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Collapse of a Crawling Peg Regime in the Presence of a Government Budget Constraint

Prepared by Miguel A. Savastano*

Authorized for Distribution by A. Linde

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Abstract

This study extends the research on balance-of-payments crises by investigating the dynamics of the collapse of a crawling exchange rate in the presence of an explicit link between the fiscal deficit and domestic credit. It shows that such an exchange rate regime is characterized by two potential steady-state equilibria. This introduces an ex-ante indeterminacy regarding the timing and magnitude of the speculative attack on international reserves in the event of a sustained inconsistency between the country's fiscal and exchange rate policies. The paper discusses the conditions that would define the actual timing of the regime's breakdown.

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Summary

This paper analyzes the consequences that the presence of an explicit link between the fiscal deficit and domestic credit has for the dynamics of the collapse of a crawling exchange rate. By introducing the assumption that the central bank follows a "passive" monetary policy, the paper highlights the role that fiscal disequilibria usually play in the breakdown of managed exchange rate regimes, an aspect that has not been appropriately captured by the literature on balance of payments crises. The paper argues that two common assumptions of this literature cannot be maintained when the evolution of domestic credit is primarily geared toward financing the fiscal deficit. In that case, not only is it incorrect to postulate that the growth rate of domestic credit remains invariant after the peg is abandoned, but it is also possible to obtain more than one stationary equilibrium in the post-attack situation.

The above argument is illustrated by including a simple financing constraint for the government in a continuous-time, perfect-foresight portfolio model of a small, fully open economy with a crawling exchange rate. The model assumes that the private sector can only hold domestic and foreign money balances, that the central bank sterilizes the changes in the domestic money supply stemming from the continuous depreciation of the currency, and that neither external nor internal borrowing is available to the government. These assumptions determine that, for the most common specifications of the demand for money, the steady-state equilibrium of the economy can be sustained by two different rates of growth of domestic credit and, consequently, by two different rates of devaluation (and inflation).

The paper shows that, in the event of a sustained inconsistency between the country's fiscal and exchange rate policies, this dual equilibrium implies an ex-ante indeterminacy regarding the timing and magnitude of the speculative attack on the international reserves of the central bank. Expressions for the exact timing and magnitude of the two potential attacks are derived for a specific functional form of the demand for money, and it is claimed that the solution to the ex-ante indeterminacy of the regime's collapse will depend on the government's capacity to make credible commitments during the disequilibrium period. In particular, the paper argues that if the authorities cannot precommit credibly to refrain from imposing capital controls or undertaking an unplanned discrete devaluation in the pre-collapse period, rational speculators will "trap" the economy at the high-depreciation equilibrium. Conversely, it argues that the operation of the inflation-tax Laffer curve will enhance the chances of success of a stabilization program based on a slowdown of the devaluation, provided that it is rapidly supported by restrictive fiscal and monetary policies.

I. Introduction

Following the pioneering studies of Salant and Henderson (1978) and Krugman (1979) the recent literature on balance-of-payments crises has analyzed extensively the conditions under which a fixed or otherwise managed exchange rate regime will collapse. 1/ According to these models expansive domestic credit policies that create a persistent deficit in the balance of payments will inevitably lead to a speculative attack on the central bank's stock of international reserves. The precise timing of the attack is determined by the speculators' rational anticipation of the regime's collapse, the policies they expect the central bank to follow after the run, and the requirement that no unplanned discrete jump in the exchange rate occur at the transition. 2/ A common assumption of these studies is the exogeneity or invariance of the rate of growth of domestic credit. This feature allows them to nail down agents' expectations and to obtain a unique and well-defined stationary equilibrium in the post-attack exchange rate regime. Specifically, these models obtain the well-known sustainability condition for an open economy that follows an active domestic credit policy: in steady-state, the rate of depreciation of the exchange rate will be equal to the (unchanged) rate of creation of domestic credit.

However, by treating domestic credit expansion as the fundamental and invariant variable driving the speculative attacks these models obscure the fiscal forces that are usually behind the breakdown of managed exchange rate regimes. In fact, if it is assumed instead that domestic credit policies are geared to the financing of the fiscal deficit, some of the features and predictions of the standard balance-of-payments crises models are altered substantially. For instance, it will no longer be correct to assume that the rate of growth of domestic credit remains invariant after the speculative attack takes place. If the unsustainable credit policies are directly related to an increase in the fiscal deficit, the decline in the demand for domestic money balances that characterizes the transition to the post-attack equilibrium will prompt an upward adjustment in the growth rate of domestic credit (to the level determined by the higher expected rate of depreciation) in order to finance the larger borrowing requirements of the public sector.

Considering explicitly the linkage between credit and fiscal policies in these models also gives rise to the possibility of obtaining two potential stationary positions at which the fiscal deficit is financed by the inflation

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1/ See, for example, the studies by Flood and Garber (1984), Connolly and Taylor (1984), Garber (1985), Obstfeld (1984, 1986b), Dornbusch (1987), Wyplosz(1986), Blackburn (1988) and Willman (1987). Additionally, almost all the recent literature on portfolio models applied to developing countries analyzes the consequences of a collapse of the official exchange rate in the presence of a parallel currency market; see, for instance, Kiguel and Lizondo (1986) and Edwards (1988, 1989).

2/ By definition, market-determined exchange rate regimes are not subject to such "surprises" in official rate-setting.

tax and the balance of payments is in equilibrium. This steady-state feature, derived from the usual assumptions regarding the shape of the inflation-revenue Laffer curve, is common of all the models that include a financing constraint for the government, and has been studied in detail for the case of a closed economy. 1/ However, its extension to an open economy with a managed exchange rate is not trivial, because the possibility of temporarily eliminating a given monetary disequilibrium through losses of international reserves changes the dynamic adjustment of the system.

In particular, in this case the reattainment of a stationary equilibrium will coincide with a speculative attack on the central bank's foreign exchange holdings, the timing of which will depend upon the public's expectations regarding monetary and exchange rate policies. Whether the economy will end up at an equilibrium with high or low inflation will, thus, depend heavily on the government's ability to commit credibly to certain policies during the transition period.

Potentially, this framework can be extended further to analyze the interaction of fiscal and monetary policies with tax and tariff reforms in stabilization programs under managed exchange rates. For instance, the framework can be used to illustrate how a sustained disinflation would reverse the erosion of conventional tax yields and, thus, reduce the distortions stemming from an intensive use of the inflation tax; or how anti-inflation policies can be reinforced by opening up to imports and to sustainable foreign financing. The model derived in this paper, however, does not incorporate all of these factors, since it assumes that the economy is already fully open, tax proceeds are exogenous, and external financing is unavailable. The model and its steady-state properties are presented in Section II. Section III illustrates the effects of an inconsistency between the stance of fiscal and exchange rate policies and derives expressions for the exact timing and magnitude of the two potential speculative attacks. It also discusses some ways in which the ex-ante indeterminacy of the post-attack stationary equilibrium can be resolved. Finally, Section IV summarizes the policy implications of the model and relates them to the recent literature on the sustainability of alternative exchange rate regimes.

II. A Portfolio Model of a Crawling Peg Regime

This section will discuss the effects of introducing a financing constraint for the government in a continuous time portfolio model of a small open economy with a crawling exchange rate. Let the nominal exchange rate be denoted by E and the rate of crawl by π (i.e., $\pi = \dot{E}/E$, where a dot over a variable represents its derivative with respect to time). In the tradition of portfolio models, it will be assumed that domestic residents allocate their

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1/ Following the study by Cagan (1956), the works of Sargent and Wallace (1981, 1987), Evans and Yarrow (1981), Liviatan (1983), Dornbusch and Fischer (1986), Bruno and Fischer (1987) and others have discussed the stability properties of the two stationary equilibria for the inflation rate in a closed economy. Kharas and Pinto (1986) extend this line of analysis to an open economy with a dual and implicitly floating exchange rate regime.

wealth between two non-interest bearing assets: domestic money (M) --held only by the nationals of the country-- and foreign money (f). 1/ The nominal stock of private wealth of the economy will then be:

$$A = M + Ef \tag{1}$$

The fraction of wealth held as domestic money, λ, is assumed to be a decreasing function of the expected rate of depreciation. Provided that the public has rational expectations --equivalent to perfect foresight in this deterministic framework-- this equals the actual rate of depreciation π. Thus, the demand for domestic money balances can be expressed as:

$$m = \lambda(\pi)a \; ; \quad \lambda'(\pi) < 0 \; ; \quad 0 < \lambda(\pi) < 1 \tag{2}$$

where m = M/E and a = A/E are the desired stock of domestic money and the stock of private wealth expressed in terms of foreign currency. Dividing (1) by the exchange rate (E) and substituting in (2), the portfolio equilibrium condition can also be written as:

$$f = \delta(\pi)m \; ; \quad \delta'(\pi) > 0 \tag{3}$$

On the supply side, ignoring the existence of a banking system, the nominal money stock at any point in time will be determined from the balance sheet of the central bank as the sum of the outstanding stock of domestic credit (D) and the domestic currency value of international reserves (ER):

$$M = D + ER \tag{4}$$

The evolution over time of this aggregate will, in turn, depend on the behavior of each of its components. In particular, if it is assumed --as is customary in open economy models-- that the central bank does not monetize the changes in the domestic currency value of international reserves that arise

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1/ This is a simplifying assumption of all the currency substitution-type portfolio models that use the framework developed by Calvo and Rodriguez (1977). See, for example, Connolly and Taylor (1984), Kiguel and Lizondo (1986), Kharas and Pinto (1986), Khan and Lizondo (1987) and Edwards (1988, 1989).

from the continuous depreciation of the exchange rate in a crawling peg regime, the flow money supply will be given by: 1/

$$\dot{M} = \dot{D} + E\dot{R} \tag{5}$$

In this context, the inclusion of a financing constraint for the government imposes some restrictions on the evolution of domestic credit. Specifically, in the absence of alternative financing sources, the particular level of the fiscal deficit, $\bar{d}$, will determine the rate of domestic credit expansion, that is:

$$\bar{d} = (g - t) = \dot{D}/E \tag{6}$$

where g and t are, respectively, the levels of government expenditures and tax revenues expressed in terms of foreign currency. 2/

On the other hand, the behavior of the second component of the money supply will be dictated by the overall result of the balance of payments and can be expressed as:

1/ The assumption that the central bank sterilizes the capital gains stemming from its exchange rate policy implies that the nominal money stock at any point in time will be given by:

$$M_t = D_t + E_t R_t - \int_{-\infty}^{t} R_s \dot{E}_s d_s$$

Equation (5) is then obtained by taking the time differential to this expression. For an alternative assumption, see Cumby and Van Wijnbergen (1989).

2/ Most of the studies on "passive" monetary policy have modelled the linkage between the fiscal deficit and the rate of money creation by means of the closed-economy counterpart of equation (6); see Auernheimer (1983), Evans and Yarrow (1981) and Bruno and Fischer (1987). However, the use of this type of constraint for the case of an open economy requires two qualifications: first, monetary policy is restricted to domestic credit policy, and second, as said in the text, it must be assumed that foreign and domestic borrowing are not available for the country in question. For an analysis of speculative attacks when the government is able to borrow, see Obstfeld (1986a) and Buiter (1987).

$$\dot{R} = CA - \dot{f} \tag{7}$$

where CA stands for the current account balance in foreign currency and $\dot{f}$ represents the capital account. 1/ Notice that the second term of (7) will be positive only if there is an expected change in the rate of depreciation; in that case the public's accumulation of foreign money balances will contribute to the drainage of international reserves and accelerate the timing of the speculative attack.

From equations (1), (3), (5) and (7) we can obtain an expression for the evolution over time of the real stock of private domestic wealth:

$$\dot{a} = CA + \dot{D}/E - m\pi \tag{8}$$

where $m\pi$ can be interpreted as the authorities' proceeds from the inflation (depreciation) tax. However, according to these models, for a given set of domestic policies the public will carry out the necessary adjustments to always maintain its portfolio of assets in equilibrium. Once this position is achieved the stock of private wealth will remain constant (i.e., $\dot{a}=0$) and equation (8) will become:

$$-CA = \dot{D}/E - m\pi = \bar{d} - m\pi \tag{9}$$

Notice that assuming that agents hold their desired portfolios does not imply that the economy has reached a stationary position. In fact, a situation of flow equilibrium in the assets market is, in principle, consistent with the presence of a current account deficit (if the government deficit is larger than the proceeds from the inflation tax) or a current account surplus (in the opposite case). Since neither of these situations is sustainable in the long run, an additional condition has to be fulfilled for this system to reach a steady-state, namely (from equation (9)) that the current account be in equilibrium (CA = 0). This, in turn, requires that the fiscal deficit be fully financed by the revenues from the inflation tax.

The precise implications of the condition derived above can be made more clear once we consider the particular way in which the inflation tax is collected in this model. The assumption that the central bank does not monetize capital gains arising from the continuous revaluation of its international reserves restricts the government to collect inflationary revenue

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1/ Adding more structure to the real sector of the model by specifying, for instance, the consumption and production functions for tradable and nontradable goods and the behavior of the real exchange rate can be done easily. However, leaving the model at this level of aggregation will suffice to highlight the problem under analysis.

only from the fraction of the money supply that is backed by domestic credit. Calling this fraction γ ($\gamma = D/M$), we can rewrite equation (9) as: 1/

$$-CA = (\theta - \pi)\gamma m \tag{10}$$

where $\theta = \dot{D}/D$ is the rate of growth of domestic credit.

From (10) it is now evident that a stationary equilibrium will require the equality of the growth rate of domestic credit and the rate of depreciation of the currency ($\theta = \pi$). In principle, this condition seems to be equivalent to the one obtained in those models where the central bank sets an invariant rule for the creation of domestic credit independently of the stance of fiscal policies. 2/ However, the fact that in this case the fiscal deficit needs to be permanently financed (equation (6)) alters significantly the nature of the adjustment process toward this steady-state solution.

Because of this financing requirement, in general there will be two different growth rates of domestic credit that will satisfy the condition for stationary equilibrium. In effect, the shape of the inflation-tax Laffer curve implicit in the most common specifications of the demand for money balances will allow for the possibility of collecting the same level of revenue from two different rates of inflation (depreciation). 3/

Moreover, once the government financing constraint is included some features of the temporary equilibrium of the model will be modified. In order to be in this position, the economy will now have to satisfy simultaneously equation (10) --flow equilibrium in the assets market-- and equation (6). In particular, if we assume that the demand for domestic money balances is of the semi-logarithmic (Cagan) form $\lambda(\pi) = \tilde{\lambda}e^{-\alpha\pi}$, equation (6) can be rewritten as:

$$\bar{d} = \theta\gamma\tilde{\lambda}\exp(-\alpha\pi)a \tag{11}$$

and, from (9), the expression for the temporary equilibrium of the system will be given by:

1/ It must be noted that, despite the fact that this assumption has been adopted consistently by almost all portfolio models since the early developments of the monetary approach (see Johnson (1972)), the empirical studies on seigniorage collection have not distinguished the different implications of alternative rules regarding the sterilization of capital gains (see, for instance, the figures presented in Fischer (1982)). Indeed, although the same equilibrium condition would be obtained if it were assumed that the central bank monetizes the changes in valuation of international reserves, the empirical computation of the inflation tax would be different under the two rules.

2/ See, for instance, Connolly and Taylor (1984) and Dornbusch (1987).

3/ This result was first obtained by Cagan (1956) and has been analyzed in detail for the closed-economy case by the literature mentioned in footnote 1/, page 2.

$$-CA = \bar{d} - \pi\gamma\tilde{\lambda}\exp(-\alpha\pi) \qquad (12)$$

The situation just described is illustrated in Figure 1. The sustainability condition implicit in equation (10), $\theta^*=\pi^*$, is shown as the 45-degree line, and the budget financing constraint (equation (11)), where the economy should always be located, is represented by the schedule **dd**. The size of the fiscal deficit ($\bar{d}$), the level of private wealth (a), and the initial share of domestic credit in the money supply (γ_0) will determine the intercept of the **dd** curve on the horizontal axis. If the agents hold their desired portfolios, at every point on **dd** and below the 45-degree line (i.e., at every point where $\theta > \pi$) the economy will be in a temporary equilibrium experiencing a continuous loss of reserves due to a deficit in the current account; at every point above that line, the economy will be running a persistent external surplus. In the long run, however, the stationary equilibrium condition requires that both the growth rate of domestic credit (θ) and the rate of depreciation (π) adjust to one of the two points of intersection of the budget constraint with the sustainability line.

The figure also shows clearly that there exists a limit to the size of the budget deficit that can be financed with inflationary revenue. This limit is given by the deficit d^*, the financing of which requires maximizing the inflationary tax by setting the rate of depreciation equal to the inverse of the inflation semi-elasticity of the domestic money demand ($1/\alpha$). 1/ If the actual deficit is larger than d^* no steady-state equilibrium will exist. For any other level of the budget deficit, however, there will be two possible steady-state positions, one at a low rate of depreciation (point **A**) and the other at a high rate of depreciation (point **B**).

It is important to emphasize that in a managed exchange rate regime like this, the economy may remain for some time at any point on the **dd** schedule different from the two stationary equilibria. In fact, if the temporary equilibrium condition (equation (10)) is satisfied, the divergence between the government's financing requirements and its collection of inflationary revenue will be reflected in the current account, without any need for a continuous change in the rate of depreciation. This implies that the dynamic adjustment of this system is significantly different from the one analyzed by the literature on dual inflationary equilibria mentioned in 1/, page 2. In particular, in this case the economy's transition toward one of its steady-state positions will not be gradual and will not depend on the local stability properties of the two potential equilibria. Instead, the movement toward that equilibrium will be abrupt and will coincide with the collapse of the managed exchange rate regime. As will be seen in the following section, the factors that will determine whether this collapse will take the economy to the stationary equilibrium corresponding to the high or to the low rate of depreciation will depend crucially on the public's expectations regarding the future actions of the country's authorities.

1/ This is the well-known condition for maximizing inflationary revenue in a non-growing economy derived by Cagan (1956) and Friedman (1971).

III. Inconsistent Fiscal Policies and the Collapse of a Crawling Peg Regime

As mentioned before, the inclusion of a financing constraint for the government in a portfolio model of an open economy highlights the role that fiscal policies commonly play in the breakdown of a managed exchange rate regime. In contrast with the usual assumptions of the balance-of-payments crises literature, the model developed above permits us to relate directly the presence of an unsustainable domestic credit policy to an inconsistency between the size of the fiscal deficit and the chosen exchange rate policy; moreover, the need to restore the consistency between these policies is precisely what explains the collapse of the exchange rate regime. However, as this section will show, the existence of two different rates of depreciation at which such consistency can be restored introduces a potential indeterminacy with respect to the timing and magnitude of the speculative attack.

In order to illustrate this feature of the model, let us assume an economy with a crawling exchange rate whose initial position is one of steady-state equilibrium with a relatively low rate of depreciation. Thus, the economy will be located at a point such as **A** in Figure 2, with a rate of growth of domestic credit θ_0 and a rate of depreciation π_0. Now suppose that the government decides to increase its real expenditures (g) without implementing a corresponding increase in taxes, while the central bank maintains unchanged the rate of depreciation of the currency. 1/ From equation (11), this increase in the fiscal deficit (from $\bar{d}$ to, say, $\tilde{d}$) will require an immediate upward adjustment in the rate of expansion of domestic credit in order to satisfy the larger financing needs of the public sector.

In terms of Figure 2, this particular fiscal shock will imply a rightward shift of the budget financing schedule from **dd** to **d'd'**, an increase in the growth rate of domestic credit from θ_0 to θ_1, and the repositioning of the economy at a point such as **A'**. At this new position the flow equilibrium in the economy's asset (money) market will be sustained, according to equation (10), by a persistent deficit in the current account. This situation, however, can only be temporary. Even in the absence of a speculative attack, the maintenance of a divergence between θ and π will ultimately lead to the depletion of the central bank's international reserves, a discrete jump of the exchange rate and the adoption of a floating exchange rate regime. 2/

The inevitability of the discrete adjustment in the exchange rate when the system is left on its own (i.e., when the collapse is not anticipated) can be shown by using equations (2) and (4) to rewrite the portfolio equilibrium condition (equation (10)) at point **A'** as:

1/ This behavior of the central bank implies either that it maintains its previously announced rate of crawl or that it follows some sort of backward-looking adjustment rule in setting this rate.

2/ Of course, the expansionary fiscal policy would be sustained for a longer period if other sources of deficit financing were available; see Obstfeld (1986a) and Buiter (1987).

Figure 1

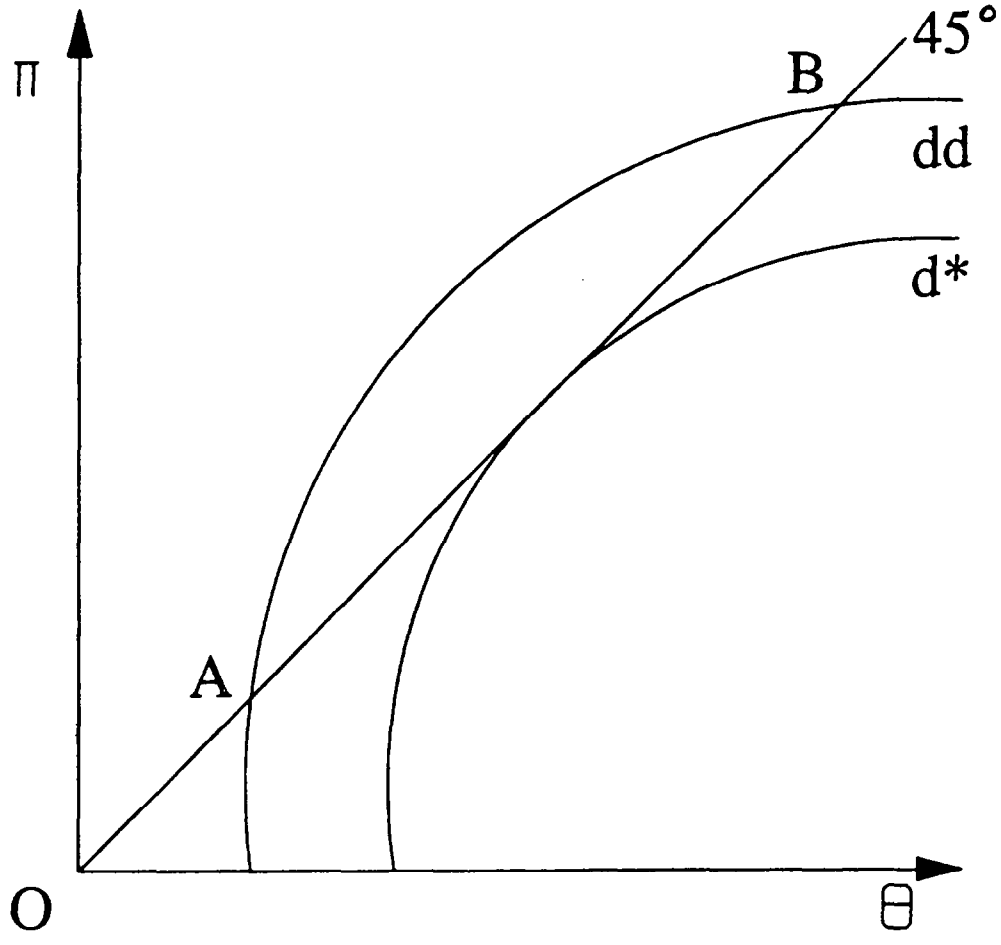
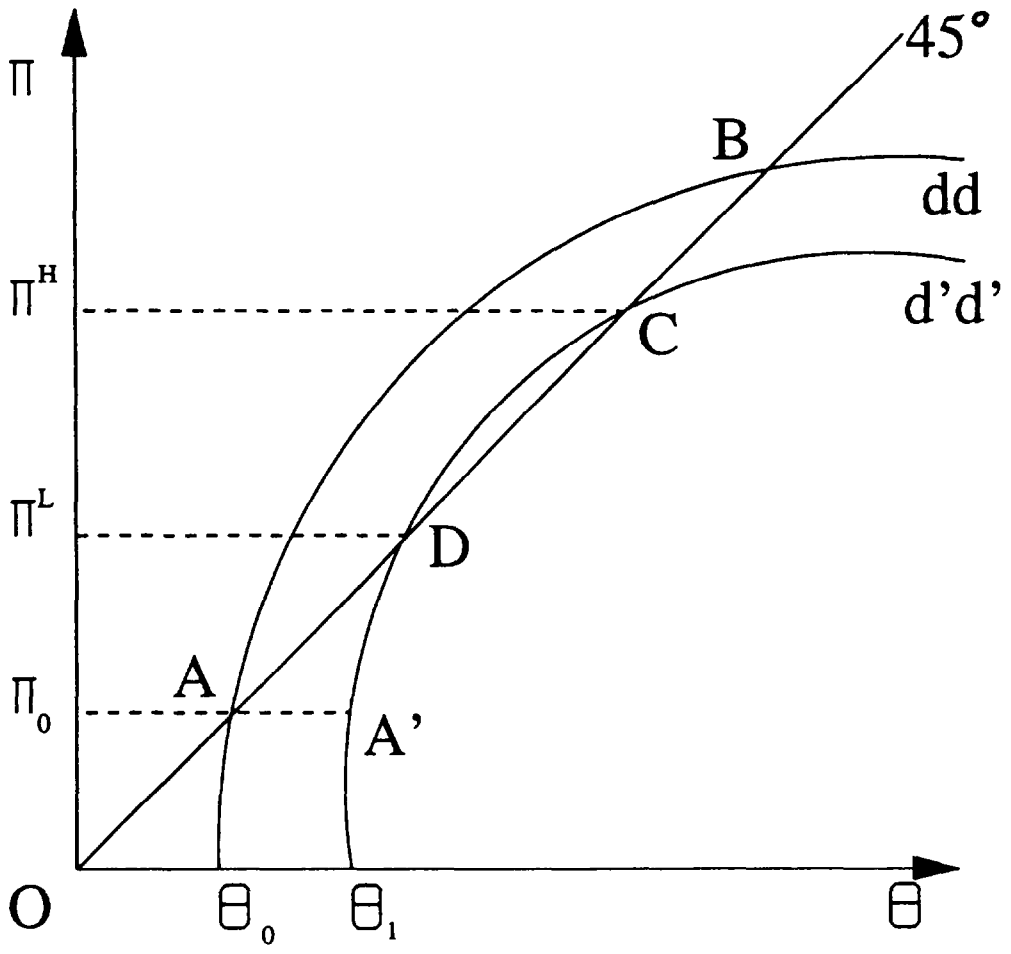


Figure 2



$$M_t = (E_0 \exp(\pi_0 t))\,\tilde{\lambda} \exp(-\alpha \pi_0)\, a = D_0 \exp(\theta_1 t) + E_0 R_t \qquad (13)$$

where the subscript "0" indicates the initial steady-state value of the corresponding variable. According to (13), the evolution of international reserves (given by the current account deficit) will be dictated by:

$$E_0 R_t = (M_0 - D_0 \exp(\theta_1 - \pi_0)\, t) \exp(\pi_0 t) \qquad (14)$$

If no speculative attack occurs, the central bank will run out of foreign exchange at some point t^*, where:

$$t^* = \frac{\log(\frac{M_0}{D_0})}{(\theta_1 - \pi_0)} = \frac{-\log \gamma_0}{(\theta_1 - \pi_0)} \qquad (15)$$

and at that instant two adjustments will have to take place: i) both θ and π will have to adjust to a point on the sustainability line consistent with the financing constraint of the government, and ii) portfolio equilibrium (equation (13)) will need to be maintained through a discrete devaluation of the currency.

However, the above scenario is inconsistent with the assumption that agents possess perfect foresight. As the literature on balance-of-payments crises has emphasized, in a situation like the one just described the private sector would anticipate the eventual breakdown of the managed exchange rate regime and would be able to make enormous capital gains by selling their domestic money holdings to the central bank just an instant before t^*. The realization of these potential profits by all speculators will cause the collapse of the regime to occur earlier than t^* (i.e., before the international reserves have been depleted), and the equilibrium in the agents' desired portfolios will be maintained by a decline in their nominal money holdings rather than by a discontinuous jump in the exchange rate.

A necessary condition for this smooth transition to take place, however, is to allow the public to anticipate exactly the stationary position at which the system will stay in the post-attack regime. In this sense, the assumption that the central bank follows an active domestic credit policy has been crucial for obtaining a unique solution in the existing models of speculative attack. In fact, in those models the invariance of the growth rate of domestic credit actually nails down agents' expectations and permits them to cause the collapse of the managed exchange rate regime at a well-defined date.

Once the financing constraint for the government is included, however, the uniqueness of the system's steady-state disappears. Given the properties of the inflation-tax Laffer curve, there will now exist two potential rates of depreciation (the ones corresponding to points C and D in Figure 2) at which the consistency between the fiscal and exchange rate policies can be restored in the post-attack regime. Moreover, since the required decline in the demand for domestic money will be different for each of these two sustainable depreciation rates, there will be an ex-ante indeterminacy with regard to the timing and magnitude of the speculative attack needed to achieve the transition

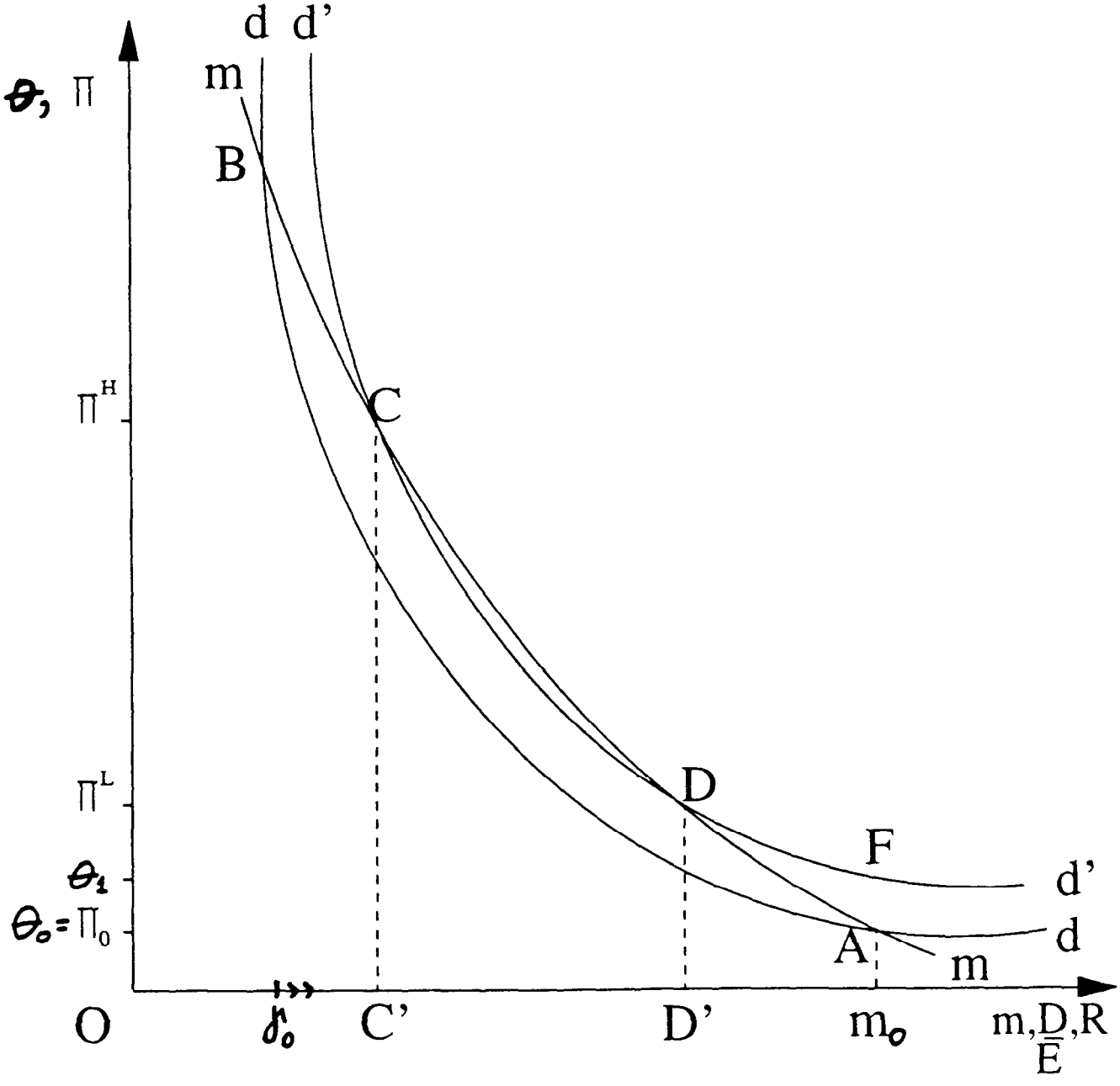
to a float without violating the continuity condition for the exchange rate. As will be discussed below, the particular way in which this indeterminacy will be solved will be extremely sensitive to the public's perception of the policies the authorities will follow during the period of transitory equilibrium.

The different magnitude and timing of the speculative attack associated with each of the two stationary equilibria can be illustrated by Figure 3. 1/ The curve **dd**, a hyperbola asymptotic to the axes, shows the combinations of steady-state rates of depreciation and domestic money holdings that are consistent with the initial fiscal deficit $\overline{d}$. The curve **mm**, in turn, represents the Cagan-type demand for real domestic money balances; in order to satisfy the portfolio equilibrium condition (equation (10)), the economy will always have to be located at some point on this schedule. The potential steady-states of the system are indicated by the points of intersection of these two curves. It is assumed that the initial position of the economy is given by point **A**; as in Figure 2 this point corresponds to a rate of depreciation π_0 that is equal to the growth rate of domestic credit θ_0. The real stock of domestic money balances that sustains this equilibrium is represented by the distance Om_0, and it is further assumed that this stock of money is backed by an amount proportional to $O\gamma_0$ of domestic credit and by $\gamma_0 m_0$ of international reserves (see equation (4)).

An increase in the fiscal deficit as the one discussed before (i.e., from $\overline{d}$ to $\overline{\overline{d}}$) will shift the **dd** schedule to a position such as **d'd'** and will change the possible stationary equilibria to points **C** and **D**. Assuming that the central bank maintains the rate of crawl at π_0, the economy will stay temporarily at **A**. However, the jump in the growth rate of domestic credit (from θ_0 to θ_1) implied by the larger fiscal requirements will originate a continuous increase in the stock of domestic credit that will be exactly offset by losses of international reserves reflecting the current account deficit. In terms of Figure 3 this process will imply a rightward expansion of the domestic credit share of the money stock along the horizontal axis. If the authorities commit all their foreign exchange to the defense of the managed exchange rate regime and the public, for some reason, anticipates that the consistency between the fiscal and exchange rate policies will be restored at the high rate of depreciation (π^H), the collapse of the regime will have to occur as soon as the stock of domestic credit reaches the level OC'. At that instant a speculative attack of a magnitude $C'm_0$ will have to take place. However, if the private agents believe that the more expansive fiscal policy will be sustained by the low rate of depreciation (π^L), they will wait until domestic credit reaches the level OD' before acquiring the remaining stock of international reserves $D'm_0$. Notice that, despite the fact that in both cases the central bank's initial stock of international reserves ($\gamma_0 m_0$) will be depleted, the collapse will have to take place earlier if the agents share the expectation that the exchange rate will depreciate at π^H in the post-attack regime.

1/ This figure has been adapted from the studies of Liviatan (1983) and Dornbusch (1987).

Figure 3



In fact, we can derive exact expressions for the magnitude and timing of the two potential speculative attacks represented in Figure 3. Ruling out the possibility of capital gains, the regime's collapse should occur as soon as the stock of domestic credit (growing at the unsustainable rate θ_1) equals the nominal value of the demand for domestic money corresponding to the new steady-state. Using, as in (13), equations (2) and (4) this terminal condition will be:

$$D_t = D_0 \exp(\theta_1 t) = E_0 \exp(\pi_0 t) \tilde{\lambda} \exp(-\alpha \pi^H) a \tag{16}$$

for the high-depreciation equilibrium (point C), and:

$$D_t = D_0 \exp(\theta_1 t) = E_0 \exp(\pi_0 t) \tilde{\lambda} \exp(-\alpha \pi^L) a \tag{17}$$

for the low-depreciation one (point D). Substituting each of these equations back in (4) we get that the precise expression for a run of magnitude $C'm_0$ in Figure 3 is:

$$R^H = m_0 [1 - \exp(-\alpha(\pi^H - \pi_0))] \exp(\pi_0 t) \tag{18}$$

while that for the amount of reserves lost in the transition to point D (the distance $D'm_0$) is:

$$R^L = m_0 [1 - \exp(-\alpha(\pi^L - \pi_0))] \exp(\pi_0 t) \tag{19}$$

Thus, as the figure shows, the difference in the size of the run associated with each of the stationary equilibria is proportional to the difference between the two sustainable rates of depreciation π^H and π^L. Manipulating equations (16) and (17) we can also determine the exact timing of the attacks indicated by (18) and (19). Given an inconsistency between the fiscal and exchange rate policies, the collapse of the managed exchange rate regime will occur either at:

$$t^H = \frac{-\log\gamma_0 - \alpha(\pi^H - \pi_0)}{(\theta_1 - \pi_0)} \tag{20}$$

or at:

$$t^L = \frac{-\log\gamma_0 - \alpha(\pi^L - \pi_0)}{(\theta_1 - \pi_0)} \tag{21}$$

from where it can be seen that $t^H < t^L$, i.e., the collapse will take place earlier if the agents anticipate the high rate of depreciation (π^H). Moreover, since $t^L < t^*$ (from equation (15)), the public will necessarily carry out the speculative attack before the accumulated deficit in the current account exhausts the initial stock of international reserves. It should also be noticed that the difference between the two potential timings of the attack (and between the two sustainable rates of depreciation) will be smaller the larger the fiscal deficit, as long as the latter stays below the critical level d^*.

Although the above computations have been made for the case where the inconsistency between fiscal and exchange rate policies arises from an

exogenous increase of the fiscal deficit, the framework is also useful to illustrate the probable effects of other measures that create similar macroeconomic inconsistencies. In particular, the previous analysis can be applied, with minor modifications, to the case where the authorities implement an exchange rate-based stabilization program. 1/

Suppose that in this alternative scenario the economy's initial position is given by point **D** in Figure 3, where a rate of devaluation π^L (equal to a growth rate of domestic credit θ^L) sustains the fiscal deficit represented by curve **d'd'**. Suppose now that the authorities decide to preannounce a lower rate of devaluation, π_0, presumably as part of a comprehensive stabilization program. Even if there is no immediate change in the underlying fundamentals of the fiscal deficit, the public can interpret the reduction of the rate of crawl as a signal that the central bank is willing to use part of its international reserves (assumed proportional to the distance $\gamma_0 D'$) to support the stabilization attempt. Consequently, in order to maintain portfolio equilibrium, the agents' initial response will be to convert the equivalent to the distance $D'm_0$ of their foreign currency assets into domestic currency and to move along the money demand schedule to a position like **A**.

The one-time increase of the central bank's international reserves and the reduction in the rate of inflation provoked by the lower rate of crawl are, however, misleading indicators of the program's success. If the fiscal deficit is not reduced **rapidly** to a level consistent with that of curve **dd** in Figure 3, the exchange rate-based disinflation scheme will break down. Specifically, if the fiscal deficit stays at **d'd'** and is financed by domestic credit growing at the rate θ_1, the collapse of the preannouncement regime will have exactly the same features as the previous example of an expansionary fiscal policy. The temporary reduction in inflation and increase in reserves will be a false sign of the agents' confidence in the program and, depending on their expectations regarding future government actions, the economy might end up with a rate of inflation higher than the one that prevailed at the outset of the stabilization attempt.

A crucial issue, then, is to identify the factors that will determine which of the two possible steady-states is going to characterize the post-attack regime of this economy in the presence of an inconsistency between the fiscal and exchange rate policies. Given the self-fulfilling nature of private agents' anticipations, this turns out to be equivalent to analyzing the variables, policies and interactions that will be considered by domestic residents in forming their expectations. In particular, the public will have to evaluate, first, the preferences and incentives of the authorities regarding the two feasible stationary equilibria, and second, the potential (private) costs of each possible course of action.

1/ This type of programs have been studied extensively, at theoretical and empirical levels, by the literature on the Southern Cone liberalization reforms of the 1970s. See, for instance, Calvo (1986a,b), Edwards and Cox-Edwards (1987), Kiguel and Liviatan (1987) and Rodriguez (1982).

With respect to the first group of factors it is clear that, since both steady-state positions will yield the same permanent flow of inflationary revenue, the government should be indifferent on this account only as to which rate of depreciation (π^H or π^L) finally sustains its budget deficit $\tilde{d}$. Nevertheless, even though the model's structure does not incorporate explicitly the preferences of the authorities, it may be reasonable to assume that most governments would prefer the low-depreciation equilibrium. In the first example, the one of an expansive fiscal policy, they would do so because it implies that the regime with a relatively low rate of depreciation (π_0) will last longer, and in the second, because the apparent success of the disinflation program will be maintained for a longer period. In this sense, the government might have some incentives to influence the post-attack outcome by revealing its preference for the low-depreciation equilibrium and by trying to precommit itself to not take any action that would interfere with the continuous loss of reserves that will take place during the pre-collapse period.

If the authorities lack the means to ensure that they will not deviate from their preferred outcome, however, an announcement of this type will not be credible. Private agents will realize that the government will very likely be tempted to try to catch them by surprise in order to postpone even further the collapse of the managed regime, either by the **unanticipated** imposition of capital controls or by undertaking an **unanticipated** devaluation. In this case, the private sector will hedge its portfolio against the risk of a capital loss by provoking the collapse of the regime as soon as domestic credit reaches the threshold corresponding to the high-depreciation equilibrium (distance OC' in Figure 3). 1/

In a way, the lack of credibility of government announcements (or, more precisely, the lack of means to enhance such credibility) provides a possible solution to the ex-ante indeterminacy of the post-attack steady-state of this economy. Since in this model speculation is privately costless, the existence of the slightest probability that the authorities will attempt to delay the transition to a float by a once-and-for-all devaluation will give agents a "one-way-option"; i.e., to attack the central bank's international reserves at the time t^H (see equation (20)).

Of course, the outcome will be different if the government finds a credible method for "tying its own hands" during the pre-collapse period. If

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1/ Notice that the authorities will also be tempted to carry out these surprises in the one-equilibrium models used by the literature on speculative attacks. In spite of the assumption that the agents foresee perfectly the law of motion of domestic credit and international reserves consistent with a given rate of devaluation, the private sector in these models does not have enough information to anticipate the imposition of capital controls or a discrete devaluation different to the one required when the peg is abandoned. Thus, when these events take place **before** the collapse date the agents are unable to take advantage of the potential capital gains created by the authorities' measure. On this see Obstfeld (1984), Wyplosz (1986) and Dornbusch (1987).

this is a feasible alternative, the inconsistency between the fiscal and exchange rate policies will last longer and the attack will take place at t^L (equation (21)). Although nothing in the structure of the model prevents the authorities from making agents' expectations converge to the low-depreciation equilibrium, it may be argued that, in the first case considered, the fiscal origin of the disequilibrium will erode the government's credibility. In the case of an exchange rate-based stabilization, by contrast, the authorities can blame their delay in reducing the fiscal deficit on the existence of structural rigidities and/or political opposition to the needed measures. In both cases, however, the intervention of an outside party might be required to coordinate the self-fulfilling beliefs of the public and avoid the attainment of the high-depreciation equilibrium. In this regard, some recent studies indicate that an outside party (such as a foreign central bank) that promises to lend foreign exchange in the event of a confidence crisis can help to postpone the speculative attack. 1/ In particular, that party might increase the commitment capacity of the government and persuade the private agents that the authorities are not going to surprise them by imposing capital controls or devaluing the currency in the period of transitory equilibrium.

In summary, the solution to the ex-ante indeterminacy regarding the timing and magnitude of the collapse of a crawling peg depends on the credibility of the authorities' resolve not to interfere with the persistent current account deficit caused by the inconsistency between their fiscal and exchange rate policies. This result highlights the severity of the problems that can be generated by an inconsistent fiscal policy in a managed exchange rate regime. If the authorities do not take into account the self-fulfilling nature of private sector's expectations when implementing unsustainable policies, the economy may end up "trapped" very rapidly in an undesirable high-depreciation equilibrium.

IV. Summary and Conclusions

This paper has extended the research on collapsing exchange rate regimes by including a financing constraint for the government in a continuous time portfolio model of a small open economy with a crawling exchange rate. By considering explicitly the linkage between credit and fiscal policies, we have dispensed with the common assumption of the balance-of-payments crises literature regarding the invariance of the growth rate of domestic credit. We also have been able to analyze the consequences of focusing on the fiscal forces that are usually behind the breakdown of fixed or otherwise managed exchange rate regimes.

In this sense it was found that, in principle, the speculative attack on the central bank's international reserves required to eliminate an inconsistency between fiscal and exchange rate policies can occur at two different points in time. Due to the self-fulfilling nature of private agents' expectations and to the presence of an inflation-tax Laffer curve, an economy with the above mentioned features will restore its steady-state equilibrium

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1/ See the discussion on this issue in Dellas and Stockman (1988) and Giavazzi and Pagano (1988).

after an imbalance created by a fiscal expansion or by a reduction in the rate of crawl by switching to a floating exchange rate regime that can be sustained by either a high or a low rate of depreciation.

Moreover, it was shown that the solution to this ex-ante indeterminacy of the post-attack depreciation rate will depend on the government's capacity to make credible announcements regarding policies to be followed in the disequilibrium period preceding the collapse. In particular, if the authorities cannot precommit credibly to refrain from delaying the attack through the unanticipated imposition of capital controls or by undertaking an unplanned discrete devaluation, rational private speculators will "trap" the economy at the high-depreciation equilibrium.

This result affects some of the policy recommendations implicit in the recent literature on portfolio models that has analyzed the main features of alternative exchange rate regimes in developing countries. 1/ Specifically, although they discuss explicitly the effects of unsustainable fiscal policies, these studies have not taken into account that the collapse of a fixed or managed exchange rate regime can place the economy at the "wrong" side of the inflation-tax Laffer curve. Quite the contrary, most of this literature simply has **assumed** that, given a fiscal shock, the stationary equilibrium will always lie on the upward sloping portion of that schedule. Without further qualifications, these studies inaccurately conclude that the negative effects of successive increases in the fiscal deficit (or in the black market premium) can always be avoided by an upward adjustment in the rate of devaluation.

The model presented in this paper also captures some of the stylized facts observed in recent exchange rate-based stabilization episodes. It shows that these programs can work even before the ex-post consistency between fiscal and exchange rate policies is attained, but that the success of the disinflation attempt will be short-lived if it is not rapidly backed by a reduction of the fiscal deficit to a level that can be sustained by the lower proceeds from the inflation tax. Furthermore, the model suggests that if the measures aimed at restoring the consistency of macroeconomic policies are sufficiently rapid and decisive, an exchange rate-based stabilization program can prompt a "virtuous cycle" of lower inflation, increased tax yields and larger international reserves. The model, however, also illustrates that these programs may provoke an inflationary outburst if the authorities delay the necessary adjustment and are unable to make credible commitments during the transitory disequilibrium period. Whether the crises episodes that ultimately determined the failure of this type of programs in the early 1980s were actually characterized by a movement towards an equilibrium inflation rate placed at the "wrong" side of the Laffer curve, as this model contemplates, can only be assessed properly with a thorough empirical investigation; subsequent research should take this direction.

1/ See the studies by Dornbusch (1986), Kiguel and Lizondo (1986), and Lizondo (1987a,b).

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