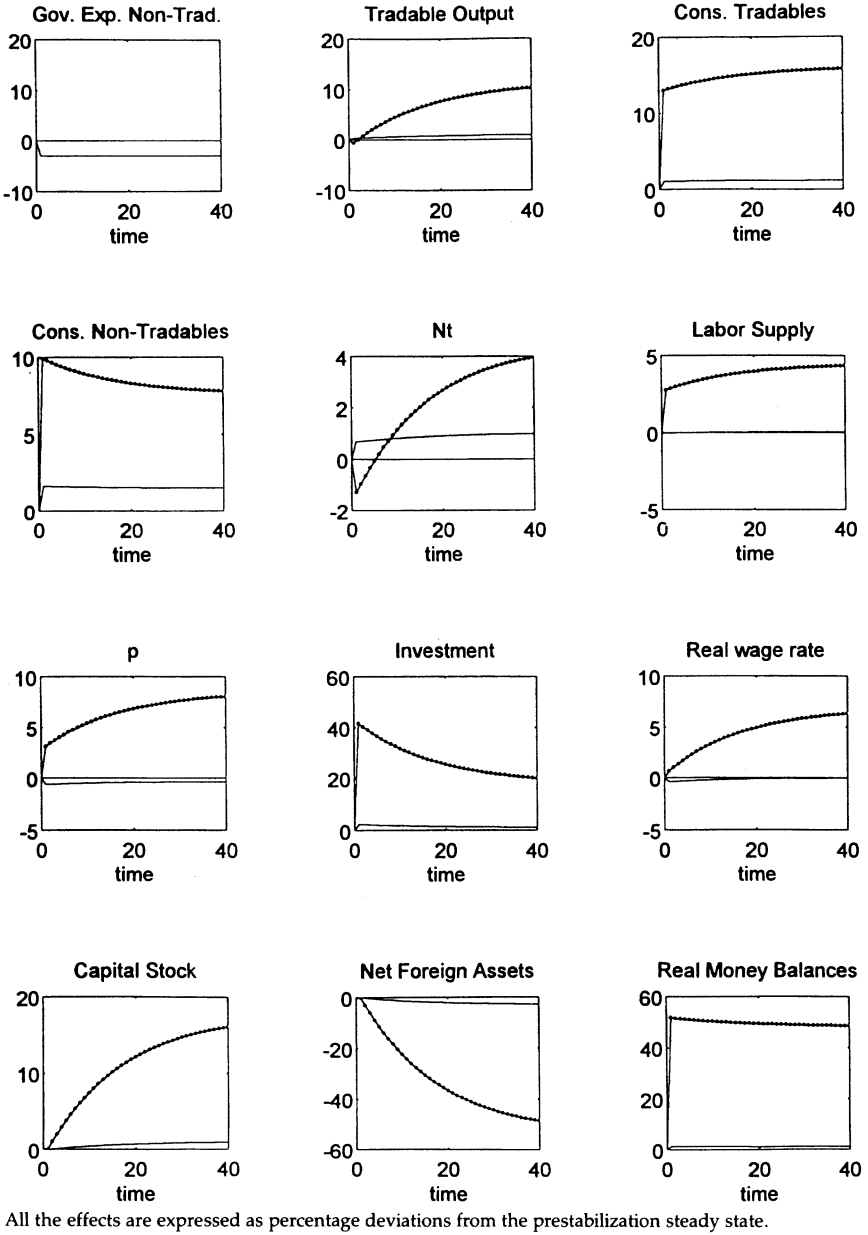
17. The relationship between fiscal revenues and the initial consumption boom in exchange-rate-based stabilizations has been stressed by Talvi (1994a).

Figure 7 PERMANENT 6% DECLINE IN GOVERNMENT EXPENDITURES ON TRADABLE GOODS



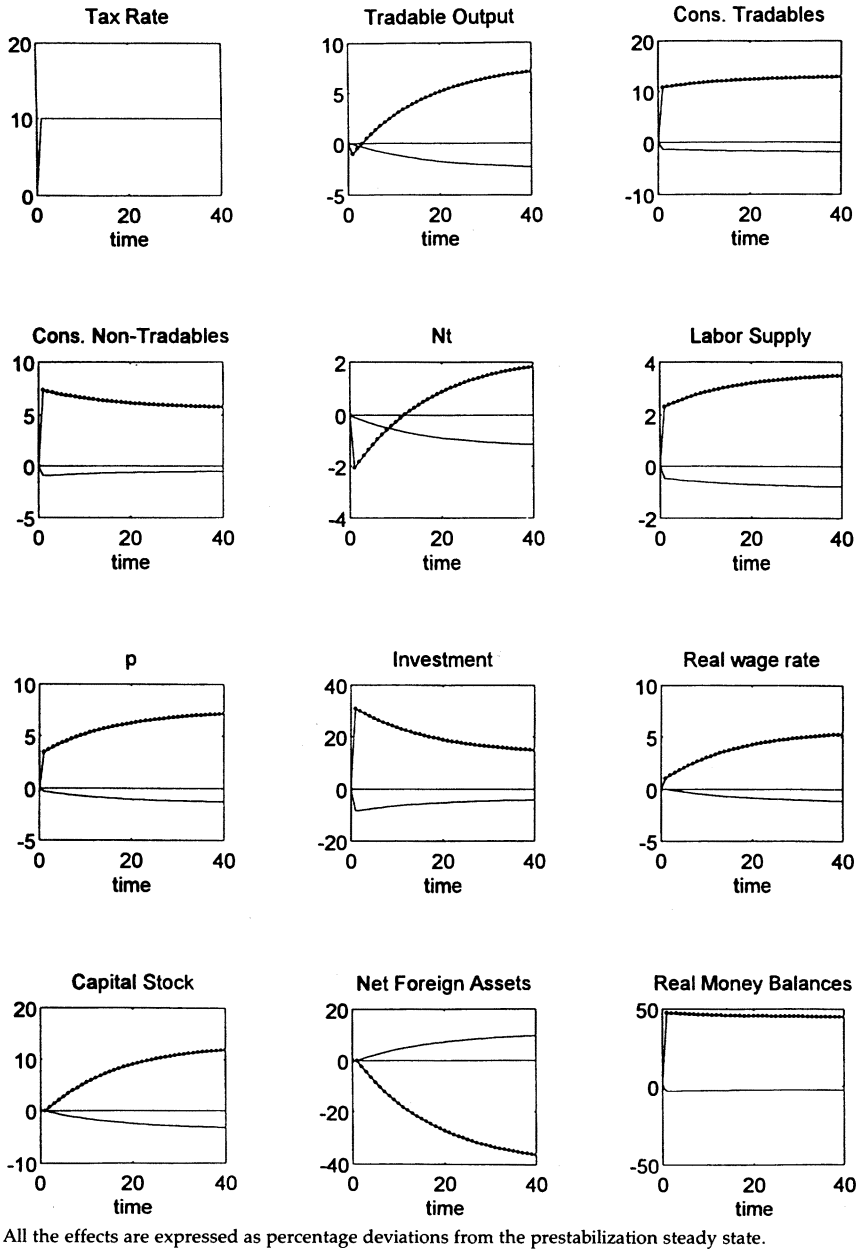
All the effects are expressed as percentage deviations from the prestabilization steady state.

Figure 8 PERMANENT 3% DECLINE IN GOVERNMENT EXPENDITURES ON NON-TRADABLE GOODS



All the effects are expressed as percentage deviations from the prestabilization steady state.

Figure 9 PERMANENT 10% INCREASE IN THE OUTPUT TAX RATE



All the effects are expressed as percentage deviations from the prestabilization steady state.

However, if we combine the effects of a contraction in G^T with those of a permanent reduction in the rate of devaluation, we obtain a scenario that comes close to what we observe. The two effects combined imply a 12% rise in consumption of tradables and an 8% increase in home-goods consumption. The real exchange rate appreciates by roughly 4% on impact. The rise in p attributable solely to the fiscal contraction is on the order of 1%.

Figure 8 shows the effect of a permanent decline of 3% in G^{NT}, which represents a 2% fall in total government spending. The response of the economy to a reduction in G^{NT} is similar to that induced by the labor-supply effect discussed in Section 3. After all, the fall in G^{NT} increases the supply of labor available to the private sector. Thus we observe a fall in p and in w. When we combine this fiscal contraction with the effects of disinflation, we obtain a scenario that fits in qualitative terms the main stylized facts. A large contraction in G^{NT} would, however, overwhelm the effects of disinflation and produce counterfactual implications. It is unfortunate that the fiscal impacts depend so heavily on the type of expenditures that is reduced, since this complicates considerably the interpretation of the evidence.

Figure 9 shows the effects of an increase in the output tax rate from 10% to 11%. This is roughly consistent with the tax increases associated with the convertibility plan (e.g., the VAT rate increased from 14% to 16% in 1991, and then increased again to 18% in 1992). Not surprisingly, the increase in taxes generates a recession, as well as other effects which are the opposite of what we observe in the initial stages of exchange-rate-based stabilizations. However, mild tax increases combined with permanent disinflation can still generate realistic scenarios.

5.4 STICKY INFLATION AND NOMINAL WAGE RIGIDITY

The earliest explanations for the empirical regularities described in Section 2—put forward by Rodriguez (1982) and Dornbusch (1982)—were based on reduced-form models which incorporate backward-looking elements into the inflationary process (i.e., adaptive expectations or backward-looking indexation of nominal wages). In these models, which were motivated by the Southern Cone *tablitas* of the late 1970s, interest-rate parity is assumed to hold, and aggregate demand depends negatively on the real interest rate and positively on the real exchange rate (the relative price of traded goods). In this context, a permanent reduction in the rate of devaluation reduces the real interest rate on impact and generates a boom in economic activity. The stickiness in the inflation of home goods causes a sustained real exchange-rate appreciation, which eventually throws the economy into a recession. This hy-

pothesis lost some practical relevance in the mid-1980s when, unlike what had been observed in the Southern-Cone *tablitas*, real interest rates rose sharply in the early stages of the plan.

From an analytical point of view, the explanatory power of sticky wages and sticky inflation has recently been called into question by Calvo and Végh (1994), who argue, in the context of an intertemporal optimizing model, that the initial fall in real interest rate will be associated with an initial boom only in the (empirically implausible) case in which the intertemporal elasticity of substitution is higher than the intratemporal elasticity of substitution. Sticky inflation, however, continues to be a popular notion for thinking about stabilization, as recently illustrated by Dornbusch and Werner's (1994) study of the Mexican 1987 stabilization.

We now examine the merits of two hypotheses that embody nominal rigidities in the context of our benchmark model. Instead of specifying nominal contracts or lags in the adjustment of prices, we fed in realistic paths for real wages or for the real exchange rate that converge to their long-run equilibrium values. This seems a natural first step in that it allows us to determine whether, given some unspecified nominal rigidity that generates the required price behavior, the model is consistent with the empirical regularities observed for real variables. If nominal rigidities survive as a useful hypothesis, the problem of uncovering the source of sustained disequilibrium rises in wages and prices becomes pertinent. We first consider the effects of a permanent disinflation together with an increase in the real wage that depends on an exogenous component and on the level of employment relative to the steady state. Then we study the impact of sticky inflation by analyzing the effects of a disinflation that is accompanied by an exogenous rise in the price of nontradables.

5.4.1 Nominal-Wage Rigidities A common explanation for the outcome of an exchange-rate-based stabilization program is that nominal wages are indexed to past inflation. The materialization of low rates of inflation after the reform makes the real wage too high. To study the implications of this hypothesis, we compute the perfect-foresight equilibrium of our base model that corresponds to a sustained, but temporary, increase in the real wage rate. Since the real wage is above its equilibrium value, we assume that the number of hours hired in the labor market is determined by the short side of the market, which in this case is the demand side.[18] Thus there will be involuntary unemployment: the number of hours

18. Cho and Cooley (1995) and King (1995) are examples of dynamic models that embody nominal rigidities and disequilibrium allocation rules. Erceg and Levin (1994) have recently discussed the role of nominal rigidities in stabilization episodes in a framework similar to the one we employ here.

employed by firms will fall short of the total number of hours available in the economy. We assumed that real wages follow the process given by

$$\hat{w}_t = \zeta_t + \upsilon \hat{N}_t,$$

where $\hat{w}_t$ is the percentage deviation in the wage rate relative to the steady state, ζ_t is a wage shock, and υ is the sensitivity of changes in the wage rate to variations in the total employment $\hat{N}_t$, defined as the percentage deviation of $N_t^T + N_t^{NT}$ from its steady-state value. The term $\upsilon \hat{N}_t$ captures the notion that the real wage rises as labor-market conditions tighten. In the results that we report we set $\upsilon = 1$. We studied the effects of a hump-shaped increase in the wage shock ζ_t with a peak value of 12%. This corresponds to half of the 24% increase in the real wage, measured in units of tradable goods, observed in Argentina. The resulting real wage is always above its equilibrium value but converges to its long-run equilibrium.

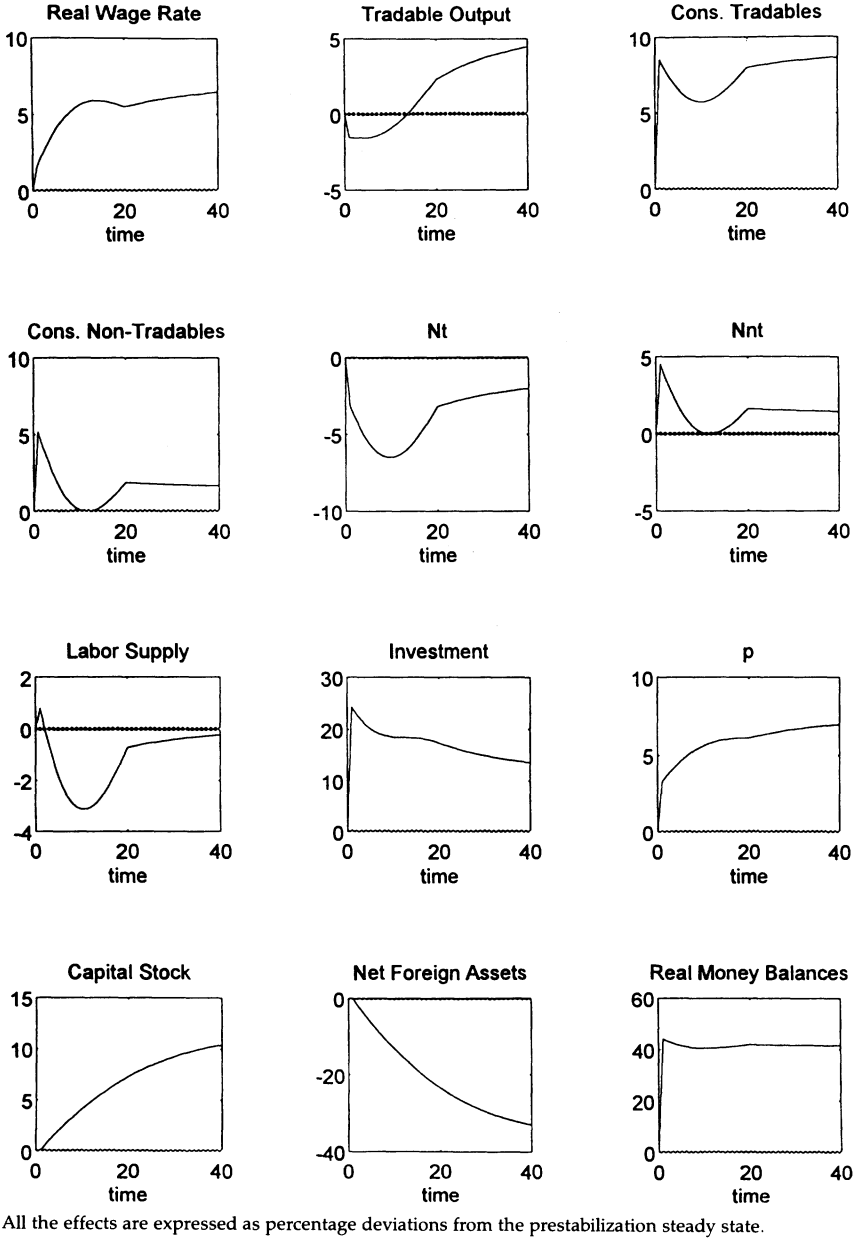
The effects of nominal-wage rigidities considered in isolation generate strongly counterfactual features: a recession in both sectors, and a decline in both consumption and investment. Firms fire workers because of the high wages, and unemployment leads to a drop in consumption. Investment falls in reaction to the low returns to capital implied by the high cost of labor.

However, much to our surprise, we found that nominal-wage rigidities combined with the supply-side effects of a permanent reduction in the rate of devaluation produce a realistic scenario (see Figure 10).

5.4.2 Sticky Inflation We now consider the effects of a permanent reduction in the rate of devaluation, which leads to the instantaneous convergence of tradables inflation but to a slow convergence in home-goods inflation. This setting, in which the price of one of the goods is sticky, is similar to the one studied in Stockman and Ohanian (1993). Specifically, we assume that in response to a permanent reduction in the rate of devaluation, the path of p follows the inverted-U pattern depicted in the first panel of Figure 11. We chose the peak value of p to be 18%, which is half of the rise in the real exchange rate observed in Argentina during the convertibility plan. Since p is higher than its market-clearing value, the consumers' demand for nontraded goods falls short of the firms' desired supply [i.e., equilibrium condition (26) does not hold]. We assume that the short side of the market prevails, in the sense that firms will only supply what consumers demand.

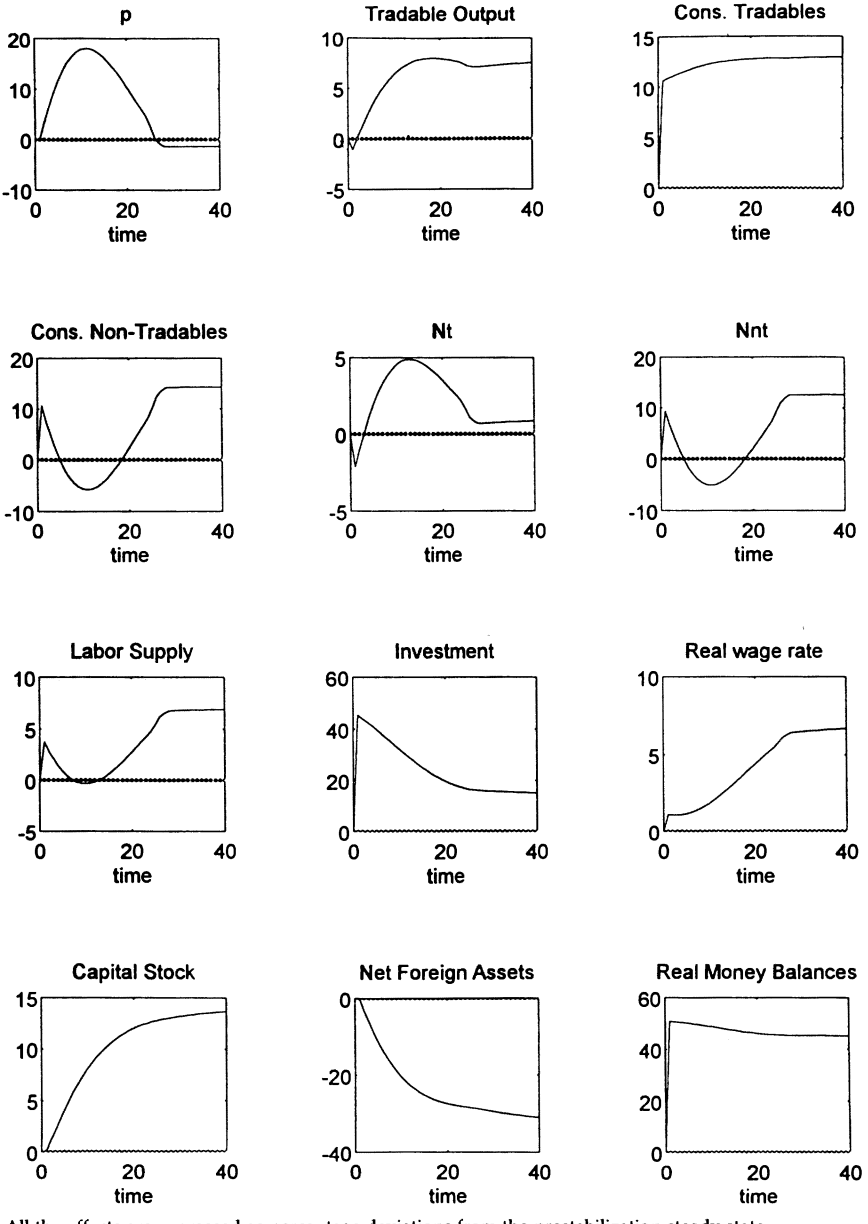
In isolation, a rise in p increases the consumption of tradable goods and lowers nontradable consumption, it raises investment (which responds to the reallocation of labor toward tradables) and lowers the real

Figure 10 PERMANENT DECLINE IN THE RATE OF DEVALUATION WITH NOMINAL WAGE RIGIDITIES



All the effects are expressed as percentage deviations from the prestabilization steady state.

Figure 11 PERMANENT DECLINE IN THE RATE OF DEVALUATION WITH STICKY INFLATION



All the effects are expressed as percentage deviations from the prestabilization steady state.

wage rate, at the same time that it deteriorates the current account.[19] Figure 11 shows the combination of these effects with a permanent reduction in the rate of devaluation. This scenario is broadly consistent with the facts discussed in Section 2.

6. *Evaluating the Different Hypotheses*

6.1 QUALITATIVE PERFORMANCE

Both a temporary and a permanent decline in the rate of devaluation are capable of reproducing most of the stylized facts described in Section 2. Our version of the temporariness hypothesis has, however, an implausible implication: investment increases by 75% on impact. This unrealistic investment response can be eliminated by increasing the degree of adjustment costs. This leads to a smaller deterioration of the current account and to a smaller real appreciation, but has a relatively minor effect on the behavior of the other variables depicted in Figure 6.

None of the three simple fiscal experiments that we consider—a permanent decline in G^T or G^{NT} and a permanent increase in the tax rate—can, in isolation, produce the main effects of exchange-rate-based stabilizations. However, mild fiscal contractions combined with the effects of disinflation can produce realistic scenarios. The most promising of these scenarios combines a contraction in government tradable expenditures with a permanent disinflation.

Nominal-wage rigidity by itself produces a recession with strong counterfactual features. However, the effects of nominal-wage rigidities combined with those of disinflation are consistent with most of our stylized facts. The same holds for sticky inflation.

Unfortunately, the ability of the different hypotheses to replicate the empirical regularities differs most with respect to the two least-documented facts: (1) a recession (or at least no boom) in the tradables sector; and (2) a boom–recession cycle observed even in successful programs.

Both a temporary and a permanent decline in the rate of devaluation are incapable of producing a visible recession in the tradables sector, unless they are combined with a fiscal contraction. The sticky-wage hypothesis leads naturally to a decline in tradables production. In contrast, the sticky-inflation hypothesis tends to predict an expansion in the tradables sector after the first quarter.

19. The fact that p is temporarily high leads to a depletion of net foreign assets. Since the long-run level of p depends on a (see Section 3), we had to construct Figure 11 using an iterative procedure. This method insures that p returns to a long-run equilibrium that is consistent with the level of a that is observed at the end of the period during which p is above its equilibrium level.

There are three hypotheses that generate a boom–recession cycle: temporariness, sticky wages, and sticky inflation. In our versions of sticky wages and sticky prices, however, the recession comes too early: after a one-quarter expansion there is a decline in investment, employment, and the production of nontradables.

6.2 QUANTITATIVE ISSUES

The evolution of some of the key macroeconomic variables is described in Table 5 for the four countries that we considered. This table makes clear that all our simulations underpredict the consumption booms observed in practice. This is partly due to the inclusion of durables purchases in the data reported in Table 5. However, the consumption booms predicted by our model are still smaller than the ones observed in nondurable consumption in the two countries for which we have disaggregated data for durables and nondurables—Mexico and Israel. It is important to stress that in our experiment the fall in seignorage was compensated by a rise in lump-sum taxes. When the total amount of resources extracted from the private sector falls one to one with the decline in seignorage, the wealth effect of disinflation is much stronger and the model generates larger consumption booms. In this case, the model comes close to replicating the rise in nondurable consumption in Mexico (15% from 1987 to 1991), but falls short of predicting the staggering 44% boom in nondurables consumption observed in Israel between 1985 and 1990.

The most important quantitative shortcoming of our model is that it produces real appreciations that are much smaller than the ones observed. The difficulties involved in accounting for the real appreciation can be demonstrated using equation (13), which requires that the value of a marginal unit of labor be identical in the two sectors. Suppose that labor is equally distributed between the two sectors ($N_t^T = N_t^{NT} = 0.5$) and that $\alpha = \eta = 0.5$. To simplify, assume also that the level of capital is fixed and that the supply of labor is exogenous. Under these assumptions, the change in the relative price of nontradables, p_t, coincides with the percentage increase in the hours of work devoted to the nontradables sector. To explain the 60% appreciation observed in Mexico over the period from 1987 to 1994, N^{NT} would have to have increased (at the expense of employment in the tradables sector) by an implausible 60%.[20] We can

20. When both sectors use capital and labor, as in the models of Rebelo (1993) and Uribe (1995), it is even more difficult to generate large increases in p_t. In that setting, p_t is proportional to $(K_t^T/N_t^T)^{\eta-\alpha}$, where η and α are the labor shares in the tradables and the nontradables sectors, respectively. Since empirically reasonably values for $\eta - \alpha$ are in the range of 0.1 to 0.4, large increases in p_t require very large changes in the capital–labor ratio of the tradables sector.

Table 5 MAJOR STABILIZATIONS: CHANGES IN SELECTED VARIABLES

Programs	*Effect*	*Relative Price of Non-tradables (% increase)*	*Real Wage (% increase)*	*Private Consumption (% increase)*	*Private Investment (% increase)*	*Real GDP (% increase)*	*Employ-ment (% increase)*	*Trade Deficit (% of GDP)*
Argentina,	After 1 year	17.6	1.7	15.7[a]	11.6	8.9	4.2	2.8
1991:2–1994:2	From beg. to peak	36.3	2.9	37.6[a]	133.7	33.0	7.1	6. 1
Israel,	After 1 year	10.9	− 2.4	14.1	− 0.2	3.6	1.4	− 3.5
1985:3–1990:2	From beg. to peak	16.6	15.4	37.3	33.1	21.4	10.5	0.7
Mexico,	After 1 year	24.3	− 2.0	2.1	8.8	1.2	0.0	5.0
1988:1–1992:4	From beg. to peak	57.3	26.3	27.3	69.3	16.6	2.2	11.4
Uruguay,	After 1 year	14.5	− 9.6	5.4	43.1	6.2	1.4	4.7
1978:4–1982:3	From beg. to peak	78.8	− 7.8	17.2	71.3	14.7	7.4	5.5

Source: IFS and National Authorities.
Notes: The period chosen comprises the quarters in which the program was in effect. If a program started late in a quarter, the following quarter is taken as the first quarter. For Israel and Mexico, duration has been arbitrarily set to 5 years. For Argentina end of period reflects data availability. Changes were computed from beginning of the program to highest value during period (lowest value for the trade balance).
[a]The data reported correspond to total consumption instead of private consumption.

reduce the magnitude of this labor reallocation if we adopt smaller values of α and η. These values, however, may be inconsistent with the share of labor in income in the overall economy. In order to generate large movements in p_t while maintaining empirically reasonable labor shares and avoiding implausible labor reallocations, we need to modify the technology in order to steepen the marginal cost schedule for nontradables production.

6.3 EXTENSIONS OF THE MODEL

We explored several extensions of the model that improve on the results discussed in the previous section. We also studied modifications of the model that significantly deteriorated its performance. We now discuss briefly both successes and failures.

First, if we modify the model to make the marginal cost of producing nontradables increase more steeply with Y^{NT}, we will obtain larger real appreciations and lower consumption booms. The simplest modification along these lines involves a reduction in the elasticity of substitution between labor and land in the nontradables sector. An interesting extreme case is obtained when we assume that there is a fixed endowment of nontradables that cannot be increased. Such modifications produce large appreciations only if we assume that the intratemporal substitution between C^T and C^{NT} is low. Otherwise, these changes in technology have a small effect on p and a large effect on the response of C^{NT}.

Second, if we assume that investment requires the use of tradables and nontradables, we obtain larger rises in p. Once again, to produce large increases in p we need to assume that substitution between these two goods is low *both* in consumption and in the investment process. It is obvious that the presence of substitutability in either of the activities will dampen the rise in the price and magnify the quantity adjustment.

Third, we incorporated a form of preferences widely used in the dynamic macroeconomics literature:

$$U = \sum_{t=0}^{\infty} \beta^t \frac{1}{1 - 1/\sigma} \{[(C_t^T)^{\gamma^T}(C_t^{NT})^{\gamma^{NT}}(1 - N_t^T - N_t^{NT})^{1-\gamma^T-\gamma^{NT}}]^{1-1/\sigma} - 1\},$$

$$0 < \gamma^T < 1,\ 0 < \gamma^{NT} < 1,\ 0 < \beta < 1,\ \sigma > 0.$$

In this version of the model the supply of labor exhibited a counterfactual decline in many of our experiments. This is not surprising, since the same wealth effect that leads agents to expand their consumption leads, with preferences of this type, to an increase in leisure. In

many of our experiments the substitution effect associated with the wage increase was not powerful enough to offset the positive wealth effect on leisure. It is the absence of a wealth effect on leisure implied by the preferences in Greenwood, Hercowitz, and Huffman (1988) that allowed our model to be consistent with the observed increase in the supply of labor.

Fourth, we considered a version of the model where S (the cost associated with transactions) represented time instead of resources. This meant that the disinflation process, by reducing S, produced a strong labor-supply effect of the type discussed in Section 3.2.2, thereby dampening the increase in p that the model generated.

Finally, we studied a version of the model in which investment transactions did not require the use of money. In this case a reduction in the rate of devaluation (both temporary and permanent) still leads to an increase in investment, as a result of an increase in the labor supply, which leads to a rise in N^T. However, this effect is quantitatively very small. The only hypothesis that produces a sizable investment increase when investment is a "credit good" is sticky inflation. In this case the rise in p can lead to a reallocation of labor toward tradables that is large enough to produce a sizable investment rise.

7. *Conclusions*

The empirical evidence on the outcomes of exchange-rate-based stabilizations defies the conventional wisdom that inflation stabilization needs to be painful. Using a dynamic model with rational agents who have perfect foresight, we have found that the following hypotheses work well on a number of dimensions: (1) a credible, permanent reduction in the rate of devaluation, (2) a reduction in the rate of devaluation believed to be strictly temporary, (3) a fiscal contraction that reduces tradables expenditures, combined with a reduction in inflation, and (4) a permanent disinflation in the presence of nominal-wage rigidities or sticky inflation. Unfortunately, the performance of these different scenarios is most distinct with regard to the two facts about which we know the least: the presence of a recession in the tradables sector and of a boom–recession cycle even in successful programs. A recession in the tradables sector arises naturally in an economy with sticky wages. In order to produce a fall in tradables production, both the temporary and the permanent reduction in the rate of devaluation need to be combined with a sizable fiscal contraction. The only hypotheses that generate a boom–recession cycle are temporariness and sticky wages or prices.

It is important to stress that the supply-side effects of disinflation

proved to be an essential component in accounting for the stylized facts of exchange-rate-based stabilizations. This is particularly true with respect to the nominal-wage rigidity hypothesis. When considered in isolation this hypothesis produces strongly counterfactual results, but when combined with the supply-side effects of disinflation, it generates a realistic scenario.

At a *quantitative* level the results for our baseline parametrization fall short of explaining the orders of magnitude involved in stabilization episodes, suggesting that the large consumption booms and the sizable real appreciations are puzzling. While there are configurations of the technology that are consistent with the magnitudes present in the data, there is currently not enough information on the role played by nontradable goods in actual economies to assess whether these configurations are empirically plausible. Improving our understanding of the role of nontradables in actual economies is a natural goal for future research.

Another research direction that seems fruitful is to improve the treatment of the way in which agents form expectations and to model the evolution of credibility over time. In all our results we made use of extreme assumptions: policy reforms were either perfectly anticipated or totally unforeseen, reform was either perfectly credible or doomed to fail with certainty. Going beyond these stark assumptions is likely to enhance our understanding of stabilization episodes.[21]

From a policy perspective, a better understanding of the dynamics involved in bringing down inflation from high levels seems essential. As recent events in Mexico vividly illustrate, some of the dynamics unleashed by an exchange-rate-based stabilization (in particular, the real appreciation and the current-account deterioration) may pose a difficult policy dilemma as to whether corrective measures are needed or not. Similar issues have also come up in the context of transition economies (Bruno, 1993; and Hansson and Sachs, 1994). While structural changes are likely to create additional uncertainty, the main lessons from the experience of high-inflation developing countries should prove quite helpful in designing effective stabilization policies for such countries.

Appendix

This appendix describes the main features of the four major stabilization plans described in Figures 1–4.

21. Baxter (1985), Kaminski (1993), and Svensson (1990) discuss methods for estimating the probability of reform continuation. These estimates can be used to improve the modeling of beliefs about the future.

A.1 ARGENTINA: APRIL 1991 CONVERTIBILITY PLAN

Date of stabilization plan: April 1991 to the present.

Exchange-rate/monetary policy: The convertibility plan was a shock orthodox program. The exchange rate was fixed, and the monetary base was, by law, fully backed by gold and foreign reserves.

Fiscal policy: During the program, the overall deficit of the public sector was basically eliminated. The plan also included a massive privatization program.

Structural policies: The main structural change has probably been the dramatic reform of the public sector, which included the privatization of some large public enterprises. Financial markets have been essentially free since the plan began.

Wage and price indexation: During the plan, formal indexation to past inflation was prohibited.

A.2 ISRAEL: 1985 STABILIZATION PLAN

Date of stabilization plan: Implemented in July 1985.[22]

Exchange-rate/monetary policy: The plan was an heterodox one which included a freeze of the exchange rate and wage and price controls. Initially (first six months), there were also ceilings on banking credit enforced through higher reserve requirements and short-term capital controls.

Fiscal policy: Drastic fiscal reforms were used to balance the budget almost overnight. The key component was about a 10% reduction in public domestic expenditure (half of this reduction reflected a decline in defense expenditure, and the rest was achieved by cuts in subsidies of various kinds). The fiscal correction actually started in September 1984 and was further strengthened in July 1985.

Structural policies: In comparison with other programs, structural policies were rather limited and gradual. The greatest changes appear to be in financial markets, which were substantially deregulated over the period 1985–1991. Basically no progress was made on privatization.

Wage and price indexation: Price and wage indexation was rampant in Israel up to the 1985 plan, which justified in the eyes of policymakers the use of wage and price controls in the 1985 program. Unions are very powerful in Israel, and a social pact was viewed as a necessary condition to break the inflationary inertia resulting from indexation to past inflation.

22. See Bruno (1993) and Bufman and Leiderman (1995) for detailed discussions of this stabilization plan.

A.3 MEXICO: DECEMBER 1987 STABILIZATION PLAN

Dates of stabilization plan: A major (heterodox, à la Israel) plan was introduced in December 1987.[23]

Exchange-rate/monetary policy: The exchange was fixed for a year, and then devalued according to a constant daily amount. Then, an exchange-rate band was implemented.

Fiscal policy: Major fiscal reforms were undertaken in the years preceding the disinflation plan. Reforms included major cuts in government spending, tax reforms to increase the tax base and collect taxes more efficiently, and privatization of state-owned enterprises. During the program, the operational deficit was high due to the service of the public debt (real interest rates were quite high) but there was a large primary surplus from the very beginning.

Structural policies: A large number of important structural changes took place during the 1980s and early 1990s, with many taking place before the plan. Both the number of public enterprises and public-sector employment were dramatically reduced over the period 1982–1992. Trade liberalization also took place, with the average tariff falling from 27% in 1982 to 13% in 1992, a process which culminated with the signing of NAFTA. Mexico was virtually cut off world financial markets up to 1989, when voluntary lending resumed.

Wage and price indexation: Indexation to past inflation was widespread. As in Israel, there was a *pacto social* to reduce inflation. The *pacto* has been renewed regularly.

A.4 URUGUAY: OCTOBER 1978 STABILIZATION PLAN

Dates of stabilization plan: Implemented in October 1978, by preannouncing the exchange rate 90 days in advance. Ended in November 1982, when the central bank was forced to let the exchange rate float, and the currency depreciated by 140%.[24]

Exchange-rate/monetary policy: Preannounced and declining rate of devaluation. There was no attempt at targeting monetary aggregates, because the high degree of capital mobility made this infeasible.

Fiscal policy: The public sector was in balance by 1979. There were no major fiscal measures during the *tablita,* except for a tax reform in late 1979, whose aim was to make the system more efficient. The large increase in the fiscal deficit in 1982 was related to an increase in social security payments and government salaries, and a reduction in labor taxes.

23. See Dornbusch and Werner (1994) and Santaella and Vela (1994) for a discussion.
24. See Hanson and De Melo (1985) and Talvi (1994b).

Structural policies: A timetable for trade liberalization was introduced in 1978. The trade liberalization proceeded gradually and was interrupted in 1983.

Wage and price indexation: During the *tablita,* semiannual public-sector wage increases and social security benefits were de facto indexed to past inflation.

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Comment

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1. Introduction

The original title of this paper was "Exchange-Rate-Based Stabilizations: Theory and Evidence." In many ways, my comments will be directed at encouraging the authors to push this work further in the direction in which I think they originally intended to go—that is, in the direction of providing empirical evidence on the adequacy of alternative theories.

To begin, I want to say that I enthusiastically endorse the basic idea behind this project. Even if one is relatively far from this field in one's own research, as I have become in recent years, it would be difficult not to notice the proliferation of theories designed to explain aspects of monetary stabilization policies in less-developed economies. In fact, one gets the uneasy feeling that there may be more theories than there are historical stabilization episodes—an undesirable state of affairs from an econometric point of view. To make matters worse, most of these theories depend in a central way on individuals' expectations concerning government behavior in the aftermath of the reform. For this reason, testing these theories will be a subtle matter.

Rebelo and Végh (RV) propose a kind of "horse race"—they propose to study the quantitative implications of alternative hypotheses within a common framework. By doing so, they hope to be able to shed light on which theories perform well when confronted with data on a wide range of economic variables. For example, if a particular theory was designed to explain a post-reform consumption boom and real exchange-rate appreciation, RV will also examine the predictions of the theory for output, investment, the current account, etc. These predictions will then be compared with a set of "stylized facts" developed from examination of a group of recent stabilization attempts. In this way, I think the authors hoped to accomplish two things. First, this exercise should cut down on the number of theories that will be allowed to participate in future horse

races. Second, by conducting a quantitative exercise, I think the authors hope to set a new standard for "success" in constructing theories of the effects of stabilization policy. My view is that both of these goals are worthy ones, and a paper such as the one by RV is long overdue.

Having said all of that, I am going to be somewhat critical of the particular way in which RV have chosen to conduct this investigation. In the remainder of this discussion, I will address two issues. First, I will discuss aspects of the model structure chosen by RV, and the extent to which I think we can trust its answers concerning the predicted effects of monetary reforms. This will necessarily involve evaluation of the plausibility of some of the central mechanisms. My second goal will be to discuss ways in which I think RV can make their analysis more informative about the mechanisms through which particular sequences of policy actions can lead to the effects we observe in the data.

2. *Model Structure*

In any investigation of this kind, there is an inevitable tension between keeping the model simple enough so that the key mechanisms remain transparent, and making the model look realistic, which of course involves additional complexity. In an exercise such as this one, in which we will use the model to evaluate the success of specific theories in explaining a set of stylized facts for a number of essentially similar countries, my view is that the balance should be tipped more in the direction of realism than might be the case in a more abstract exercise.

2.1 PRODUCTION

The production of traded goods uses capital and labor, while the production of nontraded goods uses land and labor. Labor is the only mobile factor, and is instantaneously and costlessly mobile across sectors. Further, *the traded good produced by this economy is identical to the traded good produced by the rest of the world.* Why is this the natural benchmark structure for production? Rebelo and Végh do not tell us. In particular, they do not tell us enough about the structure of output and trade in these economies for us to be able to evaluate whether the particular specific-factors model they have chosen may be adequate for the job at hand. In some recent work, Kouparitsas (1994) has assembled information on the output and trade patterns for less-developed and developed economies. He documents the fact that less-developed countries have exports that are highly concentrated in primary goods and agriculture. The imports of developed countries are concentrated in manufactured goods, both durable and nondurable.

A recent paper by Roland-Holst, Reinert, and Shiells (1993) reinforces the notion that industrial structure differs importantly between developing countries and their trading partners, in ways that may be very important for the purpose of the RV paper. Their figures show that, for Mexico, 32% of gross output in primary goods and mining were exported; the figures are 17% in manufactures, and zero in services. As regards imports, 13% of Mexican demand for agriculture and primary products is satisfied via imported goods; the figure is 37% in manufactures, and again, zero percent in services. However, although services themselves are nontraded, these are likely to be importantly affected by international trade. For example, transport and communication is one major category of services, and over half of the Mexican demand for transport equipment is satisfied by imports, about half of which comes from the United States.

It bears noting, as well, that labor shares are not necessarily indicative of factor intensities. In my examination of durables in the United States (Baxter 1994), I found that the durable-goods industries had a larger labor share than nondurables, but that this was due to a higher wage rate in durables. In fact, the capital–labor ratios in the two industries were roughly the same. Another issue concerning the modeling of labor input is the assumption of frictionless labor mobility across sectors in the RV paper. Different sectors presumably require different skills, and in any case it takes time to search for and find a new job in a different sector. An undesirable implication of frictionless labor mobility is that it tends to lead to negative correlation of investment across sectors—this effect can be seen in some of RV's experiments. Kouparitsas (1994) found that it was necessary to introduce small, convex costs of adjustment in labor as well as in capital to generate positive comovement in factor inputs across sectors. Finally, his work also suggests that intermediate goods are central for understanding the business-cycle links between developing and developed countries.

A low-cost alternative to the Kouparitsas model is the two-good, two-country model used by Backus, Kehoe, and Kydland (1992) and many others. Each country produces a distinct good, which may be used for consumption or investment. This model has, in many ways, become the "standard" in open-economy dynamic macroeconomic analysis, and it would be useful to know how that model fared in explaining the stylized facts of exchange-rate-based stabilizations.

2.2 UTILITY FUNCTION

Consumers value traded and nontraded goods—however, both of these goods are nondurable when used for consumption. This is unfortunate,

because one of the important "stylized facts" of these reforms is the sharp increase in the purchase of consumer durables, which to a large extent are imported. In fact, some of the theories reviewed by RV, such as the one by DeGregorio, Guidotti, and Végh (1994), stress consumer durables as one important link in the economy's response to the stabilization policy.

In the conference draft of the paper, individuals did not value leisure. That is, there was a fixed aggregate supply of time available for working and "shopping." In the present draft, the aggregate amount of time devoted to market work can be varied, which I think represents a definite improvement. It is interesting to note that the form of preferences commonly used in open-economy dynamic macroeconomics (the utility function is given at the end of Section 6) leads to a counterfactual *decline* in aggregate labor supply in response to wealth-increasing reforms. The reason is that the wealth effect of the reform leads to a decline in labor input that outweighs the substitution effect of the higher wages. For this reason, RV use a specification previously used by Greenwood, Hercovitz, and Huffman (1988). This specification has the feature that there are zero wealth effects on labor supply, as well as zero effects of intertemporal substitution on labor supply. This allows them to generate an increase in aggregate labor supply following the reform. However, they do not provide a convincing case that this modified utility function is something that is consistent with the available empirical evidence on consumption and labor supply.

2.3 THE SHOPPING-TIME MODEL OF MONEY

The shopping-time model is designed to capture the idea that a larger stock of real balances reduces the real cost of consumption by reducing time lost to inefficient economic organization—my understanding is that the "shopping time" parable is not to be taken absolutely literally. But I think there's an important question whether this model does adequately capture the real effects of inflation in economies such as those under study. It seems to me at least as plausible—or even more plausible—that high and variable inflation does not just disrupt the consumption process. Rather, I think it must disrupt the production process at least as seriously. This view suggests that the real money stock should perhaps be an argument of the production function. In fact, I think RV's results are strongly suggesting that this is what the data require. For example, to get an increase in labor supplied to production, a decrease in inflation is needed in order to reduce shopping time and thus release labor to the production process. Further, RV note in several places that their model behaves much better when investment is a "cash good"—they need

inflation to disrupt the investment process. Are we supposed to believe that firms hold cash for 13 weeks in order to rent capital in the next quarter? Even in these very high-inflation environments? Even in that case, however, their specification does not allow inflation to directly affect the productivity of existing capital, which it would if money were just in the production function in the first place.[1] This modification, along with modifications of the production structure I suggested earlier, should make it easier to explain the post-reform investment boom.

3. *Timing Issues*

I think there's an important question concerning the extent to which the effects of the exchange-rate-based reforms (ERBRs) are due to the monetary factors versus fiscal factors. In Argentina, the fiscal situation was brought under control about a year before the ERBR; the fiscal adjustment looks roughly contemporaneous with ERBR in Israel, and follows the ERBR in Mexico. If we look at RV's Figure 1, which has time-series plots for Argentina, we see that the real private consumption boom began at the time of the fiscal reform, i.e., before the exchange-rate stabilization began. Further, the increase in the relative price of nontraded goods jumps after the fiscal reform but before the exchange-rate reform—its subsequent increase is rather modest. Is the boom in private consumption due to a positive wealth effect associated with reduced government purchases? Or is it an attempt to find a store of value in a near-hyperinflationary period?

In Israel, the fiscal and exhange-rate reforms take place contemporaneously, and the effects of the reform coincide with the beginning of the reform period. In Mexico, the consumption boom starts with the exchange-rate reform, but investment does not really take off until the economy is once again able to obtain external financing (in 1989), by which time the fiscal deficit has shrunk to a third of its level at the time of the exchange-rate reform. My reading of this evidence is that the fiscal aspects of the reforms may be more important for real activity than the reduction of inflation.

4. *How Could We Find Out?*

Rebelo and Végh are well positioned to help us explore the extent to which fiscal versus exchange-rate reforms are important for the responses to these policy "packages." Actually, they can do something

1. The disruptive effects of inflation on market organization have been the subject of recent work by Tommasi (1995).

even more informative than this. They can use their model to simulate the effects of the sequence of policy changes undertaken in the countries under study. For example, a "stochastic simulation" of the Argentine reform would proceed as follows. The calibrated model would be fed a sequence of shocks chosen to mimic the key features of the Argentine reform. Specifically, this would involve first reducing the government deficit through spending cuts followed by tax increases. Subsequently, the exchange-rate reform would be undertaken. By studying the predictions of the model for this first experiment, we can gauge the extent of the relative importance of fiscal versus monetary reforms in explaining the Argentine experiences. We can also learn about the extent to which the model can explain the magnitude of the observed responses—the paper as it stands does not give us nearly enough information about magnitudes. With regard to the Mexican experience, the stochastic simulation would involve initial exchange-rate stabilization policies, followed by fiscal adjustment and a reopening to international capital markets.

Now, RV acknowledge that many of the theories of the effects of stabilization policy incorporate expectations in a nontrivial way. For example, Rebelo's (1994) story (cited in RV) about the expansionary effects of fiscal reforms assumes that individuals view current tax increases as signaling lower future taxes, with a lower overall present value of tax receipts. Why not show us the "Rebelo experiment" within the context of this model?

5. *Conclusion*

Let me end by saying, once again, that I admire the ambition of Rebelo and Végh, and that these comments were intended to encourage them to push harder along this line of research. In this regard, I think they should look at two very recent studies that are essentially case studies of a particular country conducted within a quantitative equilibrium framework. The first is a study of the recent reforms in Ghana undertaken by Pattillo (1994)—the puzzle there is the failure of investment to rise in the postreform period. The second study is by Ihrig (1994). Her paper studies the repatriation decision of a multinational firm in a setting in which capital controls are sometimes imposed by the repatriating country. Her study focuses on Brazil, which has a history of occasionally blocking repatriation of funds. I think it's relevant in the present context because Ihrig had to struggle with the problem of specifying the multinationals' beliefs concerning future capital controls in a way that is consistent with the operation of the Brazilian economy. If Rebelo and Végh can show that their approach provides a powerful tool for distinguishing between

various theories of exchange-rate-based reforms—and I think they can—they will succeed in setting a new standard for theoretical and empirical work in this area.

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Comment

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1. Introduction

One of the most important, and still unsettled, macroeconomic policy issues facing many governments is the appropriate exchange-rate policy in the course of disinflation. Many governments battling high inflation have attempted to use the exchange rate as a nominal anchor to bring about rapid price stability. Other countries have relied on tight monetary policy and a floating exchange rate. There is still no agreed position on the relative merits of these alternatives.

The skillful paper by Sergio Rebelo and Carlos Végh, together with many important earlier papers by Végh, often coauthored with Guillermo Calvo, can move us closer to an answer to this key question. Rebelo and Végh analyze the economics of exchange-rate-based stabilization (ERBS), particularly to understand the dynamics of output and consumption in the course of stabilization. Their main concern is to understand why many

countries have experienced an output and consumption boom in the immediate aftermath of an ERBS.

There are several crucial questions about the merits of ERBS. First, ERBS has shown itself to be capable of producing a sudden end of high inflation, especially when starting from hyperinflation. What is the source of this sudden disinflation? Is it credibility, as suggested in the seminal paper of Sargent (1982), or is it something else? Second, ERBS has often been able to produce disinflation with a smaller drop in output than a money-based stabilization (MBS). What is the source of the less-costly disinflation? Third, and more mysteriously, many episodes of ERBS have not only avoided a contraction, but have actually been accompanied by a boom, in both output and consumption. Why does ERBS sometimes contribute to boom conditions? Fourth, following the boom, some episodes of ERBS have been followed by a bust in later years. A cliche, which vastly exaggerates the generality of experience, holds that ERBS is "boom first, bust later," while MBS is "bust first, boom later." Even though such precise regularity does not exist, what could explain the boom–bust pattern in many cases of ERBS? Fifth, and finally, what have we learned about smoothing the output effects of stabilization, both in the boom and in the bust phases?

Rebelo and Végh's paper addresses mainly the third item: the sources of boom in ERBS episodes. I would like to comment briefly on all five points, to give some broader perspective to the important issues raised in the paper.

2. *Why Does ERBS Achieve Sudden Disinflation?*

Certainly the most surprising single aspect of ERBS is that it has proven capable of stopping hyperinflation almost immediately, a point first famously made by Sargent. Sargent attributed this suddenness to the reestablishment of a credible intertemporal macroeconomic policy, mainly fiscal discipline and central bank independence. It is now clear, however, that disinflation can be achieved suddenly even when credibility is not yet firmly established (as indicated, for example, by a continuing huge discount in the forward market for foreign exchange, and accompanying very high nominal interest rates, even after disinflation).

The real answer to immediate disinflation seems to be that countries in high inflation become increasingly "dollarized" in price and wage setting, in that domestic residents use an external unit of account (particularly the dollar in the recent years, but sometimes the deutsche mark) for the unit of account, even though they continue to use the domestic currency for payments. Thus, domestic prices are set as dollar prices

multiplied by the spot exchange rate between the domestic currency and the dollar. Stopping the exchange depreciation is tantamount to ending domestic inflation (and "importing" the dollar inflation rate). We also know that exchange-rate stability can be achieved in the short term (i.e., temporarily) by the defense of the currency by the central bank, even if there are rational expectations that the exchange rate will continue to depreciate at some point in the future.

3. *Why Do the Short-Term Output Losses Tend to Be Less Under ERBS than MBS?*

The basic point has to do with remonetization of the conomy, a point stressed by Mundell in the 1960s. Suppose that money demand is given by the standard relationship $M/P = m(i)$, where i is the nominal interest rate. In turn, write i as $r + \pi^e$, where π^e is expected inflation and r is the real interest rate. When disinflation comes (even if it is temporary), expected inflation drops. For a given real interest rate, the demand for real-money balances increases. In an ERBS, the money supply increases automatically as domestic wealth holders convert their foreign assets and mattress dollars back into domestic currency. The central bank intervenes to peg the exchange rate, buying dollars and selling domestic money, thereby raising M/P.

In an MBS, by contrast, the central bank does not intervene. The nominal money supply remains unchanged (assuming, as is generally the rule in MBS, no domestic credit expansion in place of exchange-market intervention). The only way for real-money balances to rise, therefore, is for the absolute price level to decline. If domestic prices are sticky downward for some reason (e.g. contracts, public-sector pricing), the result is that M/P can't increase sufficiently. As result, the fall in π^e must be matched by a compensating rise in r, the real interest rate, in order to keep the money market in equilibrium. The rise in real interest rates, in turn, reduces real output.

4. *Why do Many ERBS Episodes Begin with a Boom?*

This is the question skillfully addressed in Rebelo and Végh's paper. Even if the relative efficiency of ERBS relative to MBS is clear, for reasons just given, it is still a mystery why ERBS actually starts with a boom rather than a mild contraction. The authors test several well-known hypotheses, such as inflation inertia (which can produce low or negative real interest rates at the start of disinflation), lack of credibility

(which can cause consumers to tilt their consumption to the temporary period of low inflation), or simply the efficiency gains from low inflation (which lead to a consumption and investment boom). Interestingly, despite their best hopes, the inflation-inertia explanation, combined with supply-side gains of disinflation, proves to be most compatible with the evidence (as processed by the simulation exercises), whereas the alternative explanations seem wanting in one way or another. The temporariness hypothesis does not fare well, which is not surprising, since the boom has followed ERBS programs of varying degrees of credibility, without being linked in an obvious way to the underlying credibility of the disinflation program.

I think that the authors miss an important, and as yet poorly understood, link in the puzzle. As discussed earlier, disinflation produces a rise in real money holdings. In a fractional banking system, the rise in M/P is associated with a sharp rise in bank lending. Most developing countries have repressed financial markets, in which certain classes of customers can borrow only from certain classes of financial institutions. When the banks are illiquid as a result of low levels of domestic money holding, bank borrowers (such as consumers seeking consumer credit or home builders) are unable to get the credits that they desire from other sources. In this way, high inflation squeezes many groups out of the credit market, by causing a low level of intermediation in the banking system. Conversely, stabilization leads to a sharp increase of banking intermediation and a boom in credits to previously rationed agents in the economy. Thus, ERBS has often been accompanied by a boom in bank lending, which in turn has fueled a boom in consumption spending and household investment spending. I think that the authors miss this link by the underyling assumption of perfect capital markets and single interest rate against which intertemporally optimizing agents can borrow subject only to a long-term solvency constraint.

5. *Why Is the ERBS Boom Sometimes Followed by a Bust?*

The counterpart bust to the initial boom is even more puzzling. Many of the theories of the boom would not really predict a subsequent interval of recession. And yet, several episodes of early boom were then followed by bust. Here, it seems that a combination of nominal rigidities and the banking credit cycle both play a role. The authors find, to their obvious consternation, that the assumption of inflation inertia helps to account for the empirical experiences, since exchange-rate stabilization is followed by an overvaluation of the real exchange rate, which is subsequently resolved by a recession.

Obviously, inflation inertia seems to run counter to pure, full-information, optimizing models. Yet there are some obvious, observable factors causing inflation inertia. In practice, the inertia is in the nontradables sector, for which the dollar-based pricing discussed earlier (in Section 2) does not apply as directly. The rigidities are often in public-sector services, such as utilities fees and transport costs, which the government continues to raise gradually after stabilization in order to recoup previous declines in real public-sector prices. Also, in Chile and other countries, legally mandated wage indexation caused inertia in wage inflation, which translated into inertia in nontradables prices.

Banking credit also probably plays a role in the subsequent bust. If ERBS instigates a boom in banking credit, the banks eventually become fully loaned up (e.g., relative to prudential standards on bank capital adequacy). After rapid lending, the banks stop further extensions of credit, leading to a rapid cutback in consumer lending, causing the initial boom to tilt over into a subsequent recession. Since the banking side of the story has not yet been investigated properly, this causation is still to be verified, but it seems to be consistent with the large number of ERBS epsiodes that end with a banking crisis, after a rapid overexpansion of bank credit in the immediate aftermath of stabilization.

6. *What to Do?*

The bottom-line question then is how to enjoy stabilization at low cost to output, while at the same time avoiding the boom–bust cycle. It seems increasingly clear that the right approach is a two-step approach, of early exchange-rate pegging, in order to "import" low dollar inflation and to remonetize the economy, followed by a move to a more flexible exchange-rate system after low inflation has been achieved, in order to avoid the problems of creeping overvaluation. It seems, for example, that Mexico achieved low-cost disinflation at the end of the 1980s, but then succumbed to subsequent bust in 1994–1995, as a result of several years of growing real overvaluation, followed by a foreign borrowing crisis and a related banking crisis (see Sachs, Tornell, and Velasco, 1995).

I should stress that there is probably another reason to favor an early peg of the exchange rate, in addition to remonetization. When economies are highly demonetized, they may become subject to self-fulfilling flights from the currency. In a self-fulfilling currency panic, agents flee the domestic currency out of fear of high inflation. The currency flight, in turn, causes the inflation that was feared. Pegging the exchange rate can be a way to stop a self-fulfilling hyperinflation. (See Sachs, 1995, for a detailed discussion.)

Still, moving from an initially pegged rate to a flexible rate (e.g., a crawling band) is easier said than done. We still don't have an agreed approach to announcing, at the start of stabilization, that a peg will be temporary, to be followed by some sort of band or float. The experiences of Israel and Poland, which both had ERBS followed by more flexible arrangements, could provide valuable lessons.

At the same time, there are several other important questions. Should the monetary authorities use short-term capital controls to limit the rate of remonetization of the economy, perhaps thereby avoiding a boom–bust cycle? It seems that Chile may have been somewhat effective in this regard. Should the banking system be more tightly regulated to avoid the boom–bust cycle? This seems especially relevant in that banking deregulation, by itself, has often contributed to a boom–bust cycle of bank lending (cf. the U.S. savings-and-loan crisis, the Scandinavian banking crises following banking liberalization, and the Japanese bubble of the late 1980s, followed by bust in the 1990s). It seems that there is also a case for developing countries to resist the introduction of dollarized accounts (either indexed accounts or foreign-currency accounts) in the domestic banking system: such accounts invite panicky deposit movements between the domestic currency and the foreign currency, since the central bank cannot effectively be the lender of last resort against foreign-currency accounts. Finally, there is a need to investigate more deeply the option to combine ERBS with a currency-board approach to domestic monetary management. On the plus side, the currency board helps to limit abuses of excess domestic credit expansion; on the minus side, the currency board rules out the lender-of-last-resort function of the central bank, and thereby may permit the onset of banking panics in fragile circumstances.

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Discussion

In response to Sachs, Carlos Végh pointed out that it was very important to draw a distinction between hyperinflationary and chronic-inflation

countries. For the case of hyperinflation, as in Bolivia a decade ago or in many countries following the two world wars, it is possible to argue that at the time when a stabilization is implemented the economy is completely out of steady state. Therefore, in countries with hyperinflation it is relatively easy to explain why stabilization raises output. However, in chronic-inflation countries (i.e., countries with persistent inflation of about 40–100% per year), the economies develop extensive indexation in all markets. In these countries it is much more difficult to argue that the real effects that are observed after stabilization are just the recovery from a deep prestabilization recession. This difference between hyperinflation and chronic-inflation countries explains why the paper focuses on dynamics around the steady state.

To address Baxter's criticisms that the model is too simple, Végh said that they had begun with a much larger and more complicated set of model variants. More complicated models are indeed often more realistic, but when the complexity becomes too great, it is difficult for the researcher to understand intuitively what is generating the results. Hence the authors decided in favor of a simpler model which would allow them to study four or five basic effects and to discriminate more sharply among a few alternative hypotheses.

On the role of fiscal effects brought up by Sachs, Végh agreed that fiscal changes are an integral part of a successful stabilization program. The puzzle is that a money-based stabilization is typically followed by a recession, and an exchange-rate-based stabilization is usually followed by a boom, even though the fiscal adjustment is often similar in the two cases. Why this happens needs to be clarified before progress can be made on the role of fiscal factors in the stabilization. In response to Végh's comments, Andres Velasco asked how the authors would explain the tendency for real appreciation, increases in real estate prices, and other real effects to occur in both successful and failed stabilizations, while most of the failed stabilizations had little in the way of fiscal adjustment. Velasco ruled out as implausible an explanation based on the assumption that people expected fiscal adjustment in the failed stabilizations but the government did not deliver. Rebelo answered that fiscal adjustment could not explain everything in every stabilization; all episodes mix many factors, and it is an open question whether fiscal effects are central. Martin Feldstein pointed out that at least part of observed fiscal adjustments following stabilizations are endogenous, as a slowdown in inflation automatically produces an increase in taxes relative to real GDP through the Oliveira–Tanzi effect.

Bob Gordon asked what a country implementing a stabilization program should do to avoid a serious overvaluation of the currency. He

pointed to the case of Mexico, where the steady appreciation of the real exchange rate after the stabilization had set the stage for the crisis and the devaluation. In particular, since most of the Mexican appreciation was due to capital inflows, Gordon asked whether stabilizing countries should attempt to sterilize these inflows. Végh agreed that the tendency of the real exchange rate to appreciate following an exchange-rate-based stabilization was well established, as was a consequent tendency for the current account to go into deficit. These outcomes are perhaps unavoidable during the elimination of a chronic inflation. The question is, what is the optimal policy after three years—should the monetary authority abandon the nominal anchor and devalue? Although some economists argue in favor of devaluation, Végh stressed that the right policy is not obvious. One consideration is the nature of the initial commitment to the fixed exchange rate: If the stabilization is implemented through a convertibility plan or a currency board, for example, devaluation carries the cost of a huge loss of credibility. In cases where the government does not commit itself "irrevocably" to a fixed exchange rate (e.g., Israel), it might be best to devalue once or even several times during the life of the program.

Feldstein asked how a government could implement an exchange-rate-based stabilization without a credible promise of monetary stabilization as well. Does an external source of foreign exchange, for example, provide additional credibility to the program? Sachs noted that as long as the monetary authorities have some international reserves, they can start an exchange-rate-based stabilization. Even if everybody (rationally) anticipates that reserves are not going to last for very long, the plan does not collapse instantaneously; indeed, there may be an initial capital inflow as investors try to take advantage of the high interest rates in the period before the speculative attack. Further, as a result of the capital inflow, the banks become liquid and spending goes up. Ironically, Sachs remarked, as remonetization proceeds, the first intervention the government needs to perform is a monetary easing, to prevent excessive real appreciation of the currency. Feldstein asked whether the exchange-rate-based stabilization should not be considered as the front end of a program that will also eventually include monetary adjustment. Sachs agreed that monetary adjustment had to take place at some point; but he noted that the problem with the money-based approach is that it is not credible to announce a target money path that begins with a 50% jump, as would be required for remonetization. Hence, a money-based stabilization almost inevitably leads to a severe recession at the beginning of the program.