Exchange rate stabilization under imperfect credibility

Calvo, Guillermo and Vegh, Carlos

International Monetary Fund

August 1991

IMF WORKING PAPER

WP/91/77

INTERNATIONAL MONETARY FUND

Research Department

Exchange-Rate-Based Stabilization under Imperfect Credibility

Prepared by Guillermo A. Calvo and Carlos A. Végh 1/

August 1991

Abstract

This paper analyzes stabilization policy under predetermined exchange rates in a cash-in-advance, staggered-prices model. Under full credibility, a reduction in the rate of devaluation results in an immediate and permanent reduction in the inflation rate, with no effect on output or consumption. In contrast, a non-credible stabilization results in an initial expansion of output, followed by a later recession. The inflation rate of home goods remains above the rate of devaluation throughout the program, thus resulting in a sustained real exchange rate appreciation.

JEL Classification Number:
F41

1/ This paper was prepared for a conference of the International Economic Association on "Open Economy Macroeconomics," held in Vienna, May 30-June 1, 1991, and will be published in a conference volume. The authors are grateful to Pierre-Richard Agénor, José De Gregorio, Mohsin Khan, Saul Lizondo, Peter Montiel, Carmen Reinhart, Ratna Sahay, and seminar participants at MIT and Vienna for helpful comments and discussions.

Contents

Summary

In high inflation countries, stabilization programs that have used the nominal exchange rate as the nominal anchor have been typically characterized by an initial expansion in economic activity followed by a later recession. The initial expansion has occurred in spite of an appreciating real exchange rate. The real exchange rate has appreciated throughout the programs as a result of the slow convergence of the rate of inflation to the rate of devaluation. Later on this real appreciation gives rise to a slowdown of economic activity.

This paper develops an analytical model that accounts for the main stylized facts associated with exchange-rate-based stabilization. Lack of credibility--in the sense that the public does not believe that the program will be continued in the future--plays a key role in the analysis. The model also incorporates the assumptions of perfect capital mobility and sticky prices.

Under full credibility, a reduction in the rate of devaluation results in an immediate and permanent reduction in the inflation rate to its new, lower steady-state level, without output costs. In contrast, a noncredible program results in an initial expansion in the nontraded goods sector because the temporarily lower nominal interest rate induces higher aggregate demand. As a result of the expansion, the inflation rate of nontraded goods falls by less than the rate of devaluation--and could even increase. Hence the real exchange rate appreciates throughout the program, which eventually results in a recession.

I. Introduction

In the late 1970s, the Southern-Cone countries (Argentina, Chile, and Uruguay) launched stabilization programs based on a preannounced path for the exchange rate that exhibited a declining rate of devaluation ("tablitas"). 1/ Policymakers expected that a stabilization plan based on the exchange rate as the nominal anchor would act directly on inflationary expectations--which were viewed as a central determinant of short-run inflation--thereby increasing the chances of lowering inflation at no significant real costs.

Contrary to what had been anticipated, inflation responded only gradually to the lower rate of devaluation. 2/ For instance, by December 1980, two years after the beginning of the program, the 12-month inflation rate in Argentina was 88 percent, compared to a 12-month devaluation rate of 23 percent. As a result, the real exchange rate appreciated substantially throughout the programs. In spite of an appreciating real exchange rate, consumption and output expanded at the beginning of the programs. In Argentina, for instance, consumption grew by 12.3 percent in 1979, the first year of the program, after falling by 1.9 percent in 1978. Later in the programs, consumption and output collapsed. The trade balance deteriorated sharply throughout the programs. Explaining the intriguing phenomena that characterized these programs turned out to be a difficult and challenging task (see Rodriguez (1982) for one of the earlier and better-known accounts).

The heterodox programs in Argentina, Brazil, and Israel in the mid-1980s brought back to the forefront the same type of issues (see Kiguel and Liviatan (1989)). The case of Israel (see Figure 4) was particularly striking because it showed that, even when successful, exchange-rate-based stabilization programs may give rise to sizable real dislocations. In terms of reducing inflation, the Israeli plan of July 1985 has been a success: the four-quarter rate of inflation has remained around 20 percent through the end of 1990. However, the consumption cycle occurred anyway: consumption grew by 14.2 percent in 1986 but fell by 1 percent in 1989.

Based on the study of twelve exchange-rate-based stabilization programs, Kiguel and Liviatan (1990) argue that the experience of the Southern-Cone countries and Israel is typical of exchange-rate-based

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1/ Figures 1 through 3 illustrate the Southern-Cone "tablitas." (Bars indicate the beginning and the end of the stabilization plans.) The Southern-Cone "tablitas" have been analyzed by, among many others, Corbo (1985), Fernandez (1985), and Hanson and de Melo (1985).

2/ In Uruguay, in fact, inflation increased at the beginning of the program (see Figure 3).

stabilizations. 1/ The response of the economy to such programs is an initial consumption/output expansion and appreciation of the real exchange rate, followed by a consumption/output contraction and depreciation of the real exchange rate. This "business cycle" associated with exchange-rate-based stabilization runs counter to conventional wisdom--according to which stabilization is expected to be accompanied by an immediate contraction--and has been a source of confusion and puzzlement for economic theorists and policymakers alike.

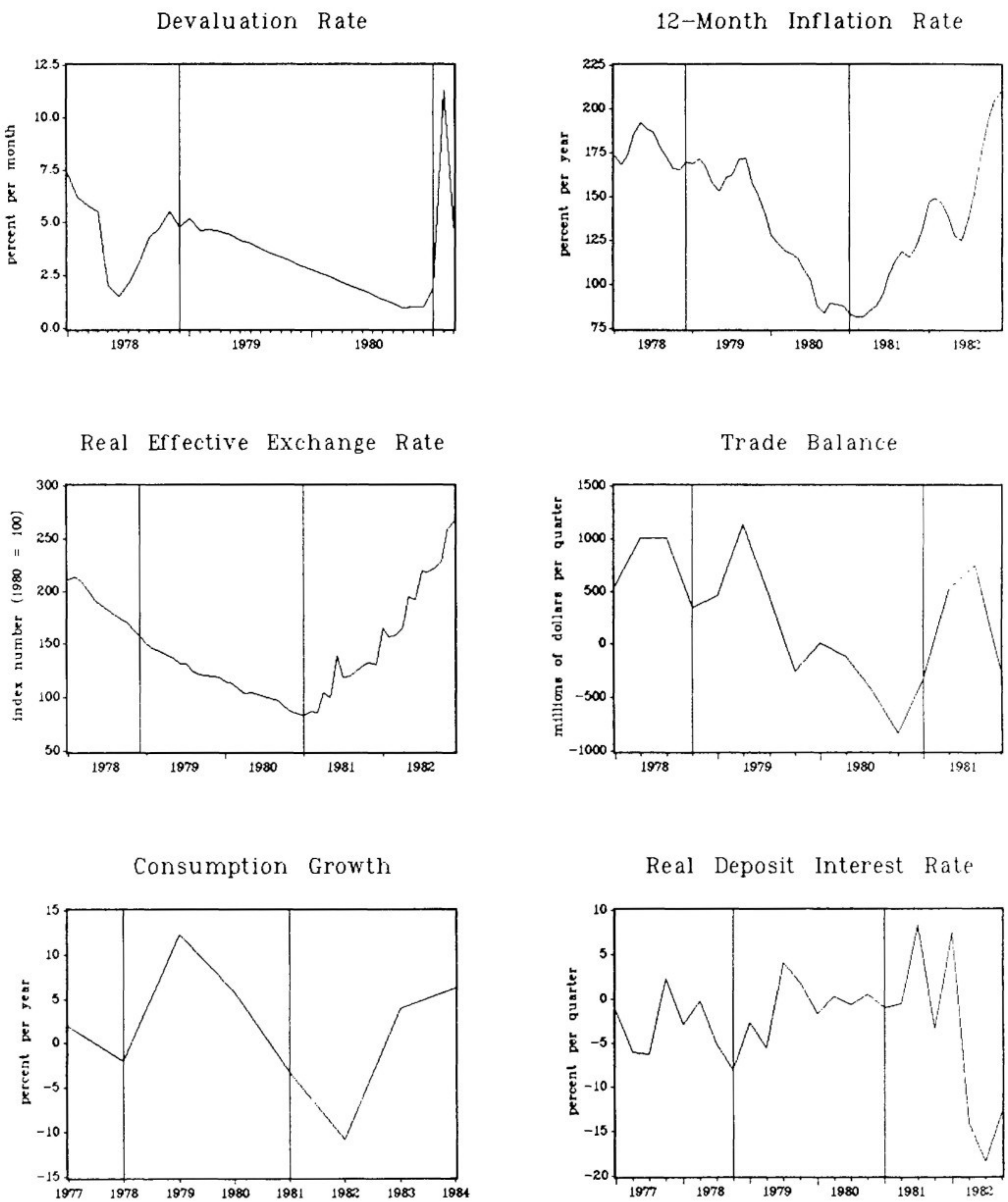
As a general rule, stabilization programs are not fully credible at the time they are being launched. This lack of credibility is a natural consequence of high inflation, since the latter reflects either sheer incompetence by policymakers or hard-to-resolve political tensions. Evidence of this lack of credibility is provided by the protracted high differential between domestic and international interest rates exhibited by most stabilization programs. Therefore, a plausible conjecture is that the puzzling "business cycle" associated with exchange-rate-based stabilization programs may be due, in part, to the programs' lack of credibility.

The central objective of this paper is to explore the role of credibility for the dynamics of exchange-rate-based programs and, in particular, to examine under what conditions lack of policy credibility could account for the above-mentioned "business cycle." To sharpen the focus of our discussion, we will define a stabilization program as the announcement of a lower (and constant) rate of devaluation. "Lack of credibility" will be identified with a situation in which the public believes that the program will be maintained for a given period of time, after which the rate of devaluation is expected to return to a higher (and constant) level, contrary to the policymaker's announcement. 2/

1/ The term "chronic inflation," coined by Pazos (1972), refers to inflationary processes that last many years and exhibit considerable inertia. In contrast, as Pazos (1972) argues, hyperinflations usually last short periods of time and are explosive processes. It should be noted that, unlike the programs analyzed by Kiguel and Liviatan (1990), the recent stabilization attempt in Poland, also a chronic-inflation country (see Coricelli and de Rezende Rocha (1990)), has been accompanied by an initial output contraction. Such a contraction may be explained by supply-side considerations and/or tight credit policy (see Calvo and Coricelli (1991) and the discussion in Section III regarding the use of the money supply as an additional nominal anchor).

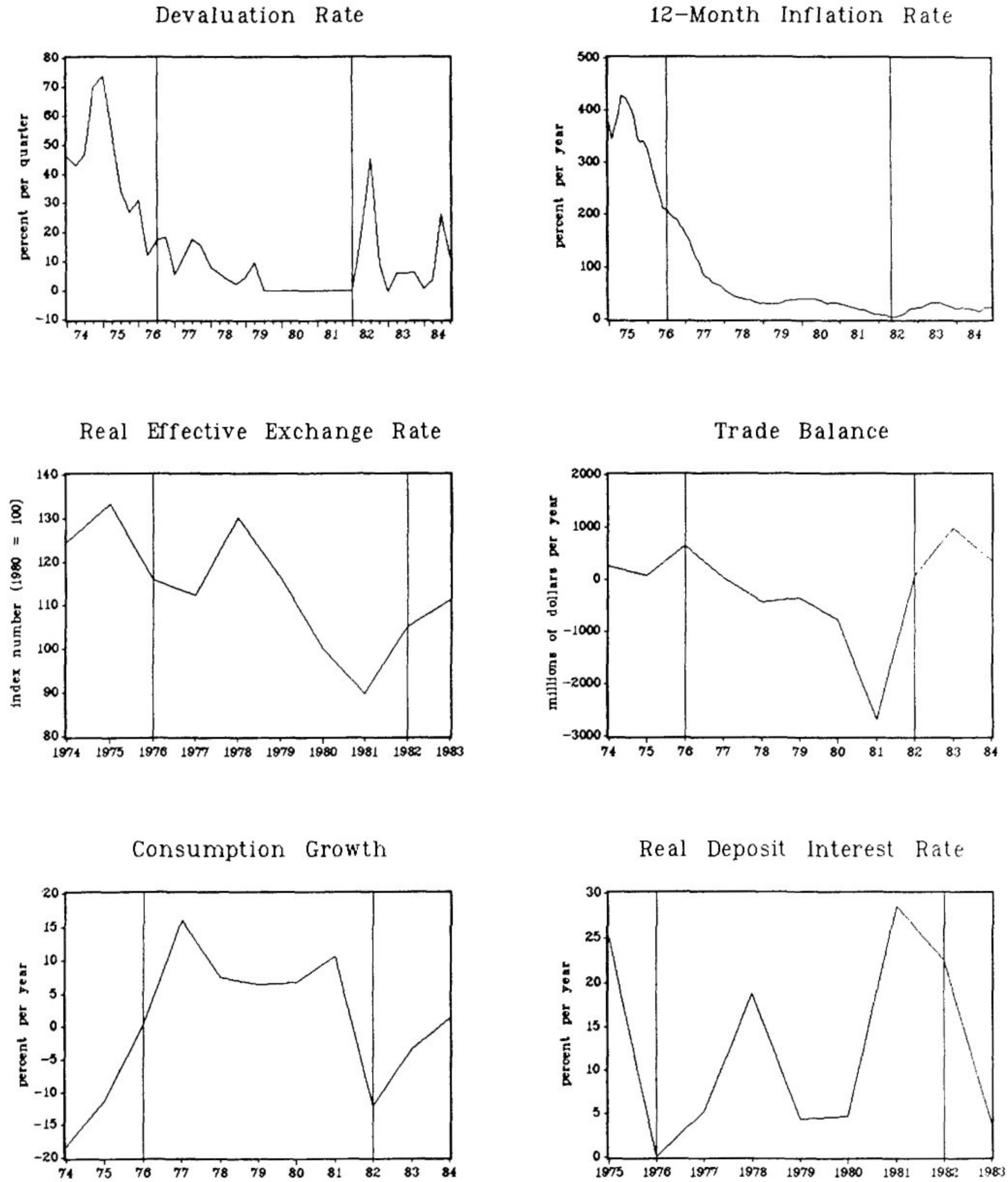
2/ We view this as the relevant exercise even for cases such as the "tablitas" in which the exchange rate was not fixed at the beginning of the program because, when the "tablitas" were later discontinued, the devaluation rates that followed the abandonment of the programs were of such a magnitude that the "slope" of the "tablitas" is relatively insignificant.

Figure 1. Argentinean Tablita



Source: IFS, Balino (1987), and Fund staff estimates

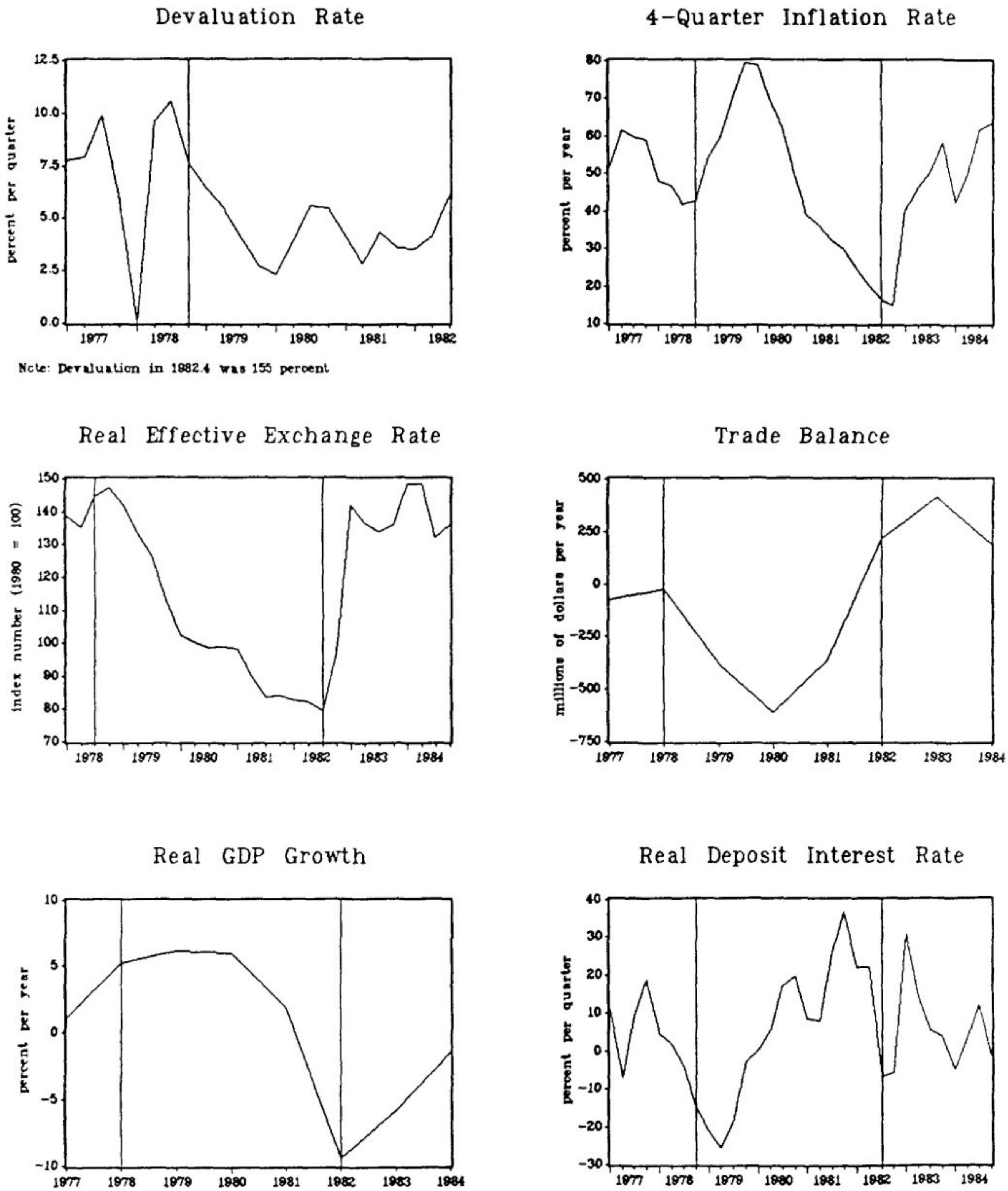
Figure 2. Chilean Tablita



Note: Figure for 1975 corresponds to second semester

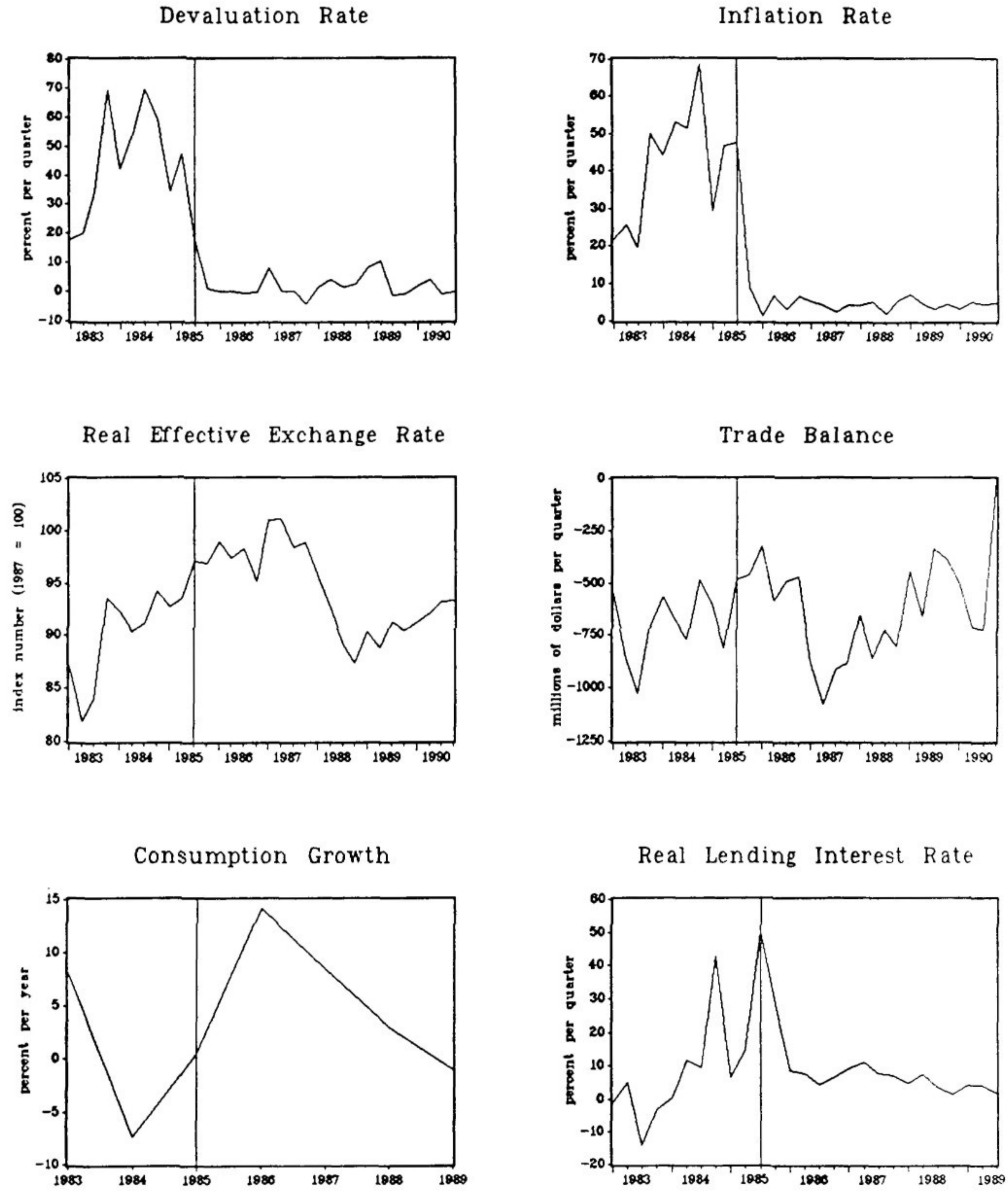
Source: IFS, Banco Central de Chile, and Ramos (1986)

Figure 3. Uruguayan Tablita



Source: IFS, Perez-Campanero and Leone (1991), and Fund staff estimates

Figure 4. Israeli Stabilization



Source: IFS, Bruno and Meridor (1990), and Fund staff estimates

This paper develops a cash-in-advance, staggered-prices model that accounts for the following stylized facts: (i) when the program is implemented, there is an increase in consumption of traded goods and, as a result, a trade balance deficit; (ii) in the first stages of the program, the non-traded-goods (or home-goods) sector is operating above its full-employment level at the same time that the real exchange rate is appreciating; (iii) the home-goods sector enters into recession (i.e., output falls below its full-employment level) either when or before the program is expected to be discontinued; and (iv) the inflation rate of home goods remains above the rate of devaluation until the time at which the program is expected to be discontinued, thus resulting in a sustained and cumulative real exchange rate appreciation. It is worth emphasizing that price stickiness is not brought into the picture just to belabor a tired Keynesian theme; rather, price stickiness is essential in generating the results (ii) through (iv) mentioned above. The first result, which depends only on the assumptions of cash-in-advance and perfect capital mobility, is the one emphasized by Calvo (1986) in the context of a flexible-prices model. 1/

Following Calvo (1983), sticky prices are modeled with a (forward-looking) staggered-prices technology a la Phelps (1978)-Taylor (1979). It satisfies a convenient (and somewhat remarkable) feature: if the economy starts at steady state, a once-and-for-all credible reduction in the rate of devaluation results in an immediate and permanent reduction in the inflation rate to its new lower steady-state level, without either output costs or changes in the consumption path. This is an interesting result because it shows that the existence of sticky prices does not necessarily generate a tradeoff between output and inflation. Analytically, the main advantage of this sticky-prices model is that no "business cycle" associated with exchange-rate-based stabilization arises if the stabilization program is fully credible. This feature of the model will make it easier to identify the effects of lack of credibility discussed in the paper.

The basic intuition behind the main results is as follows. The model postulates a cash-in-advance constraint, according to which the demand for money is a fixed proportion of consumption. Thus, the "effective" spot price of consumption of traded goods is an increasing function of the (instantaneous) nominal interest rate, since the latter is the user's cost of liquidity held against consumption. Moreover, due to the assumption of perfect international capital mobility, the nominal interest rate rises and falls, point by point, with the expected rate of devaluation. Therefore, an expected discontinuation of the stabilization program at time T implies that the effective price of consumption is expected to be high in the future (i.e., after time T) relative to the present (i.e., from the start of the program to time T), which induces an increase in the

1/ See Végh (1991) for an interpretation, in terms of the present model, of stylized facts associated with exchange-rate-based stabilization.

consumption of traded goods between time 0 and time T. Since the relative price of traded with respect to non-traded goods (i.e., the real exchange rate) is a predetermined variable, the increase in consumption of traded goods must be accompanied by an increase in consumption of home goods, thus generating the initial output boom (output of home goods is demand-determined). 1/ The rise in aggregate demand implies that the reduction in the inflation rate of home goods falls short of the reduction in the rate of devaluation--and could even increase. As a result, a prolonged period of real exchange rate appreciation sets in as the rate of inflation of home goods remains above the rate of devaluation until time T. Thus, an overheated economy co-exists with an appreciating real exchange rate for a prolonged period of time.

As the real exchange rate appreciates over time (i.e., as the relative price of home goods increases over time), aggregate demand for home goods falls, which in turn reduces output of home goods. This implies that, if the credibility horizon, T, is large, output falls below its full-employment level even before time T arrives, as a result of the highly appreciated real exchange rate. The model can thus explain the recession that has been observed in practice in successful programs or, in failed programs, before the collapse occurred (see Kiguel and Liviatan (1990)). 2/ At time T, a sharp (i.e., discrete) fall in output accompanies the fall in consumption of traded goods at time T, due to the same type of argument examined above. Hence, for small credibility horizons, output falls below its full-employment level only at the time at which the program is expected to collapse.

The paper proceeds as follows. Section II introduces the model and analyzes a non-credible reduction in the devaluation rate. Section III discusses extensions of the model (specifically, the use of the money supply as an additional anchor and the effects of backward indexation), and then concludes.

II. The Model

Consider a small open economy inhabited by a large number of identical individuals. The lifetime utility of the representative individual is given by:

1/ The real exchange rate is a predetermined variable because, first, the stabilization plan involves a lowering of the rate of devaluation, initially keeping unchanged the level of the exchange rate (which determines the domestic price of tradables), and, second, the price of home goods is, by the staggered-prices technology, also a predetermined variable.

2/ Naturally, we are implicitly assuming that the actual collapse took place when it was expected to occur.

$$(1) \qquad \int_0^\infty [u(c_t) + v(c_t^*)]\exp(-\beta t)dt,$$

where c^* and c denote consumption of traded and non-traded (or home) goods, respectively; and β is the subjective discount rate. To simplify the exposition, the instantaneous utility function is assumed to be separable. 1/

Consumers can hold two assets: domestic non-interest-bearing money and an internationally-traded bond, which yields a constant return in terms of traded goods equal to r. 2/ Financial wealth in terms of traded goods is denoted by a and is given by

$$(2) \qquad a_t = m_t + b_t,$$

where m and b stand for real monetary balances and the stock of real bonds in the hands of the public, respectively. The overall budget constraint for the representative individual is

$$(3) \quad a_0 + \int_0^\infty (y_t/e_t + y_t^* + \tau_t)\exp(-rt)dt = \int_0^\infty (c_t/e_t + c_t^* + i_t m_t)\exp(-rt)dt$$

where y^* and y denote output of traded and non-traded goods, respectively; e stands for the relative price of traded in terms of home goods (i.e., the real exchange rate); τ denotes government lump-sum transfers in terms of traded goods; and i stands for the instantaneous nominal interest rate in terms of domestic currency. Equation (3) represents the familiar budget constraint whereby the consumer's lifetime expenditure equals the present discounted value of his income. At each point in time t, his

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1/ The functions u(c) and $v(c^*)$ are assumed to be twice-continuously differentiable, increasing, and strictly concave. Our main results would still hold for non-separable instantaneous utility functions provided that c^* and c are normal goods.

2/ Throughout the paper, and except for the real exchange rate (see below), the term "real" refers to nominal variables deflated by the price of traded goods.

expenditure is given by the cost of consumption, $c_t/e_t + c_t^*$, plus the rental cost of money holdings, $i_t m_t$.

The consumer is required to hold domestic money to carry out his consumption purchases. More specifically, he is subject to a cash-in-advance constraint

$$(4) \qquad \alpha(c_t/e_t + c_t^*) \le m_t, \qquad\qquad \alpha > 0,$$

under which minimum real monetary balances are directly proportional to the value of consumption expenditures. 1/ Notice that if the nominal interest rate, i, is positive, the rational consumer will hold the minimum required monetary balances which, according to equation (4), are given by $\alpha(c_t/e_t + c_t^*)$. Since the analysis will concentrate on situations in which i is positive, the budget constraint (3) can be rewritten as

$$(5) \quad a_0 + \int_0^{\infty} (y_t/e_t + y_t^* + \tau_t)\exp(-rt)dt = \int_0^{\infty} (c_t/e_t + c_t^*)(1 + \alpha i_t)\exp\text{-}(rt)dt$$

The consumer's optimization problem is to maximize his utility function, (1), with respect to the path of c and c^*, subject to his initial financial wealth, a_0, and his intertemporal budget constraint, (5). The first-order conditions for this optimization problem are: 2/

$$(6) \qquad v'(c_t^*) = \lambda(1 + \alpha i_t),$$

$$(7) \qquad v'(c_t^*)/u'(c_t) = e_t,$$

where λ is the (time-invariant) Lagrange multiplier associated with constraint (5), and, as usual, can be interpreted as the marginal utility of wealth. Equation (6) is the familiar condition whereby, at the

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1/ See Feenstra (1985) for the derivation of the cash-in-advance constraint in continuous time.

2/ In what follows, it will be assumed that $r = \beta$. This assumption is made in order to highlight the dynamics of temporary policy in an otherwise essentially stationary environment.

optimum, the marginal utility of consumption of traded goods equals the marginal utility of wealth times the effective price of traded goods. The effective price of traded goods is the sum of the market price (equal to unity) and the opportunity cost of the monetary balances held per unit of traded goods consumed, αi_t. Finally, condition (7) equates the marginal rate of substitution between traded and home goods to their relative price, e.

The other main actor in this economy is the government. The government's budget constraint indicates that the present discounted value of (lump-sum) transfers, τ, equals the government's initial holdings of bonds, h_0, plus the present discounted value of the proceeds from money creation. Formally,

$$\int_0^\infty \tau_t \exp(-rt)dt = h_0 + \int_0^\infty (\dot{m}_t + \varepsilon_t m_t)\exp(-rt)dt, \tag{8}$$

where ε is the instantaneous rate of devaluation (i.e., $\varepsilon = \dot{E}/E$, where E denotes the nominal exchange rate, defined as units of domestic currency per unit of foreign currency). The terms $\dot{m}_t + \varepsilon_t m_t$ represent the proceeds from money creation.

Equilibrium in the home-goods sector requires:

$$c_t = y_t. \tag{9}$$

Moreover, perfect capital mobility is assumed, which implies that:

$$i_t = r + \varepsilon_t \tag{10}$$

Combining equations (3), (8), (9) and (10) yields the budget constraint for the economy as a whole

$$k_0 + \int_0^\infty y_t^* \exp(-rt)dt = \int_0^\infty c_t^* \exp(-rt)dt, \tag{11}$$

where $k = b + h$ is net national wealth. Thus, equation (11) states that the economy's wealth in terms of traded goods equals the present discounted value of traded goods consumed.

We now turn to the supply side of the model. For simplicity of exposition, it will be assumed that the supply of traded goods is exogenously given and constant, while the home-goods sector operates under staggered price-setting and supply is demand-determined. 1/ Following the staggered-prices model in Calvo (1983), we postulate:

$$(12) \qquad \dot{\pi}_t = -\theta D_t, \qquad\qquad \theta > 0,$$

where π is the inflation rate of home goods, and $D = y - \bar{y}$, where $\bar{y}$ may be interpreted as "full employment" output, is a measure of excess demand in the home-goods market. Equation (12) can be derived from a set-up in which firms set prices in an asynchronous manner, taking into account the expected future path of both the average price of home goods and the path of excess demand in that market. Equation (12) indicates that the <u>rate of change</u> in the inflation rate is a <u>negative</u> function of excess demand. Intuitively, the higher is excess demand at time t, the higher will be the prices set by those firms that revise their prices at time t. Therefore, the higher is excess demand at time t, the higher will be the rate of inflation at t, π_t. Furthermore, excess demand at time t is not taken into account by price setters at t', for all t' > t. Hence, the higher is excess demand at time t, the sharper will be the drop in the inflation rate after t, which is what equation (12) asserts. 2/

By equation (7), there exists an implicit functional relationship between the consumption of home goods, c, traded goods, c^*, and the real exchange rate. Formally, 3/

$$(13) \qquad c_t = \phi(\underset{+}{e_t}, \underset{+}{c_t^*}).$$

1/ A more symmetric, but less tractable, treatment of the two sectors obtains if it is assumed that, first, output in each of the two sectors is a neoclassical function of labor; second, prices are perfectly flexible; and, third, wages are staggered. As discussed in Calvo and Végh (1991), the basic results remain unchanged.

2/ The microfoundations of the staggered-prices model are discussed in Calvo (1982) and Romer (1989).

3/ Signs under the arguments of a function denote the signs of the corresponding partial derivatives.

The signs of the partial derivatives follow from standard comparative statics, recalling that functions $u(c)$ and $v(c^*)$ are assumed to be increasing and strictly concave.

Substituting equation (13) into equation (12), and using (9) (recalling that $D = y - \bar{y}$) yields

$$(14) \qquad \dot{\pi}_t = \theta[\bar{y} - \phi(e_t, c_t^*)].$$

By definition, $e = EP^*/P$, where P^* is the foreign currency price of the traded good, and P is the average price of non-traded goods. Thus (assuming, for simplicity, that P^* is constant),

$$(15) \qquad \dot{e}_t = (\varepsilon - \pi_t)e_t,$$

where ε denotes the constant rate of devaluation.

Equations (14) and (15) constitute the basic dynamic system implied by the model. We are now in the position to address the central issues of the paper. In the first place, consider the impact of a once-and-for-all change in the rate of devaluation, ε. This experiment corresponds to the case in which the announcement by the authorities of a permanent change in the rate of devaluation is fully credible. Because of perfect capital mobility (equation (10)), the nominal interest rate changes to a new (but still constant over time) level. Hence, by equations (6) and (10), it follows that consumption of traded goods is constant over time. Thus, by equation (11), c^* is equal to its permanent-income level (i.e., $c_t^* = y^* + rk_0$, for all t) and is independent of the rate of devaluation. 1/ Consequently, c^* is invariant to <u>permanent</u> changes in the rate of devaluation. We now turn to examine the behavior of the other variables in the model.

Figure 5 depicts system (14)-(15) for a time-invariant path of c^* (i.e., $\dot{c}_t^*=0$). It can be verified that the system exhibits saddle-path stability. Hence, under perfect foresight--and for a given set of parameters--all converging and continuous equilibrium paths (the only ones

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1/ For simplicity, it will be assumed that y_t^* is constant over time (i.e., $y_t = y^*$ for all t.)

considered in the present paper) must lie on the saddle path A'A'. 1/ The real exchange rate, e, is a predetermined variable (i.e., it does not jump), while the rate of inflation, π, is free to jump. Therefore, given the real exchange rate, the inflation rate will adjust so as to position the system on the saddle path A'A', which implies that the equilibrium path is unique.

For the sake of concreteness, let us now assume that the system is initially at steady state A, where the rate of inflation of home goods equals that of traded goods and is equal, in turn, to the rate of devaluation, ε^h. 2/ Moreover, by equation (14), at steady state we have $\bar{y} = \phi(e_{ss}, c^*_{ss})$. Thus, since, as shown above, c^* is not affected by permanent changes in ε, the steady-state real exchange rate is the same for all constant rates of devaluation, ε. Suppose then that the rate of devaluation is reduced to ε^{ℓ}. By equation (15), this implies that, starting at steady state, if the inflation rate, π, changes in exactly the same magnitude as the rate of devaluation, then the system will move immediately to the new steady state. Since, as argued above, equilibrium solutions are unique, it follows that a permanent change in the rate of devaluation results in an equal change in the rate of inflation of home goods, while the real exchange rate does not move. In terms of Figure 5, the system will move from point A to point B. Consequently, by equation (13), consumption of home goods is not affected by a permanent change in the rate of devaluation. 3/

The experiment shows that, by announcing a permanently lower rate of devaluation which is fully credible, inflation could be immediately lowered, without provoking any change in real variables, despite the presence of staggered prices. This is due, in part, to the fact that our price-setting mechanism is essentially forward-looking.

We now turn to examine the implications of transitory stabilization experiments. In this connection, the central insights can be obtained by focusing on the simple case in which the rate of devaluation is temporarily set at a lower (constant) level, and is later raised back to its original level. As will be argued below, this experiment yields the same outcome that would obtain in the following case of lack of credibility: the policymaker announces a permanent reduction in the rate

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1/ As shown in Calvo (1983), the path of the inflation rate must be continuous along an equilibrium solution. Hence, since the real exchange rate, e, is necessarily continuous, equilibrium paths in the (π, e) plane are continuous, as assumed here. Moreover, the convergence condition could be justified following the lines suggested by Obstfeld and Rogoff (1983).

2/ Steady-state values will be denoted by the subscript "ss"; superscripts "h" and "l" denote "high" and "low" values of a given variable, respectively.

3/ Indeed, proceeding as in Calvo and Végh (1990b), one can show that "superneutrality" of permanent changes in ε also holds when the system starts outside the steady-state equilibrium.

Figure 5
Dynamic System

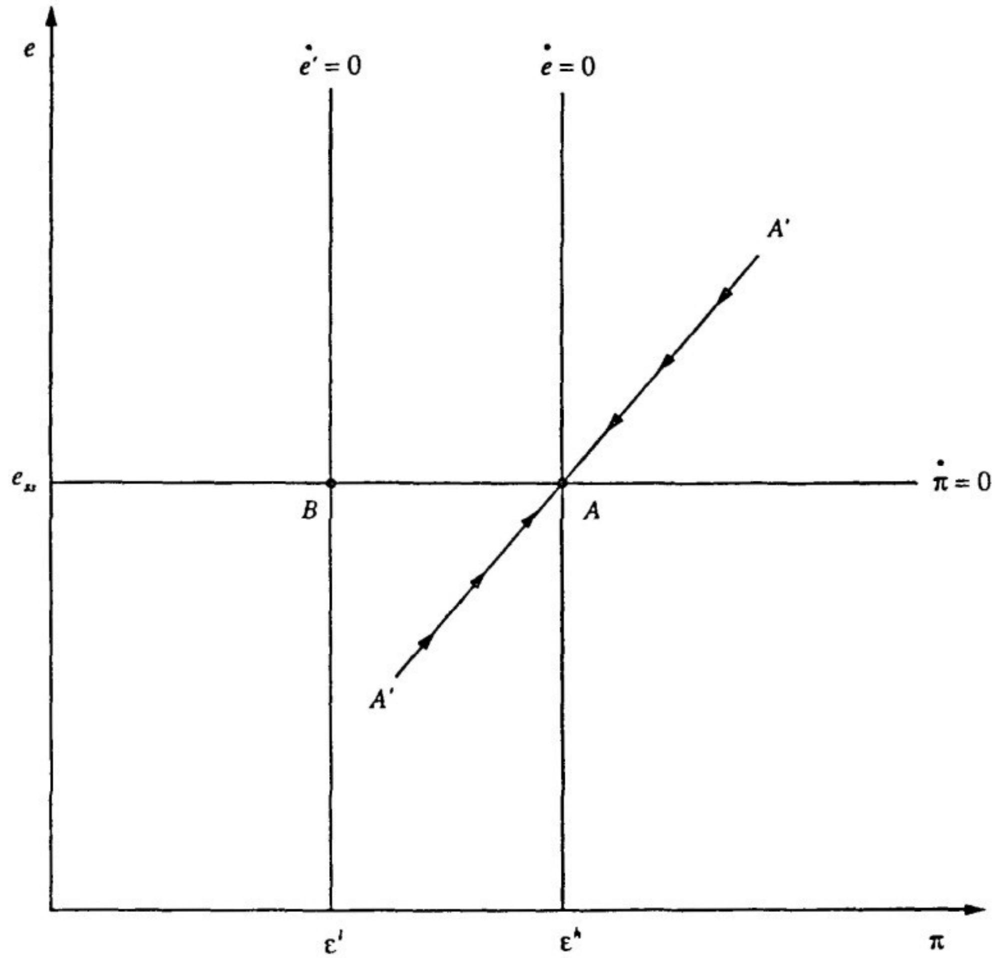
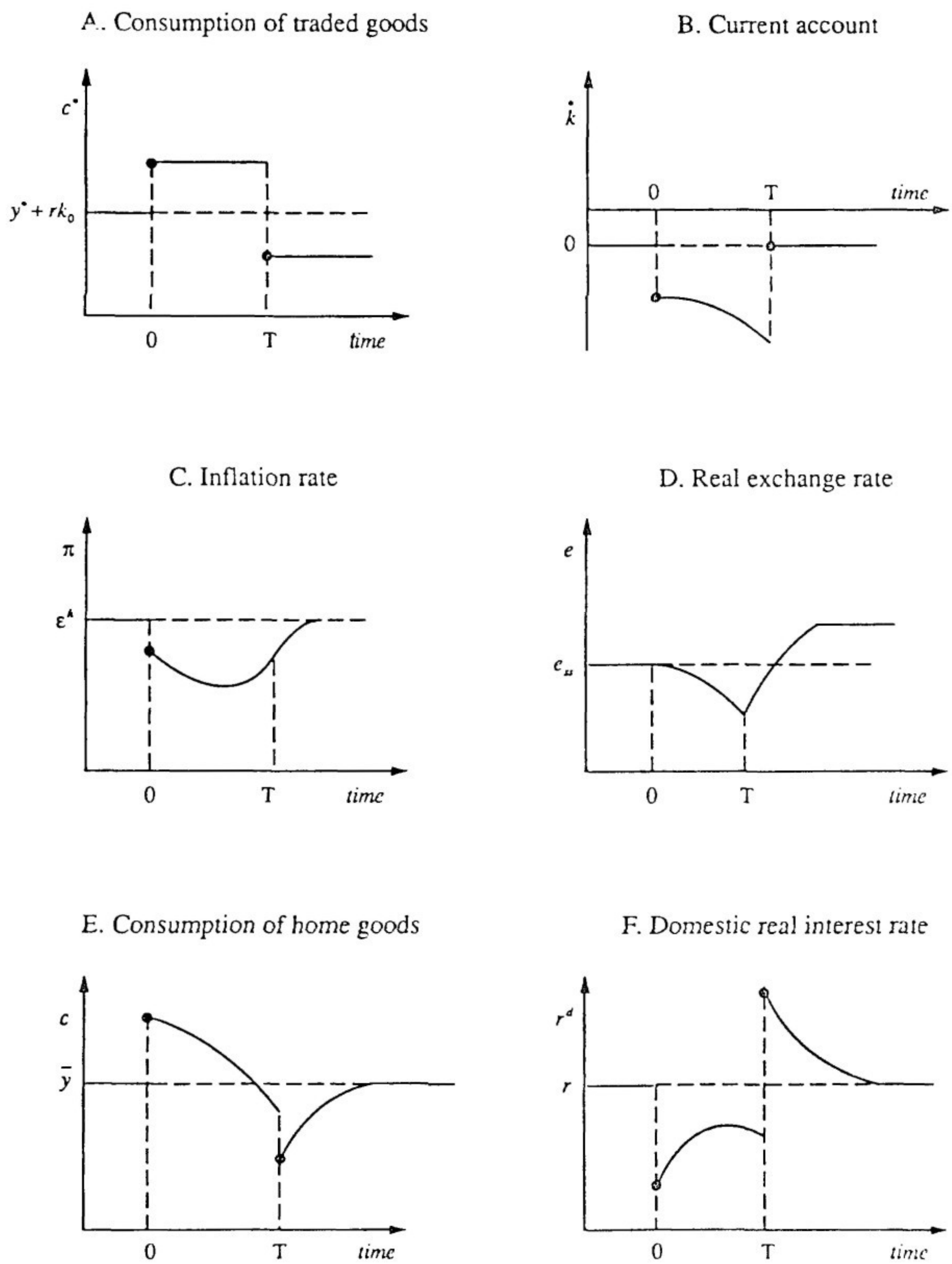


Figure 6

Temporary Reduction in Devaluation Rate



of devaluation, but the public believes that the rate of devaluation will go back to its initial level after a certain period of time. Formally, we take $t = 0$ as the "present". The initial steady state (i.e., before $t = 0$) corresponds to a rate of devaluation $\varepsilon = \varepsilon^h$. At $t=0$, the authorities announce the following policy:

$$\text{(16a)} \qquad \varepsilon_t = \varepsilon^\ell, \quad \text{for } 0 \le t < T,$$

$$\text{(16b)} \qquad \varepsilon_t = \varepsilon^h, \quad \text{for } t \ge T,$$

where $T > 0$, and $\varepsilon^\ell < \varepsilon^h$.

By the assumption of perfect capital mobility (10), policy (16) implies that during the interval $[0,T)$--hereafter referred to as the "transition"--the domestic nominal interest rate, i, is lower than after T. This implies, by first-order condition (6), that consumption of traded goods during the transition is higher than after T. 1/ More specifically, one can show that there are consumption levels c^{*h} and $c^{*\ell}$ (where $c^{*h} > c^{*\ell}$) such that

$$\text{(17a)} \qquad c_t^* = c^{*h}, \quad \text{for } 0 \le t < T,$$

$$\text{(17b)} \qquad c_t^* = c^{*\ell}, \quad \text{for } t \ge T.$$

This result is quite intuitive. As noted before, the effective price of traded goods includes both their market price and the opportunity cost of the associated money holdings. Therefore, the effective price of traded goods is relatively low during the transition, and thus induces a correspondingly higher consumption.

The overall budget constraint (11) implies that during the transition consumption of traded goods is larger than initial permanent income (i.e., $c^{*h} > y^*+rk_0$), while consumption of traded goods falls below initial permanent income after time T (i.e., $c^{*\ell} < y^*+rk_0$). Panel A in Figure 6 illustrates the time path of consumption of traded goods. The resulting time path of the current account--which is illustrated in Panel B in Figure 6--follows from the flow constraint of the economy as whole, given by

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1/ Note that the multiplier λ adjusts instantaneously to its new steady-state value at $t = 0$. Therefore, the increase in i at time T implies that consumption of traded goods falls at that time.

(18) $\dot{k}_t = y^* + rk_t - c_t^*$.

On impact, the current account jumps into deficit as a result of the increase in consumption of traded goods, which causes the trade balance to deteriorate. Although the trade balance remains constant during the transition, the current account deficit widens over time, as net interest income on foreign assets decreases, and jumps back into balance at time T. As Figures (1)-(4) illustrate, a deterioration of the trade balance characterized both the Southern-Cone "tablitas" and the Israeli plan.

Figure 7 can be used to derive the dynamic path of inflation of non-traded goods and the real exchange rate. The initial steady state is at point A where $\pi_{ss} = \varepsilon^h$ and $e_{ss} = v'(y^*+rk_0)/u'(\bar{y})$. (The latter equation follows from equation (7), (9), and the fact that, at the initial steady state, $c_{ss}^* = y^*+rk_0$.) At the new steady state, given by point C in Figure 7, inflation remains unchanged but the real exchange rate is higher (i.e., $e_{ss} = v'(c^{*\ell})/u'(\bar{y})$), because consumption of traded goods is lower. Thus, the dynamic system must hit C'C'--the saddle path corresponding to steady-state C--at t = T. During the transition, the dynamic system is governed by the laws of motion drawn in Figure 7, which correspond to point D. Point D represents the stationary point of the dynamic system during the transition (where $e = v'(c^{*h})/u'(\bar{y})$ and $\pi = \varepsilon^h$) and D'D' denotes the corresponding saddle path. Therefore, on impact (i.e., at t = 0)--and assuming that T is relatively large--the system jumps to a point like G, proceeds along an unstable path to hit point H at t = T, and then travels along the saddle path C'C' towards point C. 1/

The time paths of the inflation rate of home goods and the real exchange rate are illustrated in Panels C and D, respectively, in

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1/ The system cannot jump to point K or to the left of point K because, if it did, it would not hit C'C' at time T (recall that the inflation rate cannot jump at time T). The path AGHC illustrated in Figure 7 assumes a relative large value of the credibility horizon, T. For small values of T, the rise in consumption of traded goods at time 0 is relatively large (the proof would proceed along the lines of Calvo and Végh (1990a)), which implies that inflation always falls during the transition, as illustrated by the path AEFC in Figure 7. (For graphical simplicity, Figure 7 abstracts from the fact that the shifts in the $\dot{\pi} = 0$ schedule depend on he magnitude of T.)

It can also be shown that the inflation rate of home goods can actually go up on impact (path AIJC in Figure 7). For this to happen, the reduction in the rate of devaluation must be large enough <u>and</u> the credibility horizon, T, must be small. Both features ensure that the expansionary effect of the stabilization plan on the consumption of traded goods is large. In such a case, the positive effect on the initial jump of the inflation rate resulting from the increase in consumption of traded goods is large enough so as to offset the negative effect on the inflation rate of the lower rate of devaluation.

Figure 7
Dynamics in the (π, e) Plane

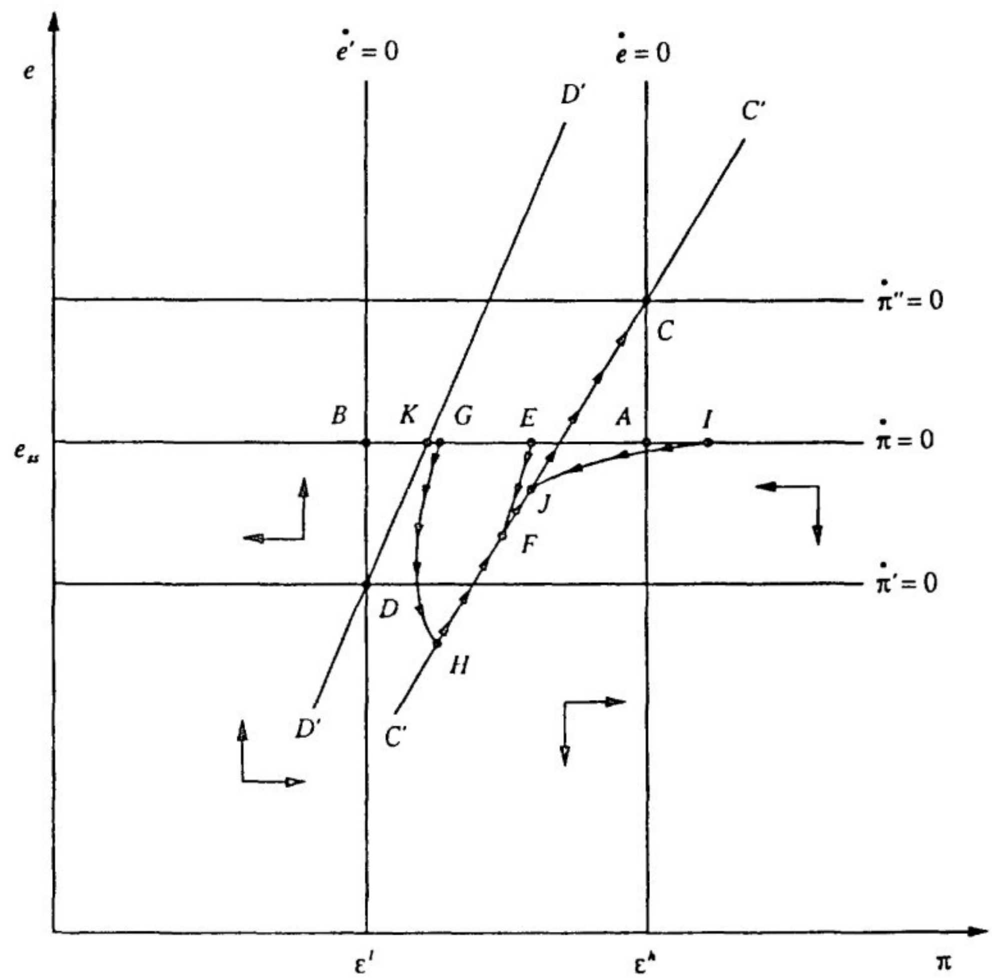

Figure 6. As illustrated in Figures (1) through (4), the appreciation of the real (effective) exchange rate is particularly marked in the Southern-Cone "tablitas" (with an occasional interruption in the trend in Chile due to nominal exchange rate adjustments). 1/ In the Israeli case, the pattern is less pronounced at the beginning of the program due to the depreciation of the dollar in international exchange markets. Figures (1) through (4) also show the "stickiness" of the inflation rate which, in the context of this model, is due to lack of credibility. 2/ The notable exception is Israel, where the inflation rate fell sharply at the very beginning of the program and remained at around 20 percent a year ever since. In the Southern-Cone "tablitas," where erratic quarter-to-quarter changes make it more illuminating to look at the trend, inflation fell only very slowly, particularly in the case of Argentina. In Uruguay, in fact, inflation increased at the beginning of the program, a possibility that is consistent with the model, as discussed above.

Consider now the time path of consumption of home goods. Differentiating equation (7), and recalling that consumption of traded goods is time-invariant, yields

$$(19) \qquad u''(c_t)\dot{c}_t/u'(c_t) = -\dot{e}_t/e_t,$$

which implies that consumption of home goods moves in the same direction as the real exchange rate does. Figure 6, Panel E, illustrates the time path of consumption of home goods. The fall in the rate of devaluation causes the nominal interest to fall and consumption of traded goods to increase on impact. Since the relative price of traded goods in terms of home goods (i.e., the real exchange rate) is given at time 0, consumers do not want to alter the consumption of home goods relative to consumption of traded goods. Therefore, the rise in the consumption of traded goods must be accompanied by a rise in consumption of home goods (see equation (7)). Over time, the appreciation of the real exchange rate, which renders home goods more expensive relative to traded goods, leads to a declining consumption path of home goods. For large T, c falls below its full-employment level <u>before</u> time T arrives, as illustrated in Figure 6, Panel E. 3/ At time T, the downward jump in consumption of

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1/ Note that the real exchange rate illustrated in Figures (1)-(4), which is an effective exchange rate, does not correspond exactly to the definition used in the model. However, other definitions of the real exchange rate followed the same pattern.

2/ In the model, the inflation rate depicted in Figures (1) through (4) corresponds to an average of the inflation rate of traded goods, ϵ, and the inflation rate of home goods, π.

3/ For small values of T, consumption of home goods is above $\bar{y}$ for all $t < T$.

traded goods must be accompanied by an downward jump in consumption of non-traded goods. The high growth of consumption in the first stages of the programs shows very clearly in Figures (1) through (4). In some cases (Argentina and Uruguay), consumption growth began to slow down before the plans ended. In the Israeli case, consumption growth has turned negative in spite of the success of the plan.

The time path of the domestic real interest rate, r^d, is illustrated in Figure 6, Panel F (for a large T). The time path can be derived by noting that, by definition, $r^d = i - \pi$. On impact, r^d falls because inflation of home goods declines by less, if at all, than the rate of devaluation. At time T, the rise in i implies that r^d jumps upwards. During the transition, r^d remains below its initial value. 1/ The behavior, at the beginning of the program, of real interest rates in the Southern-Cone "tablitas" appears consistent with the predictions of the model. As illustrated in Figures (1) through (3), real (deposit) interest rates were relatively low at the beginning of the programs and increased afterwards. In fact, the conventional wisdom at the time (see Fernandez (1985), Corbo (1985), and Hanson and de Melo (1985)) was that the fall in real interest rates at the beginning of the program caused the initial boom, as Rodriguez's (1982) model predicts. Towards the end of the programs, however, real interest rates reached very high levels, a feature that the present model does not capture most likely because of the lack of uncertainty regarding the end of the program (see Section III). In the case of Israel, real interest rates increased sharply upon implementation of the program, as illustrated in Figure 4. As discussed in Section III, these high real interest rates can be explained analytically if money is taken to be an additional anchor, which is consistent with the Israeli case (see Barkai (1990)).

Suppose now that the policymaker actually announces that the rate of devaluation ε will be permanently maintained at the lower level ε^{ℓ}, but the public, disbelieving the policy announcement, expects that ε will go back to its higher level ε^h after a certain time T. Clearly, during the transition all the equilibrium variables will behave exactly as they do under a temporary experiment like the one just analyzed. This shows that a policy intended to lower inflation with minimal real effects may fail to achieve its objective as a result of not enjoying full credibility on the part of the public.

1/ For a small T, r^d always increases during the transition.

III. Final Remarks

This final section discusses the use of money as an additional nominal anchor, the effects of backward indexation (or inflation inertia), and then offers some concluding remarks.

1. Money as an additional nominal anchor

The analysis has shown that a policy intended to lower inflation with minimal real effects may fail to achieve its objective as a result of not enjoying full credibility. Thus, the question arises as to whether using money as an additional anchor may help to insulate economic variables from the effects of imperfect credibility. For instance, the Israeli 1985 plan had an explicit target for bank credit, which was to be achieved by a combination of higher reserve requirements and a higher discount rate (see, for instance, Barkai (1990)). The idea behind having some monetary anchor is to offset the inflationary consequences of a potentially huge increase in the supply of money during the first stages of the program. High reserve requirements, by forcing the banks to pay less on interest-bearing money, decrease the demand for money. A high discount rate tends to reduce the supply of money by making it more difficult for banks to get access to reserve money. In Calvo and Végh (1991), we capture the idea of using money as an additional anchor by assuming that the stock of money is predetermined at each point in time due to the presence of capital controls. We find that using money as an additional anchor may be effective in curtailing the initial consumption boom precisely because of the resulting liquidity "crunch." However, we show that the initial appreciation of the real exchange rate may not be avoided (although it could perhaps be lessened). Furthermore, lack of credibility may still be costly because it may generate an initial recession. We also show that the real interest rate in terms of traded goods--which, naturally, remains constant under perfect capital mobility--rises at the beginning of the program. The domestic real interest rate is also above its initial value in the last phase of the transition. This result is in accordance with the general belief (see, for instance, Barkai (1990)) that the highly restrictive monetary policy at the beginning of the Israeli stabilization was responsible for the large increase in real interest rates (see Figure 4).

2. Backward indexation

An important issue that arises regarding stabilization programs is the possibility of inflation "inertia." As shown above, inflation inertia is not a necessary consequence of the existence of staggered price-setting. This is partly due to the fact that price setters are assumed to be forward-looking. Several authors have argued, however, that in some high-inflation countries (e.g., Chile during the 1970's and Brazil) wage contracts are characterized by backward-looking, price-indexation clauses. 1/ This type of indexation is high in the list of

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1/ See, for example, Dornbusch and Simonsen (1987) and Edwards (1990).

suspects for explaining slow inflation convergence to its target value (see Dornbusch and Simonsen (1987)). To analyze its effect in the present model, Calvo and Végh (1991) assume full credibility and modify the price-setting mechanism of the model to accommodate backward price indexation. Interestingly, while the model exhibits an initial appreciation of the real exchange rate, the initial stages of the program show a contraction of consumption and output. This suggests that, in the presence of optimizing consumers and full credibility, backward indexation may not be capable of accounting for the simultaneous occurrence of an expansion in the home-goods sector and real exchange rate appreciation. 1/

3. Conclusions

This paper has illustrated the vulnerability of stabilization programs with respect to beliefs of the private sector about the economic and/or political sustainability of such programs. The examples are particularly worrisome because vulnerability of stabilization programs is displayed even though there is no inertia or confusion on the part of the public about the relevant model and its associated parameters. Thus, to avoid the credibility-related transitional dynamics, policymakers should be able to convince the public that the program will be carried out as announced. This is not an easy task because modifications of the announced program do, by necessity, occur in the future. Therefore, in principle, there is no way for the policymaker to categorically prove to the public that the policy announcement will be honored until the economy actually arrives at the point in time at which the public expects the policy to change its course. Hence, in practice, a stabilization program is likely to suffer from credibility problems during some initial period of time and, consequently, to be buffeted, even to the point of sinking the ship, by the occasionally strong and persistent lack-of-credibility winds.

The paper also illustrates how misleading it may be to conduct policy under the assumption that credibility can be taken for granted (and that backward indexation would automatically vanish when faced with the "blinding light" of exchange-rate-based programs). Under full credibility and sudden deindexation, the mere announcement of a fixed exchange rate would stop inflation on its track. There may be no need to sterilize capital inflows or to interfere with the economy in any form or manner. Thus, a fixed exchange rate regime could bring, in a short span of time, if not immediately, all the benefits of Germany's price stability to any country that pegs its currency to the DM. Unfortunately, one is at a serious loss in finding actual examples of such costless stabilization episodes, particularly in the post-modern world of high capital mobility.

1/ Where there is lack of credibility, the presence of backward indexation does not change the basic results obtained in Section II.

The realization that a "quick-fix" stabilization policy is unlikely to be an option brings to the fore issues like credibility and backward indexation. Backward indexation is relatively easy to deal with by, for instance, outlawing wage contracts exhibiting such characteristics. Credibility, on the other hand, is enormously more subtle and complicated. The paper suggests that if credibility is a problem, there are no costless solutions. However, the discussion also suggests that policy could actually have an impact on cushioning and even changing the direction of certain variables over time. Thus, a policy package will have to involve measures other than mere fixing (or predetermining) the exchange rate to steer the system closer to the optimum. In this respect, using the money supply as an additional anchor may help to stabilize consumption because a predetermined money supply may have severe dampening effects on consumption.

Our results rely on the consumption effects of temporarily lower nominal interest rates. We believe that such a channel is empirically important in high inflation countries in which nominal interest rates are substantially lower at the beginning of the plan than after the plan is abandoned. In Uruguay, for instance, loan rates reached a low of 62 percent per annum in the third quarter of the program compared to 105.5 percent per annum in the first quarter after the plan was abandoned. In addition to the intertemporal channel discussed in this paper, lower nominal interest rates can also result in higher consumption if consumers face financial liquidity constraints whereby cash is needed to meet interest payments (see Calvo and Végh (1991)). Such liquidity constraints affect consumption both by further reducing the effective price of consumption and by lowering the real interest rate relevant for consumption decisions.

In the present model, interest rates do not exhibit risk premia because the public knows with certainty when the program will be abandoned. Risk premia could be incorporated into the model by assuming, first, that the public is uncertain as to when the program will end (as in Helpman and Drazen (1988), and, second, that there will be a one-step adjustment in the nominal exchange rate when the program is abandoned. We conjecture that our previous results will still hold under these conditions.

Finally, it may be instructive to endogenize credibility. This is a major task in itself. We conjecture that reasonable extensions of the present model that allow for endogenous credibility will not substantially change the implications obtained in this paper for the early stages of the program, particularly if history matters (i.e., if people's priors depend on past government behavior, and their priors change slowly over time). However, we think that endogenizing credibility is likely to shed important light on policy issues. For example, endogenous credibility would make it possible to find conditions under which controls on capital mobility are a useful device to smooth out the "business cycle" associated with exchange-rate-based stabilization (for an early effort in this direction, see Persson and van Wjinbergen (1988)). Specifically, one would like to answer questions such as: How is credibility affected by policy? Will it be enhanced, or, perhaps reduced even more because interventionist governments reveal a preference for time inconsistency?

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