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Exchange Rate Policy and Debt Crises in Emerging Economies

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Abstract

We explore a model intended to capture the interaction between exchange rate policy, fiscal policy, and outright default on foreign-currency denominated debt. We examine how the exchange rate affects the supply of short-term debt facing the government. We show that under a credible hard peg (currency board), default is a more likely outcome, even without an exceptionally large short-term debt, precisely because a devaluation is not an option. In a more conventional fixed peg, it can be optimal for the government to choose a level of the exchange rate that would be likely to result in partial or complete debt default. Depending on the exchange rate regime, multiple equilibria exist, in one of which the interest rate is high, the exchange rate is overvalued, output is low, and default is high. Under a hard peg, there is a unique equilibrium.

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I. Introduction

In 1994, the government of Mexico undertook a devaluation that had been recommended to it by knowledgeable observers, in part to correct a real exchange rate overvaluation that appeared to be stifling growth in the country. A similar correction of the exchange rate had, in fact, resulted in an acceleration of economic growth a few years before in the United Kingdom and Italy when these countries decoupled their currencies from the ERM (exchange rate mechanism of the European Monetary System) and allowed them to depreciate. Surprisingly, in Mexico, the devaluation was followed not by an acceleration of growth, but by a debt crisis (a refusal of creditors to roll over existing debt or extend new loans) that resulted in a sharp contraction of economic activity.

Most observers have explained the emergence of the debt crisis as attributable to the significant worsening of the Mexican government's fiscal position created by the devaluation, in light of the large net stock of short-term dollar-denominated debt that the government had incurred during the course of 1994 through a combination of reserve depletion and refinancing of the government's peso-denominated debt. According to these observers, the increased peso value of the government's debt appears to have created the expectation of a potential default on the part of creditors.

This is somewhat puzzling, because in view of Mexico's relatively low ratio of public debt to GDP, its government's demonstrated record of fiscal adjustment, and the improved prospects for the Mexican economy as a result of the exchange rate adjustment, perceived insolvency of the Mexican government should not have been an issue. One problem, however, was that the short maturity of the existing debt signified a sharp deterioration in the government's *flow* fiscal position — an increase in its near-term borrowing requirements — implying the possibility that *if* creditors collectively withheld resources, the Mexican government would have found itself in a position in which it was forced to choose between defaulting on its short-term obligations or making a further fiscal adjustment. If creditors had reason to believe that the Mexican government would opt for default rather than fiscal adjustment under these circumstances, then it would, indeed, have been optimal for them to withhold funds.

In this paper, we investigate the conditions under which such equilibrium is likely to arise. The objective of the paper is to better understand the interaction between devaluation and a debt crisis (default) in emerging economies like Mexico. In particular, why should Mexico's creditors have converged on the expectation of default in the event of a "run" on government debt? Should a devaluation make a default more or less likely ex post? These questions are particularly important because Mexico's circumstances in 1994 do not appear to be general. For example, investors in Argentina recently appear to have feared a default on public sector debt in part precisely because that country's currency-board arrangement made a devaluation of the Argentine peso *less* likely. This raises the question of what distinguishes these two cases from each other.

While the cases of Mexico and Argentina have received a substantial amount of attention, there is substantial evidence that debt and exchange rate policies are strongly linked in emerging economies more generally. Reinhart (2002), for example, finds that 84 percent of all default episodes in her 59-country sample over the period 1970–99 were followed within 24 months by currency crises, while 66 percent of all currency crises in her developing-country subgroup were followed within 24 months by debt defaults.[2] It remains to understand why the link between the two phenomena should be so strong empirically, as well as why in some cases the two types of crisis tend to occur together while in others they do not. Our purpose is to attempt to identify the underlying characteristics of economies that help to explain the links between these phenomena.

Two separate strands of literature address this issue peripherally. One such strand is the literature on sovereign debt. Following the debt crises in the early 1980s, several authors focused on how a no-default debt equilibrium could be explained for sovereign borrowers (see Eichengreen, 1991 for a review) using models based on reputation (Grossman and Van Huyck, 1988) or sanctions (Bulow and Rogoff, 1989). Some early empirical work associated with this literature (for example, Edwards (1984), Cline (1983)) attempted to link sovereign default to exchange rate policy by considering how the exchange rate regime prevailing prior to a debt crisis would influence the occurrence of such a crisis. The central idea was that the willingness to use the exchange rate as a means of adjustment could have the effect of reducing the likelihood of a crisis. However, this literature produced neither formal models nor empirical evidence supporting such views. A second strand is the second-generation variant of the currency crisis literature (for example, Obstfeld, 1996), which examines the factors that influence an optimizing government's choice to alter (or not) an existing exchange rate peg. But this literature does not typically consider such a choice as part of a wider menu of policies that also includes a fiscal instrument and a debt default option. This paper can thus be perceived as addressing gaps in both the debt crisis and currency crisis literatures by simultaneously looking at the interaction among exchange rate policy, fiscal policy, and default on external debt.

The structure of the paper is the following. In the next section, we will describe a simple model that can be used to explore how a benevolent government chooses between fiscal adjustment and default on debt. In Section III, we use this model to analyze the behavior of a government that exercises discretion in making this choice — that is, one that is not bound in its debt-servicing decisions by its previous promises to pay, which is the standard framework adopted in the analysis of sovereign debt. Section IV considers how this government's fiscal and debt-servicing decisions are affected by the level of the exchange rate. Finally, in Section V, we analyze the conditions under which devaluation-cum-default would be a rational choice by a welfare-maximizing government. The final section summarizes our results.

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[2] There were no defaults among industrial countries in Reinhart's sample.

II. The Model

We explore a model intended to capture the interaction among exchange rate policy, fiscal policy, and outright default on foreign-currency denominated debt. The model contains a representative agent and a benevolent government. The government has two policy instruments at its disposal — a fiscal policy and an exchange rate policy. In addition, it has the option to default either partially or totally on its outstanding debt. In specifying the fiscal policy, we will assume that the government chooses an optimal rate of taxation, given the level of public expenditure. Thus, the rate of taxation determines the government's fiscal policy. The exchange rate is fixed, but adjustable. We will consider separately the cases of "hard" (as in a monetary union or a currency board) and "soft" pegs. Given the domestic price level, the level of the nominal exchange rate affects real output in the economy, because it determines the extent of real exchange rate misalignment. Because the government's debt is denominated in foreign currency, the nominal exchange rate also affects the domestic-currency magnitude of the government's debt service obligations. While the government can repudiate a part or the totality of its debt, debt repudiation adversely affects the welfare of the representative agent.

There are two periods in the model. At the beginning of period zero, the government inherits a stock of long-term foreign-currency debt d_L from the past. For simplicity, we will assume that this debt has infinite maturity (i.e., we take it to be consol debt). The total service due on this debt in period 1 is thus $R_L\, d_L$, where R_L is the contracted interest rate on long-term debt. At the beginning of each period, the government tries to roll over its short-term debt. Since we ultimately want to ask why short-term creditors converge on a no-lending equilibrium (i.e., why total default occurs), our interest is precisely in understanding what determines the shape of the supply curve of short-term debt facing the government, and how that curve is affected by changes in the nominal exchange rate. We will assume that risk-neutral investors decide at the end of period zero whether they are willing to renew the stock of short-term government debt d_S. They have access to an alternative, risk-free asset whose rate of return is denoted R. In period 1, the government has the option of defaulting on some or all of its debt. As we will see, the inability of the government to credibly commit to repaying its debt gives rise to a classical time-inconsistency problem: in period 1, the government takes the short-term interest rate as given, but in this perfect foresight framework, investors anticipate the government's future actions and adjust their lending rate accordingly. This means that in a discretionary equilibrium the interest rate may turn out to be higher than the risk free rate, depending on the incentives the government faces to default (at least partially) on its outstanding debt.

If neither long-term nor short-term debt has seniority status, when the government undertakes a partial default it will default on the same share (say θ) of all of its outstanding debt (this can be seen as an *ex post* tax on all bond holders). When θ is the expected rate of default on short-term debt, risk neutral investors set the nominal rate R_S on new government short-term debt such that:

$$(1 + R_S) = (1 + R)/(1 - \theta) \quad (1)$$

The government is assumed to be benevolent. It sets its policies so as to maximize the utility of a representative agent in period 1. We express utility as linear in consumption, and write it as $u(c_t) = c_t$. The representative agent's period 1 consumption is given by:

$$c_1 = (1 - t - z(t))y_1 - a\theta D\, e_1 - \psi/2\, (e_1 - e_0)^2 \quad (2)$$

where $D = R_L d_L + (R_S + 1)\, d_S$ denotes the government's period-1 debt service obligations, t is the (proportional) tax rate, and $z(t)$ represents the deadweight cost of taxation, with $z' > 0$ and $z'' > 0$. e is the nominal (and real) exchange rate, defined as the value of the foreign currency expressed in units of national currency.[3] The second term represents the cost to the representative domestic agent of a partial default by the government on the service of its dollar-denominated debt, both long-term and short-term. This cost is assumed to be proportional to the size of the default — i.e. to the magnitude of the shortfall of debt service paid from the contracted amount, with the parameter a denoting the factor of proportionality.[4] Finally, $\psi/2(e_1 - e_0)^2$ represents the costs associated with exchange rate changes in period 1. These can be interpreted, for example, as costs to the representative agent caused by changes in the real value of foreign currency-denominated private debt.

We define output as the sum of two elements:

$$y_1 = y^* - \alpha/2(e^* - e_1)^2 \quad (3)$$

The first term can be interpreted as potential output. The second term measures the response of output to deviations of the real effective exchange rate from its equilibrium level (i.e., it captures the effect of real exchange rate misalignment on real output). Real output is taken to be a decreasing function of such deviations, whether the real exchange rate is over- or undervalued.

The budget constraint of the government is given by:

$$ty_1 \geq g_1 + (1 - \theta)De_1 \quad (4)$$

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[3] Since we are taking the domestic price level to be constant, we can set the domestic and foreign price levels both equal to unity. In that case, e can also be interpreted as the real exchange rate.

[4] The more effective foreigners are in penalizing domestic residents for default, the larger is a.

The government cannot spend more than its revenue, but it has the possibility of partially or completely reneging on its debt-service obligations.

III. Debt Sustainability Ex Post

Our objective is to examine the determinants of the government's maximum sustainable level of short-term debt, given creditors' awareness that the government may choose to exercise the option to default on some part of this debt in the future, rather than raise the fiscal resources to service it fully. In particular, we wish to examine how the maximum sustainable level of debt is affected by the factors that influence the government's fiscal decisions. In this section, we examine debt sustainability conditioned on a given value of the exchange rate. In the section that follows, we will consider how the level of the exchange rate affects the supply of short-term debt facing the government. Later we will consider whether it can ever be optimal for the government to choose a level of the exchange rate that would be likely to result in debt default.

For now, we assume that the economy operates a fixed exchange rate in the form of a "hard" peg, so that the government has recourse only to the fiscal instrument.[5] This allows us to characterize optimal fiscal policy and to examine the determinants of default conditioned on the exchange rate. We relax this assumption subsequently. Given the fixed peg, we have that $e_1 = e_0$. Equation (2) thus becomes:

$$c_1 = (1 - t - z(t))y_1 - a\theta De_1, \tag{5}$$

with y_1 and e_1 both taken as given by the government.

A. The Discretionary Solution

When the government exercises discretion, it chooses the tax ratio and the rate of default so as to maximize the utility of the representative consumer, taking the interest rate on short-term debt R_S as given. However, its budget constraint (4) implies that it cannot choose these independently. Thus it determines t^* and θ so as to maximize (5) subject to (3) and (4), taking D as given. To find the optimal value of t chosen by the government, first isolate θ in (4). This yields the following constraint:

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[5] In other words, we assume that ψ is sufficiently large as to preclude the possibility of devaluation by an optimizing government. We will turn to the more general case in Section V.

$$\theta \geq 1 - \frac{(ty_1 - g_1)}{De_1}, \tag{6}$$

where $1 \geq \theta \geq 0$. Note that for c_1 to be at its optimal value, (6) must hold as an equality, since default rates over and above those required by the government's budget constraint would serve only to diminish private consumption, according to (5). Substituting the resulting form of (6) into (5), the first order condition for optimal tax policy simplifies to:

$$1 + z'(t^*) = a \tag{7}$$

Note that the optimal tax rate does not depend on items in the government's budget such as the level of spending, the interest rate on government debt, the exchange rate, or even the level of debt outstanding.

This property of our model is an important one, since it implies that under the conditions postulated here, the solution to the government's optimizing decision is recursive. The reason for this is the following: in this purely discretionary setting, we can think of the budget constraint as being met through a decision on the part of the government concerning its rate of default. If default were costless, taxation would yield no benefits, and an increase in the tax rate would have a marginal cost of $(1 + z'(t))y_1$, which is increasing in t. Thus the government would maximize the welfare of the representative individual by setting the tax rate such as to minimize the marginal cost of taxes — i.e., at the corner solution with $t^* = 0$, and would set the default rate θ at the residual value required to satisfy its budget constraint.

When default is penalized, however, raising the tax rate provides a marginal benefit to the representative consumer, in the form of a reduced default penalty. But this marginal benefit depends only on the penalty per unit of default, as well as on the *marginal* effect of changes in the tax rate on the size of the default. The key point is that the latter does not depend on the magnitude of the government's other budgetary obligations. An increase in the tax rate, by supplying the government with revenue, reduces the default *rate* (θ) at the margin by $y_1/D\,e_1$, and it reduces the *size* of the default at the margin by y_1. When default incurs a utility penalty of a per unit, therefore, the marginal benefit to the representative agent amounts to ay_1, and setting marginal cost equal to marginal benefit yields (7). Since $z'' > 0$, we can verify from (7) that the optimal tax rate increases with the size of the penalty a.

Given the optimal tax rate t^*, the default strategy is given trivially by:

$$0 \leq \theta^* = 1 - \frac{t^*y_1 - g_1}{De_1} \leq 1 \tag{8}$$

The interpretation of this equation is straightforward. Given the exogenous values of y_1 and g_1, the optimal tax rate derived from (7) determines the government's primary surplus $t^*y_1 - g_1$. These are the resources that the government is willing to commit to debt service. If the optimal value of the primary surplus is nonpositive, the government must default completely on its debt (i.e., $\theta = 1$), since even after taking the utility cost of default into account, its optimal tax policy does not generate any resources for the service of debt. As t^* increases from a position of primary balance, the default rate falls because the resources transferred to creditors represent an increasing share of the government's (fixed) contractual debt service obligations. When the value of t^* reaches the critical level $t^* = (De_1 + g_1)/y_1$, the government honors all of its contractual debt-service obligations.

B. Perfect Foresight Equilibrium

The preceding scenario can represent a perfect foresight equilibrium with a positive level of debt only if $t^* \geq (De_1 + g_1)/y_1$ — that is, only if the government chooses to honor all of its debt service obligations. If this is the case, then creditors who use the model to assess their likelihood of being repaid would expect $\theta = 0$. Thus, they would set $R_S = R$ and would be willing to lend the government the new amount d_S. Since they would indeed be repaid, their expectations are model-consistent — i.e., the resulting equilibrium is a perfect foresight equilibrium. But for $t^* < (De_1 + g_1)/y_1$ the solution for θ^* given by (8) would not necessarily represent a perfect foresight, since it may not be consistent with the value of θ expected by creditors when they set R_S through equation (1). Thus, to find the perfect foresight equilibrium of this model we need to solve equation (6) for θ while imposing the condition that $(1 + R_S) = (1 + R)/(1 - \theta)$.

Doing so yields the result that under perfect foresight the default rate is given by:

$$0 \leq \theta^* = 1 - \frac{t^* y_1 - g_1 - (1 + R)d_S e_1}{R_L d_L e_1} \leq 1 \tag{9}$$

To interpret this condition, note that under perfect foresight, the government's payments to its short-term creditors are not affected by a partial debt default. When short-term debt is positive, these creditors adjust the contractual interest rate on their claims to offset their expected losses from partial defaults, leaving debt service payments constant at the amount $(1+R)d_S e_1$. In effect, short-term creditors acquire effective "senior" status by being able to negotiate their contractual debt payment after observing the parameters of the government's decision problem. Thus, the payments that the government can make on its long-term debt amount to the excess of its primary surplus over its short-term debt service — i.e., $t^*y_1 - g_1 - (1+R)d_S e_1$. To the extent that this amount falls short of its contractual long-term debt service obligations $R_L d_L e_1$, the government at least partially defaults on its long-term debt.

How much short-term debt can the government roll over at the end of period zero under these circumstances? Note first that if the optimal tax rate implies that the government will run a primary budget deficit in period 1, there will be insufficient resources available to pay any portion of the debt service due on either short- or long-term debt in that period. Thus, the government defaults completely, and consequently it will be unable to roll over short-term debt at the end of period zero. This means that if a is sufficiently small and the costs of default are therefore low enough, there is no equilibrium in period 1 with positive values of short-term debt. At the end of period zero, investors will simply not continue to hold the government's debt, because they know that if they do so they will not be repaid. Under discretion, therefore, a positive level of short-term debt can be supported in period 1 only if default is sufficiently painful for the government.[6]

Alternatively, if the optimal tax rate allows the government to run a primary surplus in period 1, then a perfect foresight equilibrium with positive short-term debt exists. In this equilibrium, the government's debt may or may not be serviced fully. The amount of debt that the equilibrium can support depends on the size of the primary surplus and the contractual debt payments due on long-term debt, as well as on the risk-free interest rate and the exchange rate. Suppose that we define:

$$d_S^* = \frac{(t^* y_1 - g_1) - R_L d_L e_1}{(1 + R) e_1}, \tag{10a}$$

and:

$$d_S^{**} = \frac{t^* y_1 - g_1}{(1 + R) e_1} = d_S^* + \frac{R_L d_L}{(1 + R)} \tag{10b}$$

Then, as can be verified from (9), for values of d_S such that $d_S \leq d_S^*$, we must have $\theta = 0$. That is, for small enough levels of short-term debt, the government will be able to service its debt fully, and will thus be able to borrow short-term at the risk-free interest rate. On the other hand, if $d_S^* < d_S < d_S^{**}$, equation (9) implies that the government will partially default on its debt (i.e., $0 < \theta^* < 1$). In this case, it can still roll over its short-term debt, but at interest rates that increase with the amount of short-term debt to be renewed. The maximum amount that the government can renew, however, is d_S^{**}. Beyond this point, it is impossible for short-term creditors to set an interest rate on their claims on the government that would yield them a market return, given the resources expected to be at the government's disposal, so they are unwilling to roll over their loans to the government for another period.

The resulting supply curve for short-term debt is illustrated in the form of the dashed curve in Figure 1. As long as $d_S < d_S^*$, the government can renew its short-term debt at the risk-free interest rate R. For values of d_S that exceed d_S^*, θ becomes positive and the government can renew its short-term borrowing, but only by paying the higher interest rate $R_S = (1 + R)/(1 - \theta) - 1$. If d_S exceeds d_S^{**}, however, creditors will be unwilling to renew their loans at any contractual interest rate.

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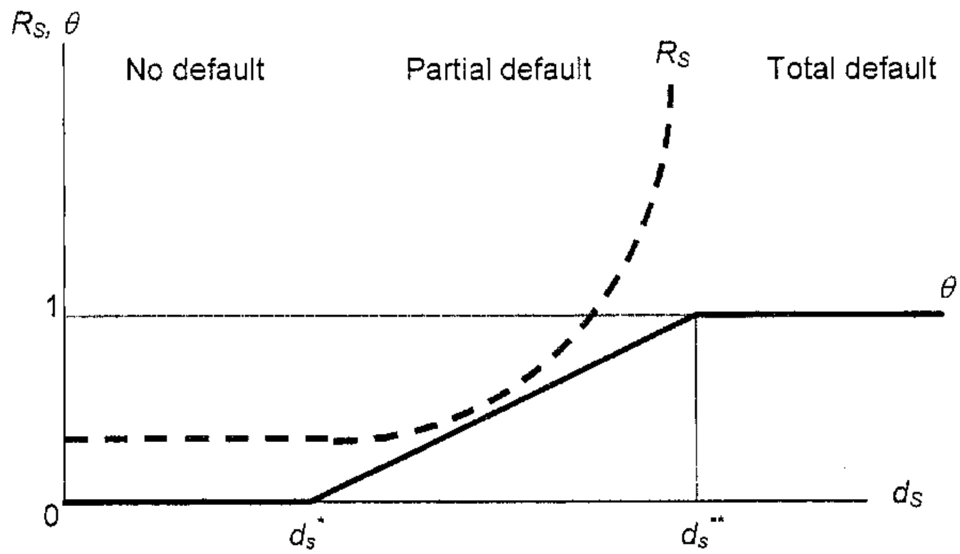
[6] In the no-borrowing case discussed previously, an interior solution for the tax rate is ruled out by the government's budget constraint. Thus, equation (7) fails to hold, and the tax rate must be equal to $t^{**} = g_1 / y_1$.

Figure 1. Short-Term Debt Supply Curve



IV. Exchange Rate Policy

An interesting property of the critical values d_S^* and d_S^{**} of the last section is that, as can be verified from equations (10a) and (10b), they both depend on the level of the exchange rate.[7] This raises the question of the role of exchange rate policy in influencing the government's default decision, and thus its ability to sustain its short-term borrowing. We consider that issue in this section.

We are interested in identifying the effects of exchange rate changes on the credit supply curve depicted in Figure 1. To address this issue, we can simply differentiate d_S^* with respect to e_1. Recall that d_S^* is given by:

$$d_S^* = \frac{t^* y_1 - g_1 - R_L\, d_L\, e_1}{(1 + R)\, e_1}.$$

Using equation (3), this becomes:

[7] Specifically, d_S^* depends on the exchange rate, but the *difference* between d_S^* and d_S^{**} does not.

$$d_S^* = \frac{t^*[y^* - \alpha/2(e^* - e_1)^2] - g_1 - R_L d_L e_L}{(1 + R) e_1}$$

$$= \frac{t^*[y^* - \alpha/2(e^* - e_1)^2] - g_1}{(1 + R) e_1} - \frac{R_L d_L}{(1 + R)}$$

Differentiating this expression with respect to e_1, we have:

$$dd_S^*/d e_1 = \frac{t^* \alpha(e^* - e_1)}{(1 + R) e_1} - \frac{t^* y_1 - g_1}{(1 + R) e_1}$$

$$= (1/e_1)\left\{\frac{t^* \alpha(e^* - e_1)}{(1 + R)} - d_S^{**}\right\}$$

Thus, an exchange rate depreciation has two effects on d_S^*, shown on the right-hand side of the first line above. On the one hand, a change in the exchange rate affects the period-1 value of exchange rate misalignment, and through this channel influences real output and real tax revenue. This effect is captured by the first term above. For example, if the currency is initially overvalued ($e^* > e_1$), an exchange rate depreciation increases real output, which increases government revenues and thus makes it possible for the government to sustain a larger burden of short-term debt, causing d_S^* to increase. If it is undervalued, on the other hand, a depreciation would aggravate the extent of misalignment, thus reducing real output and tax revenues, thereby *reducing* the volume of short-term debt that the government's fiscal resources can support. At the same time, a depreciation reduces the foreign-currency value of the government's primary surplus. This unambiguously *decreases* the amount of foreign currency-denominated debt that the primary surplus can support. This effect is larger the larger the initial value of the primary surplus, and thus the larger the initial maximum value of short-term debt that the government can support, given by d_S^{**}. This effect is captured by the second term.

As the second line shows, the key factors in determining the net result of these two effects are the sign and magnitude of real exchange rate misalignment $(e^* - e_1)$, the sensitivity of real output to such misalignment (α), and the magnitude of the government's initial capacity to service debt. If the extent of overvaluation of the currency is not very large, and/or the effects of misalignment on real output are not very significant — specifically, if $\alpha(e^* - e_1) < d^{**}(1 + R)/t^*$, then an exchange rate depreciation will reduce both d_S^* and d_S^{**}. In that case, the loan supply curve of Figure 1 will shift to the left. If this condition is reversed, on the other hand, the curve will shift to the right.

The application of the results of this section to the Argentine case is straightforward. Prior to the ultimate collapse of the Argentine currency board, Argentina had been forced to pay high premiums to renew its short-term government debt. These high premiums apparently did not reflect currency risk, but rather default risk. Our model suggests that default risk may have emerged in the Argentine case precisely *because* the currency board made the exchange rate peg credible, at least in the short run. The Argentine case can be interpreted as one in which the loan supply curve was displaced sharply to the left by a severe pre-existing overvaluation of the currency. The combination of cumulative inflation since the adoption of the currency board in 1991, the appreciation of the U.S. dollar in the second half of the 1990s, the effect of the Asian financial crisis on world commodity prices, and the depreciation of the Brazilian currency that was associated with the currency crisis in that country at the beginning of 1999, may all have contributed to a substantial overvaluation of the Argentine peso — i.e., a very high value of $(e^* - e_1)$. The depressing effects of this overvaluation on economic activity and tax revenue in Argentina, combined with the commitment to the exchange rate peg, implied that $d_S{}^*$ and $d_S{}^{**}$ were relatively low for Argentina, implying the possibility of a default even without an exceptionally large short-term debt-service burden. Thus, default became a possibility in Argentina precisely because devaluation was not.

But why should creditors take the government's tax effort as given under these circumstances? Could they not expect the government to make a larger fiscal effort in this case? The answer is no, because as can be verified from equation (7), the government's optimal tax rate in period 1 is not a function of the degree of exchange rate overvaluation. The optimal tax rate that yields the probable default scenario already takes into account the social costs of default. The government therefore cannot precommit to applying the tax rate that would be required to yield a sufficiently large volume of resources in period 1 to service its debt fully. Because the government always has the incentive to levy the tax rate implied by (7) and default on the excess of its debt service obligations over its primary surplus, it would not be rational for its creditors to expect it to levy a tax rate other than t^*.

This leaves another question, however. Just as is the tax rate, the exchange rate is a policy instrument that can at least potentially be chosen by the government. In the absence of the very large costs of exchange rate adjustment that we have assumed in this section, would it ever be optimal for the government to choose a value for e_1 that places its short-term debt in the partial-default range to the right of d* or in the full default range above d^{**}? The next section takes up that question.

V. Debt Sustainability Under Optimal Exchange Rate Policy

We have seen that there exist circumstances under which, if creditors expect more depreciated values of the future exchange rate, they would demand a higher risk premium from the government or refuse to roll over their short-term debt. The question now is: is it ever rational for the government to implement an exchange rate that would induce its creditors to behave in this way? In particular, can it ever be optimal for the government to choose a level of the exchange rate that would be likely to result in partial or complete debt default? If the answer is yes, then devaluation-cum-debt crisis can be a rational equilibrium outcome.

A. Optimal Exchange Rate Policy

Suppose, then, that the government simultaneously chooses the exchange rate, tax rate, and default rate on debt. That is, it chooses t^*, e_1, and θ so as to maximize:

$$c_1 = (1 - t - z(t))(y^* - \alpha/2(e^* - e_1)^2) - a\theta De_1 - \psi/2(e_1 - e_0)^2, \tag{11}$$

subject to its budget constraint (6). Since the effects of changes in the tax rate on (11) are not a function of the exchange rate, the solution for t^* remains unchanged and continues to be given implicitly by equation (7). The first-order condition for the optimal value of the exchange rate is given by:

$$e_1 = e^* - \frac{aD + \psi(e^* - e_0)}{\alpha(1 - t^* - z(t^*) + at^*) + \psi}. \tag{12}$$

This equation establishes an optimal degree of real exchange rate misalignment. In setting the optimal exchange rate, the government does not necessarily seek to eliminate misalignment. It is indeed induced to prevent misalignment by the output costs associated with it and the associated loss in consumption (given by $\alpha(1 - t^* - z(t^*) + at^*)$). However, it is prevented from eliminating misalignment entirely by two factors:

(a) The first is precisely the effect of exchange rate depreciation on the size of its default and the associated utility cost of a nonzero default. This factor induces the government to maintain an overvalued currency (note that this effect goes away if $a = 0$); and

(b) In addition, however, the assumed marginal utility cost of exchange rate adjustments acts to prevent the government from making large exchange rate changes. If the currency is initially overvalued $(e^* > e_0)$, this reinforces the tendency to overvaluation, while if it is undervalued $(e^* < e_0)$, it acts to offset that tendency. Note that as $\psi \rightarrow \infty$, we have $e_1 = e_0$, which was the case analyzed in the previous section.

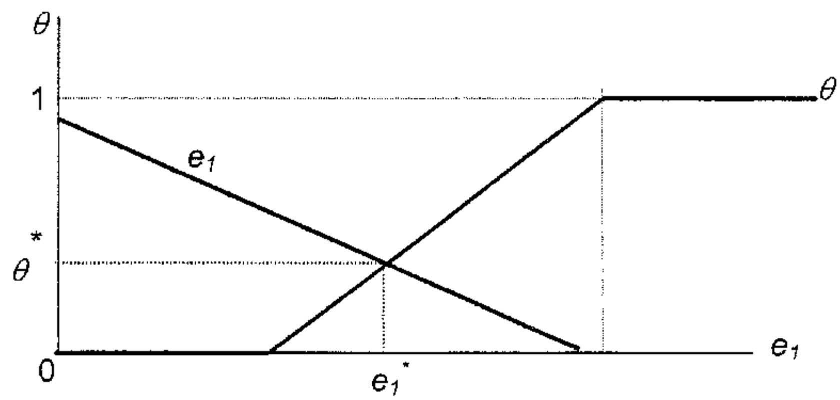
B. Perfect Foresight Equilibrium

To solve for the equilibrium in this case, we use equation (9) as before, together with the optimal exchange rate policy (12) and the rational expectations condition (1). From equation (9), we can derive the effects of exchange rate changes on the default ratio. Differentiating (9) with respect to e_1, this effect is given by:

$$d\theta/de_1 = \frac{t^*y_1 - g_1}{R_L\, d_L\, e_0^2} - \frac{t^*\alpha(e^* - e_0)}{R_L\, d_L\, e_0} \tag{13}$$

A depreciation of the exchange rate is likely to increase the default ratio (i.e., this effect is likely to be positive) the larger the initial primary surplus and the smaller the initial degree of real exchange rate overvaluation. In this case, there is little to be gained from depreciating the exchange rate because the costs of servicing debt increase in proportion to the depreciation. However, if the initial degree of real exchange rate overvaluation is important and the output response to change in the real exchange rate is sufficiently large, a depreciation yields sufficient gains to reduce the default ratio. In Figure 2, equation (9) is drawn with a positive slope over the range $0 < \theta < 1$.

Figure 2. Optimal Exchange Rate and Default Ratio



Substituting (1) into (12) and differentiating with respect to θ, on the other hand, we can determine how the optimal exchange rate policy is affected by the expected default ratio:

$$de_1/d\theta = -\frac{a(R+1)d_S/\Delta}{(1-\theta)^2} < 0, \tag{14}$$

where $\Delta = a[1 - t^* - z(t^*) + at^*] + \psi > 0$. An increase in the expected probability of default increases the interest rate that short-term creditors demand, and this increase in the government's debt-service obligations discourages it from devaluing the exchange rate. The curve depicting the optimal exchange rate policy as a function of the default rate is labeled e_1 in Figure 2, and is shown with a negative slope. The optimal values of the exchange rate and default rate are found at the intersection of the θ and e_1 curves, and are labeled θ^* and e_1^* in Figure 2.

As drawn in Figure 2, the optimal default ratio is positive, but less than unity. Under this scenario, the government would remain able to roll over short-term debt, but at punitive interest rates that factor in the expected default. It is easy to see, however, that this outcome need not hold, and that there are alternative circumstances under which perfect foresight equilibria would entail full debt service or an anticipated default and a consequent inability by the government to roll over its short-term debt.

Now consider the effects on such equilibria of changes in the penalty associated with altering the exchange rate, ψ. From equation (12), the effect of a change in ψ on the optimal exchange rate is given by:

$$de_1/d\psi = \Delta^{-2} (e^* - e_0) \{\frac{aD}{e^* - e_0} - \alpha(1 - t^* - z(t^*) + at^*)\}. \tag{15}$$

This expression must be negative if the real exchange rate is sufficiently overvalued initially (i.e., if $e^* - e_0$ is sufficiently large). In that case, an increase in ψ would tend to discourage the government from reducing the magnitude of the deviation between the optimal exchange rate and the exchange rate that prevailed in period zero by depreciating the currency in period 1. Now suppose that, starting from an initial position such as that in Figure 2 and from a sufficiently large initial overvaluation of the currency, the costs of making exchange rate adjustments were to decrease (say because a new political administration is not held to the exchange rate commitments made by a previous administration). For a given value of θ, if initially $(e^* - e_0)$ is sufficiently large, a reduction in ψ would be associated with a more depreciated value of e_1. That is, the e_1 locus in Figure 2 shifts vertically upward. Since the change in ψ has no effect on the θ locus, the devaluation would have the effect of increasing the default ratio, possibly to the point where the ratio equals unity. Anticipating a default under these circumstances, short-term creditors would refuse to roll over their claims.

The application of such an exercise to the Mexican case is obvious. In anticipating the effects of a devaluation of the Mexican peso, the key consideration for the government's short-term creditors in deciding whether and on what terms to roll over their claims would have been to determine by how much the devaluation would have increased real economic activity — and thus boosted tax revenues — in Mexico in the short run, given the fiscal effort that the Mexican authorities could have been expected to make (in the form of the optimal tax rate t^*). If the market determined that this effect was not likely to be very large (perhaps because the currency was not severely misaligned in the first place, or because misalignment had a relatively minor effect on real output), then the devaluation of the currency would have worsened the government's fiscal position in the short run. Under these circumstances, creditors would rationally have responded to the anticipated devaluation by renewing their loans at a higher premium in the expectation of a partial default or by refusing to roll over their loans at any interest rate, if their expectation was for a full default. However, the devaluation would nonetheless have been perceived as welfare-enhancing on the part of the government and thus would have been enacted despite its implications of default. From equation (15), the conditions that make such an outcome more likely, in addition to large initial overvaluation, are low perceived costs of default and large perceived benefits of eliminating misalignment.

C. Multiple Equilibria

As argued in the last section, it is possible that for a highly overvalued exchange rate, the default rate is high or even unity. We saw from equation (13) that if the primary surplus is sufficiently small and the response of output to a depreciation sufficiently high, the default rate would tend to be decreasing with e_1. However, even in this case, past some critical value of e_0, the optimal default rate may begin to *increase* with a continued depreciation. If this is so, the situation we have analyzed may be characterized by multiple equilibria.

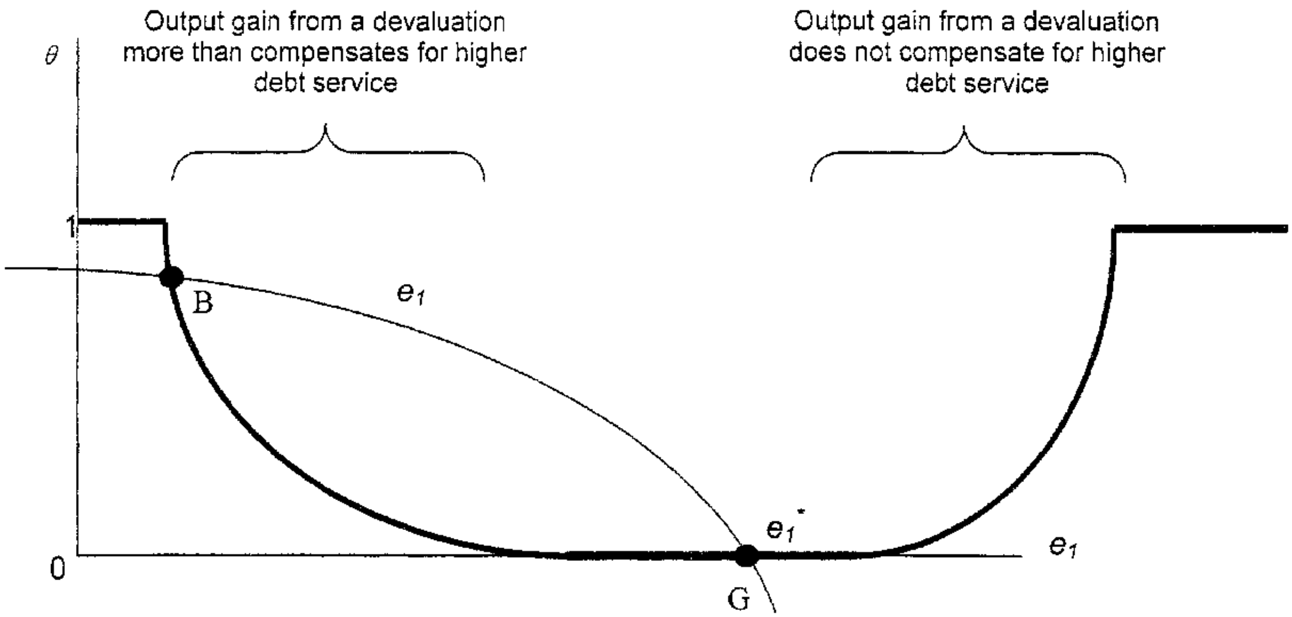
The critical value of e_0 is found by setting (13) equal to zero and solving for e_0. We can then determine the values of the parameters for which multiplicity of equilibria can arise. The critical value, if it exists, is given by:

$$e^{CR} = e^{*} - (t^{*} y^{*} - g_1) / (\alpha\, t^{*} e^{*})$$

If this expression is negative, e^{CR} does not exist. We can see this as a condition on the parameter α. If $\alpha < (t^{*} y^{*} - g_1)/(t^{*} e^{*2})$, the economy's level of real output is not sufficiently responsive to real exchange rate misalignment to allow for the existence of multiple equilibria, and for such a country a devaluation implies a constant or higher default rate. This is the case presented in Figure 2.

However, if $\alpha \geq (t^{*} y^{*} - g_1)/(t^{*} e^{*2})$, then a positive value for e^{CR} exists. For any value of e_1 greater than e^{CR}, a devaluation implies a constant (if zero or unity) or higher default rate. For any value of e_1 smaller than e^{CR}, a devaluation implies a constant or *lower* default rate, as before. In this case, the optimal default response of the government is *declining* for sufficiently low values of e_1, and then increasing for higher values of e_1. In that case, given the exchange rate policy response, two equilibria exist, as shown in Figure 3. In one equilibrium (labeled B in the figure below), the real exchange rate is heavily appreciated and the default rate is high because tax revenues are low. In the other (labeled G), the real exchange rate is relatively depreciated, tax revenues are high, and the default rate is low. It is straightforward to make a welfare comparison of these two equilibria (based on equation 2). Welfare must be higher under the low-default equilibrium, because output is higher and the default rate is lower, permitting a higher level of private consumption.

Figure 3. Multiple Equilibria



It is worth making several observations about this possible multiple-equilibrium outcome. First, multiple equilibria can arise only in countries with a relatively high output response to real exchange rate misalignment. Countries whose exports are based on a small set of primary commodities probably do not fit that pattern. However, middle-income emerging economies that have oriented their development towards the export market, such as Mexico and Argentina, may well do so. Second, if for any reason investors' expectations settle on a high default rate, an optimizing government's response can only validate those beliefs, implying that the economy will end up in the *bad* equilibrium (point B). As we have noted, in that equilibrium the default rate is high, the exchange rate is highly overvalued (this is a response to the higher costs of debt service), and output is low. On the other hand, if investor expectations settle on a low default rate (or no default), the economy ends up in the good equilibrium. Interest rates on new short-term debt are lower, and so is the default rate. The exchange rate exhibits less real appreciation and output is higher than in the bad equilibrium. The government has no means of selecting between these outcomes and the economy's equilibrium ends up determined by investors' beliefs.

However, the government may be able to avoid the bad equilibrium through its choice of exchange rate regime. Specifically, if the country adopts a hard peg, the exchange rate response curve becomes vertical and there is only one equilibrium. If the government chooses the value of the exchange rate correctly, it can avoid the bad equilibrium, and place the economy at the good equilibrium G.

Thus, the existence of multiple equilibria highlights the risks and dilemmas a highly indebted open-economy faces. On the one hand, an open economy characterized by a high elasticity of output to the real exchange rate can effectively use the exchange rate as an instrument to promote export-oriented growth. On the other hand, exchange rate flexibility makes the economy more dependent on investors' expectations. In this case, it is possible to end up in a bad equilibrium characterized by a debt crisis, a real exchange appreciation, and a recession. That outcome can be avoided by the choice of a hard peg (currency board or monetary union). In this case, only one equilibrium exists and it is fully determined by the choice of the parity. A hard peg anchors investors' expectations to the good equilibrium. However, there are risks associated with such a strategy. First, the parity must be *right*, that is, in the non-default zone (see figure 3). If the peg is set at an overvalued or undervalued level, default occurs. Second, because of the rigidity of the hard peg, external shocks can move the country from a no-default zone to a default zone. In this case, the inability to make exchange rate adjustments when they are required increases the likelihood of a debt crisis.

VI. Summary and Conclusions

We have developed a model that is able to capture the links between exchange rate policy and debt default. Existing empirical work acknowledges that this link is strong. However, the interactions between exchange rate policy and debt repayment have not been investigated analytically. Our model allows us to determine what types of equilibria can be expected and why. For instance, on the one hand, we show that it can be optimal for a government to implement an exchange rate change likely to result in a debt crisis. On the other hand, in certain circumstances, the *absence* of an exchange rate option can put the government in a no-devaluation and default equilibrium, even with a low level of short-term debt. This outcome is most likely if the country experiences a serious exchange rate misalignment associated with a weak fiscal position.

The exchange rate that creditors expect to prevail in the future will, in general, affect the supply of credit to the government, but the direction of this effect depends on the economy's circumstances. On the one hand, an outcome such as Mexico's, in which a devaluation of the exchange rate appears to have triggered a debt crisis, is the expected outcome of this model when the government is running a relatively large primary surplus, but the initial level of short-term debt is close to the maximum that the economy can support, and when devaluation is not likely to have very large positive effects on government revenues, either because the exchange rate is not far from equilibrium or because the economy's real output is not greatly affected by exchange rate misalignment. On the other hand, a heavily appreciated real exchange rate such as that of Argentina is likely to result in a very large premium in external borrowing (a loan-supply curve sharply shifted to the left in Figure 1) when the government's primary surplus is small and exchange rate misalignment is very costly in terms of foregone real output and government revenues.

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