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The Basic Macroeconomics of Debt Swaps

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ABSTRACT

In any external debt swap, a country must surrender an asset in return for having a liability extinguished. Typically, the external liability is the government's, while the domestic assets available for swapping belong to the private sector. Hence, the government must gain control of these privately owned resources--whether by taxing them away, or purchasing them with money or bonds. This crucial aspect of debt conversion operations has so far been neglected in the literature.

Each one of these types of debt swap financing will have different macroeconomic effects. Under a dual exchange rate system, money-only swaps can lead to a depreciation of the parallel exchange rate and a temporary current account deficit. The effect of bond-financed swaps, on the other hand, will depend on the size of the secondary market discount and the differential between foreign and domestic real interest rates. For realistic parameter values, we show that debt-financed swaps can be a fiscally expensive proposition, increasing the total interest burden of the public sector. If the public expects that the growing stock of domestic debt will eventually be monetized, the domestic inflation rate will immediately begin to rise.

Hence, the simple model used lends some theoretical backing to commonly voiced fears concerning the macroeconomic effects of debt swaps.

I. Introduction

The practice of using debt-equity swaps or debt-debt swaps to reduce the debt overhang of developing countries has given rise to an active controversy. Academic economists have contributed to the debate by analyzing the welfare characteristics of such swaps, their potential for reducing net capital outflows, and the degree to which they can reduce the negative incentive effects of a debt overhang. Attention has also been focused on the determination of secondary market prices for debt, and the effects that swaps can have on these prices. See, for instance, the work by Helpman (1988 and 1989), Ffrench-Davis (1987), Krugman (1988a and b), Bulow and Rogoff (1988a and b) and Rodriguez (1989).

By contrast, policy-makers in developing countries have tended to evaluate the desirability of these schemes on the bases of their short-term consequences. This is not an indication of short-sightedness, but simply a confirmation that the debt crisis of the 1980s has placed countries in a vulnerable situation where day-to-day concerns about prices and exchange rates take on paramount importance. Newspapers report that countries consider suspending debt-conversion programs because they can be inflationary, because they put excessive pressure on the free market for foreign exchange, or because replacing foreign debt with domestic debt can be expensive.[1] The existing literature offers little systematic analysis of these potential evils or guidance for avoiding them. Partial exceptions are Alexander (1987a and b) and Morandé and Schmidt-Hebbel (1988).

This paper departs from the existing literature in one fundamental respect. In any debt swap the country must surrender an asset in return for having a liability extinguished. What this asset is and who it belongs to matters very much. Consider the case of a debt equity swap in which external government debt is exchanged by a claim on the capital stock owned by the domestic private sector. For this transaction to be carried out, the government must somehow gain control of these privately owned resources --whether by taxing them away, or purchasing them with money or bonds.[2]

The literature thus far has side-stepped this issue by assuming that the home country is one consolidated unit (i.e. there is no private-public distinction) or that the government can freely tax away as large a portion of the private sector's assets (or the income flow they generate) as it

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[1] Mexico and Brazil have recently suspended debt conversion programs, mentioning such reasons.

[2] Of course, confiscation, taxation and bond-finance may be hard to distinguish ina fully Ricardian world.

desires.[3] By contrast, we realistically assume that all debt being retired is public while the internationally tradable assets being given away are private, and focus on the implications of different mechanisms for financing the necessary domestic transefer of resources to the government. As a result, swaps involve choices about monetary and fiscal policy, and these choices can have an array of macroeconomic effects. Indeed, several of the perverse effects feared by policy makers are shown to be plausible: in certain circumstances swaps can induce current account deficits, a depreciation of the paralell exchange rate, increasing domestic budget deficits, or inflation.

The analysis is conducted in the starkest possible setup. We consider an endowment economy where income is fixed, in order to focus on the asset and wealth effects that are central to the problem. For the sake of realism, the economy is assumed to function under dual exchange rates and no private capital mobility. Expectations are rational, and anticipations of future policies play a central role.

Section II begins by modelling a situation in which the official exchange rate (used for commercial transactions) crawls in a predetermined fashion, while the parallel (financial) exchange rate floats freely. In Section III we use this model to analyze the implications of bond versus money financing of a government repurchase of official debt. As long as domestic spending adjusts to keep the budget in balance, debt-financed swaps have real effects only insofar as the discount captured by the country as a whole provides it with a positive wealth effect, increasing consumption and creating a current account surplus in the transition to a new steady state. Money-financed swaps, on the other hand, can provoke excess liquidity and a depreciation of the paralell exchange rate. Simple numerical calculations are provided in order to assess the likelihood that this much-feared outcome will occur.

Section IV alters the model to develop a focus on budgetary and inflationary factors. There the official rate is also assumed to float, and accumulation of domestic government debt is permitted. This latter point is crucial, for certain countries (especially Chile) have so far managed to avoid unwanted monetary effects of debt swaps by relying on repeated domestic bond issues to finance these operations. Nonetheless, there are two possible problems. First, if domestic real interest rates exceed world rates such swaps can be a fiscally expensive proposition. Second, there are limits to how much home debt can be issued. If swaps lead to sustained domestic bond accumulation, expectations of how the government will put an end to this process become crucial. We show, among other things, that if

3 The latter assumption is employed by Helpman (1988 and 1989).

agents perceive that the debt will eventually be monetized, inflation will begin to rise as soon as the initial swap is carried out. Once again, numerical examples are provided to assess the plausibility of alternative outcomes. Finally, section V offers a summary and conclusions.

II. The Basic Model

In this section the budget is assumed to be continuously balanced, abstracting initially from fiscal considerations. As already stated, the commercial exchange rate is predetermined. We use this model to analyze the implications of bond versus money financing of a government repurchase of official debt.

An infinitely-lived representative individual, endowed with perfect foresight, maximizes an additively separable utility function

$$\int_0^{\infty} [u(c)+v(m)]\ e^{-\delta t}\, dt, \qquad \delta>0 \tag{1}$$

where c denotes consumption and m=(M/E) real money balances, δ is the subjective rate of discount, and u() and v() possess the usual properties.[4] The economy is small and open, and the one perishable consumption good is perfectly tradable. If we assume for notational simplicity that international prices are constant,[5] the commercial nominal exchange rate E becomes equivalent (via purchasing power parity) to the domestic price level, and we can define

$$\pi = \dot{E}/E = \text{inflation rate} = \text{devaluation rate} > 0 \tag{2}$$

In this section the commercial exchange rate is a policy variable. It is fixed at each instant of time, but allowed to depreciate at a constant rate π. Under the assumed purchasing power parity, this is equivalent to setting a rate of inflation also equal to π. As a result, m becomes a predetermined variable as well, and real balances can only be deccumulated or accumulated through a balance of payments deficit or surplus.

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4 That is to say, $u'>0$, $u''<0$, $v'>0$ and $v''<0$, plus the usual limit conditions.

5 We also normalize the international price level to equal one.

Private agents can store their wealth in three domestic assets: money, indexed government bonds (b) and a fixed amount of real capital (k_o). Since we assume no international capital mobility, these assets are held by domestic residents only. A unit of capital, whose real price is denoted by q, yields a fixed flow of ρ units of the consumption good per unit time. Finally, domestic residents also own a fixed stock of international bonds (f_o), which, for simplicity, is assumed to yield ρ units of consumption per unit time.[6] If we further assume that real capital and international bonds are perfect substitutes, it follows that the real price of these bonds is also q, which can therefore be also interpreted as the "parallel" or financial exchange rate.[7] And by arbitrage between international and domestic bonds, it must be true that

$$r = (\rho + \dot{q})/q \tag{3}$$

where r is the yield on government bonds, which can be interpreted as the domestic (endogenous) real rate of interest.

If $a = b + m + q(f_o + k_o)$ are total assets held by the public, we have

$$\dot{a} = \dot{m} + \dot{b} + \dot{q}(f_o+k_o) \tag{4}$$

Total individual savings, on the other hand, given that income is exogenous and equal to y per unit time, are given by

$$(\dot{M}/E) + \dot{b} = y + rb + \rho(f_o+k_o) + g - c \tag{5}$$

where g denotes real government transfers (net of taxes: g can be negative), taken as given by the private agents. By (4) and (5), the flow budget constraint of the representative individual is therefore

$$\dot{b} + \dot{m} = y + r(b+m) + \rho(f_o+k_o) - (r+\pi)m + g - c \tag{6}$$

Maximization of (1) with respect to b, m and c, subject to (6), yields[8]

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[6] This assumption only simplifies the algebra. It would be straightforward to analyze the case where the fixed yields differ for the two assets. Their prices would differ as well, but the arbitrage equations would still hold.

[7] In the sense that it is the relative price of foreign bonds in terms of the consumption good. It is not (at least directly) the relative price of domestic and foreign monies --the more common definition of the paralell exchange rate.

[8] We must also impose the usual solvency constraint, which can be written as

$$v'(m) = u'(c)(r+\pi) \tag{7}$$

It is easy to show that optimality also requires that[9]

$$\dot{c} = -[u'(c)/u''(c)][r-\delta] \tag{8}$$

which also can be written as

$$\dot{c} = -[u'(c)/u''(c)] \left[\frac{v'(m)}{u'(c)} - \pi - \delta\right] \tag{9}$$

Finally, combining (3) and (7) we have

$$\dot{q} = q\left[\pi - \frac{v'(m)}{u'(c)}\right] - \rho \tag{10}$$

Equations (6) through (10) completely describe private behavior. The government, on the other hand, uses domestic credit creation and lump-sum taxes to finance real government transfers to the private sector and required debt service. Its flow budget constraint is therefore[10]

$$\dot{b} + (\dot{D/E}) = rb + r^*d_o + g \tag{11}$$

where D is the stock of nominal domestic credit, d_o is the stock of foreign debt and r^* the international interest rate.[11] We assume that the government chooses between these two possible sources of financing by employing a simple rule: $(\dot{D/E})=\pi m$. That is to say, the government issues domestic credit only to compensate the public for the erosion of real money balances caused by inflation. Under this assumption we can write:

$$\dot{b} = rb + r^*d_o + g - \pi m \tag{12}$$

$\lim_{t \to \infty} (a)e^{-rt} \geq 0$

9 See for instance Calvo (1981).

10 Notice that, for simplicity, international reserves are assumed not to pay interest.

11 Of course, one of the crucial features with no capital mobility such as this one is that the domestic real rate of interest is in general different from the world rate.

In order to abstract from fiscal considerations, which take center stage later in the paper, in this section we also assume that g adjusts continuously to ensure that $\dot{b}=0$. Notice that this implies that the government has the power to tax in order to finance debt retirement. We therefore have

$$rb_0 + r^*d_0 + g = \pi m \tag{13}$$

Substituting this expression into (6) we obtain

$$\dot{m} = y + \rho(f_0+k_0) - r^*d_0 - c \tag{14}$$

that is to say, the economy can only accumulate real balances if it runs a current account surplus. Terms containing b and g "wash out" since they involve transactions among domestic residents only.

Expressions (9), (10) and (12) constitute a system of three differential equations in m, c and q, analogous to that developed by Obstfeld (1981). Appendix 1 proves that the system is saddle-path stable. The analysis can be conducted in terms of a simple phase diagram in c,m space, because equations (9) and (12) do not depend on q. In turn, equations (15c) and (15d) provide the $\dot{c}=0$ and $\dot{m}=0$ schedules, as they appear in Figure 1. The upward-sloping saddle path reflects the fact that m and c move together along a perfect-foresight equilibrium path.

In steady state, the economy is characterized by the following equilibrium conditions:

$$r = \delta \tag{15a}$$

$$\bar{q} = \rho/\delta \tag{15b}$$

$$v'(\bar{m}) = u'(\bar{c})(\delta + \pi) \tag{15c}$$

$$\bar{c} = y + \rho(f_0+k_0) - r^*d_0 \tag{15d}$$

Notice that while steady state equilibrium requires that the domestic rate of interest converge to the rate of discount, there are no forces that ensure equalization of world and domestic real interest rates. Since the domestically held stock of foreign assets (f_0) is fixed, there is no arbitrage. If the country is effectively rationed out of international capital markets -- the most relevant case for highly-indebted Latin American economies--

then the domestic real rate of interest (r) will normally exceed the world rate (r*). This is indeed what we assume in what follows, and this realistic assumption, confirmed by the data contained in Table 2, plays a crucial role in the analysis.

We will consider cases in which the country's external debt trades at less than par value. Why do such discounts on debt occur? In a world of perfect foresight, a discount must reflect the expectation on the part of traders in the secondary market that at some point in the future the real value of a country's outstanding debt will be reduced --either because the country will default on some portion of its obligations or because some sort of negotiated "writedown" will have to be agreed upon. [12] Assume that at some initial time (t=0) both creditors and debtor come to expect a debt writedown, and that they all agree it will happen T periods later. At that time, a portion of the debt will simply be forgiven or defaulted upon. Clearly, if T=0, the writedown happens immediately.

Given that the country's external debt yields r* per unit time, and that this yield is equal to the international rate of interest, the international price of one unit of debt must have initially been equal to unity. That is no longer the case after the writedown is announced: for any time τ, such that $0 \leq \tau \leq T$, the price of one unit of debt must be below unity.[13] Let τ be the time at which a domestic agent repurchases some of this discounted external debt. Clearly, this repurchase can be anticipated or unanticipated by the domestic economy --it could be unanticipated if the government suddenly buys back its debt, or if without previous warning it authorized previously restricted domestic residents to buy debt abroad.[14]

The different values that T and τ can take on give rise to several possibilites, which are summarized in the following matrix:

[12] Equivalently, the interest rate could be reduced below market rates.

[13] This is formally shown in Appendix 2.

[14] In most Latin American countries an authorization from the Central Bank is required to buy official debt abroad or even to prepay private external debt.

		Writedown $T=0$	Writedown $T>0$
Repurchase	$\tau=0$	Writedown Unant. Repurchase Unant.	Writedown Ant. Repurchase Unant.
	$0<\tau\leq T$	Writedown Unant. Repurchase Ant.	Writedown Ant. Repurchase Ant.

In what follows we concentrate in the simplest possible case, contained in the NW cell of the matrix: both the writedown and the repurchase are unanticipated. Appendix 2 treats the NE case, in which the writedown is anticipated but the repurchase is not.[15]

III. The Importance of Bond Versus Money Financing

Consider first the simplest type of unanticipated swap, involving an exchange of the foreign bonds owned by the private sector for government external debt; that is to say, a repurchase of official debt with private resources. Algebraically, $\Delta f_o = (1-\alpha)\Delta d_o = (1-\alpha)\phi d_o$, where $0<\alpha<1$ is the discount --the larger α, the better off the country is.[16] Notice furthermore that ϕ, $0<\phi<1$ is the portion of the debt that is subject to a discount.[17] The second equality follows from the assumption that the country repurchases all of the available discounted debt.[18]

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15 Notice that the SE alternative only makes sense if we assume that agents are willing to repurchase debt even if no discount is expected.

16 Notice that in the swap the domestically held international bond is valued at its exogenous international price of q^*, normalized here for simplicity at unity. This implies, furthermore, that $r^*=\rho$ always.

17 It could be the case that $\phi<1$ if the government has external debt owed to official creditors, on which it will never default.

18 This means that we neglect the distinction between large and small swaps and between marginal and average debt, central to the analysis of Bulow and Rogoff (1988a and b). Moreover, for the swap to be feasible it must be the case that $f_o>d_o$.

In Figure 2, such a change shifts the $\dot{m}=0$ curve up by the distance

$$\Delta\bar{c} = r^*\alpha\Delta d_o > 0 \tag{16}$$

and leaves the $\dot{c}=0$ schedule unchanged. Since the discount increases the sustainable level of consumption, c jumps on impact and then continues to increase along with m (there is a current account surplus). From (10) and (15b) we know that q must also be increasing in the transition. Since its steady state level is unchanged, it follows that q must have jumped down initially: the news causes the parallel exchange rate to appreciate, and to remain above its "normal" level as long as the current account surplus lasts.[19] Recalling (3), it also follows that the domestic real rate of interest is above its long-run level in the transition.

These results follow from the fact that the swap considered constitutes a transfer from the rest of the world to the domestic economy. The same effects would occur if a) the private sector surrendered real capital in exchange for the debt; b) if there were private foreign debt outstanding and domestic residents repurchased it rather than the government's debt; or c) official reserves paid interest and the government used them to repurchase its own debt directly. In the absence of a discount ($\alpha=0$), on the other hand, no schedules in Figure 2 would shift, and all that would take place is a change in the composition of the country's net foreign assets.

In the real world, of course, things are more complicated. Domestic residents cannot (or do not wish to) hold goverment external debt in their portfolio. Therefore, the government will usually buy the debt from private agents and issue some other kind of asset (domestic bonds, money). Consider first the case in which the government "pays" with its own domestic bonds, so that simultaneously with the other swap we have $(1-\beta)\Delta d_o = -\Delta b_o$, where $0<\beta<1$ is the discount received from the private sector by the government.[20] Behavior coresponds to that already depicted in Figure 2. Such a swap affects the goverment budget constraint in two

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Notice also that that, as before, the domestically held international bond is valued at its exogenous international price of q*, normalized here for simplicity at unity.

19 Following common usage, we say that the parallel exchange rate "appreciates" when q falls. This also means, of course, that the stock market is depressed in the transition. Given the "newly acquired" resources that result from the discount, the price of already existing assets goes down.

20 Notice that the total discount received by the country is α. Of this, the government gets β and the domestic private sector gets $\alpha-\beta$.

ways. The discount received reduces the external interest overhang, but shifts the burden to more expensive domestic debt; at the same time, the instantaneous increase in domestic interest rates also worsens the government's budgetary position. But under the chosen assumption that the government automatically adjusts transfers or taxes,[21] this second swap does not add any additional effects on the schedules in Figure 2, regardless of the value of β.

In short, if the government retires its external debt by issuing domestic bonds, using the local private sector as intermediary, we find:[22]

a) There are no macroeconomic effects when the international discount is zero (α=0).

b) When there is a discount, the economy will display a current account surplus, accompanied by an initial appreciation of the parallel exchange rate, a bear market for stocks and higher real rates of interest. The dynamics are independent of the discount received by the goverment.

This analysis assumes that there is a well-developed domestic capital market in which the government can place its domestic bonds. That is not the case, of course, in many heavily indebted developing countries. Consider therefore what happens when the government chooses to finance its repurchase of debt using money, so that we have $(1-\beta)\Delta d_0 = -\Delta m_0$ simultaneously with the swap of external debt undertaken by the private sector. In other words, the government carries out an open market operation involving its own debt, and expanding the supply of money. How will the demand for money react to the swaps? From our earlier analysis we know that the discount given to the country affects the new steady state level of consumption and, *ceteris paribus*, the new steady state level of money holdings. By totally differentiating (13c) we obtain

$$\Delta\bar{m} = \sigma\,\Delta\bar{c} \qquad (17)$$

where $\sigma \equiv \dfrac{u''(\bar{c})}{u'(\bar{c})}\,\dfrac{v'(\bar{m})}{v''(\bar{m})}$ is the steady state elasticity of money with respect to consumption. Combining (16) and (17) we have

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21 This assumption does not seem farfetched in the case of many Latin American countries. In the presence of a fiscal gain, Chile might lower taxes while Brazil increases transfers, for instance. The effects of fiscal rigidities are central to the analysis in Section III.

22 Notice that this operation is also analogous to having the government repurchase debt with interest-paying reserves (absent from this model).

$$\Delta \bar{m}^{d} = \sigma r^{*} \alpha \Delta d_{0} \qquad (18)$$

where the superscript "d" stands for demand. On the other hand, we know that $\Delta m_0 = -(1-\beta)\Delta d_0$ is the initial increase in the supply of money. The dynamics of the system depend on whether one of these two quantities is larger than the other.

The two possible cases appear in Figures 3a and 3b. If the initial expansion in money supply falls short of the ultimate increase in the demand, then the transition of the system is analogous to the previous case, as shown in Figure 3a. The real quantity of money jumps on impact (recall prices are predetermined) and so does consumption, putting the system on the saddle path. The country must "accumulate money" by running a current account surplus. This means that consumption must undershoot its long-run level and gradually increase along with m thereafter. As before, this elicits a temporary fall in q and an increase in consumption and domestic real interest rates.

If, on the other hand, the initial supply expansion is greater than the long run demand increase, the reverse dynamics take place. Consumption must overshoot, giving rise to a current account deficit. Furthermore, the parallel exchange rate jumps up on impact (the local currency is devalued) and only returns gradually to its stationary level, leading domestic arbitrageurs to accept a temporary decline in domestic interest rates. This dynamic adjustment process appears in Figure 3b.

Using (18) we see that this second scenario will occur (that is to say, $\Delta m_0 > \Delta \bar{m}^{d}$) if and only if

$$-(1-\beta)\Delta d_0 > \sigma r^{*} \alpha \Delta d_0 \qquad (19)$$

which implies

$$\sigma r^{*} \alpha < (1-\beta) \qquad (20)$$

That is to say, a situation characterized by reserve losses and high foreign exchange prices is more likely to occur when:

a) σ is small, so that money demand is relatively inelastic and does not respond vigorously to the long-run increase in consumption and national income.

b) α and β are small, so that the discounts received by the country and the government, respectively, are small.

c) the real world rate of interest r^* is small, so that the net gain to the country from reducing its foreign debt is small as well.

Notice that, unlike the previous bond-swap example, the size of the discount captured by the government matters very much: a larger discount means a smaller monetary expansion, and a lower likelihood that this money financing will play a "destabilizing role."[23] Table 1 presents some plausible estimates of this "stability condition." The calculation employs observed interest rates and the discounts obtained by four highly-indebted countries, plus some reasonable values for the consumption-elasticity of money demand. Given these parameters, it is hard to avoid the conclusion that money-financed swaps will almost always be destabilizing in the sense of creating a temporary excess supply of money and a depreciation of the parallel exchange rate. The suggested results match the fears often expressed by the authorities of debtor countries.

IV. Fiscal Deficits and the Possibility of Inflation

The analysis presented so far has two principal limitations. First, the assumptions of a predetermined commercial exchange rate and strict purchasing power parity do not permit consideration of the short-run dynamics of inflation. Second, lump-sum taxes and transfers that adjust automatically to ensure budget balance assume away the problem of fiscal disequilibrium, central to any inflationary phenomenon. This section attempts to relax these restrictive assumptions.

We suppose now that the commercial exchange rate also floats, and that therefore (keeping purchasing power parity) domestic prices are perfectly flexible in both the long and short run. While such a scenario is obviously a simplification, it enables us to focus on the dynamics of inflation in a simple way. In a regime of perfectly floating exchange rates and no capital mobility the domestic stock of foreign assets cannot change, for the Central Bank will not and the private sector cannot sell foreign assets. Therefore the current account must always be balanced, implying $\bar{c} = y + \rho(f_o+k_o) - r^*d_o$ always. Since consumption is therefore constant, we know from (8) that the domestic net rate of interest must be equal to the rate of discount at all times. This also means, by (3), that the parallel exchange rate q will be unchanged as long as the yield on foreign bonds (ρ)

23 The phrase is in quotation marks because, technically speaking, the system is stable regardless of the magnitude of β.

does not change. The presence of a flexible commercial exchange rate takes the burden of adjustment away from the parallel exchange rate.

The other change in the structure of the model comes on the fiscal side. We now allow the government to borrow domestically to finance shortfalls --that is, b can increase or decrease as long as the government's intertemporal solvency condition is met. The government flow budget constraint becomes

$$\dot{b} = rb + r^*d_o + g - \mu m \tag{21}$$

where $\mu = \dot{M}/M$ is the rate of nominal monetary expansion, and g is now fixed. The individual budget constraint, on the other hand, is

$$\dot{m} + \dot{b} = y + rb + \rho(f_o+k_o) + g - c - \pi n_i \tag{5a}$$

Combining (5a) and (21), and recalling that the current account must now be continually balanced, we have

$$\dot{m} = m(\mu - \pi) \tag{22}$$

Finally, substituting an equilibrium version of (7) into (22) we obtain

$$\dot{m} = m[\mu - \frac{v'(m)}{u'(\bar{c})} - \delta] \tag{23}$$

A steady state obtains when

$$\mu = \pi \tag{24a}$$

$$\bar{q} = \rho/r = \rho/\delta \tag{24b}$$

$$v'(\bar{m}) = u'(\bar{c})(\delta + \pi) \tag{24c}$$

$$rb + r^*d_o + g = \mu m \tag{24d}$$

Equations (21) and (23) constitute a system of 2 differential equations in two unknowns, m and b, depicted in Figure 4. The $\dot{m}=0$

schedule depends only on m and is therefore perfectly horizontal, while the $\dot{b}=0$ schedule slopes up: in steady state, higher money holdings imply higher inflation tax revenues, meaning that the government can sustain a larger stock of bonds. The system is unstable, for both roots of the linear approximation are positive and only one variable (m) can jump. Nonetheless, we can use the system to study inflationary dynamics, as shown by Drazen (1984), Helpman and Drazen (1986) and Drazen and Helpman (1987).

Consider now the same two-step swap as before. First the domestic private sector exchanges its foreign assets for government external debt, so that $\Delta f_o = \Delta d_o$ (for simplicity, in this section we set $\alpha=0$, so that there is no external discount). At the same time, the government repurchases its external debt issuing domestic bonds: $(1-\beta)\Delta d_o = -\Delta b_o$. This operation has two consequences. First, it shifts the intercept of the $\dot{b}=0$ schedule down by $r^*\Delta d_o$. For any level of inflation revenue, the government can now sustain a higher stock of bonds in steady state. The $\dot{m}=0$ schedule, on the other hand, is unchanged. Second, it instantaneously expands the stock of bonds, moving the system horizontally and to the right along the $\dot{m}=0$ line. The new steady state of the system would be at $\bar{b}'$. If the bond issue is of exactly the right size to place the economy there, then the system will be locked into the new steady state instantaneously. But if it either undershoots or overshoots this point an unstable process will be generated, with bonds decumulating or accumulating without bound, respectively. Notice this interesting result: even though the government receives a discount that will presumably ease its budgetary situation, the initial swap can produce a destabilizing budget deficit. This is because domestic financing is expensive, given our assumption that the country is rationed out of international capital markets.

What occurs depends on the slope of the $\dot{b}=0$ schedule, as well as on the size of β. From (24d) it is easy to calculate that the steady state sustainable stock of bonds increases by $-(r^*/r)\Delta d_o$, while initially the supply of bonds is increased through the open market operation by $-(1-\beta)\Delta d_o$. Hence, the system overshoots its bond steady state level if and only if $(1-\beta)>(r^*/r)$. If the discount obtained by the government is not large to offset the interest differential (r^*/r) the government will find itself in a deficit after the swap, a fact that will compel it to begin issuing growing quantities of bonds.

Table 2 provides some realistic computations of this new "stability" condition.[24] Once again, measured (*ex post*) domestic and world real interest rates are used, in conjunction with average discounts obtained by the governments of four highly-indebted countries. The striking fact is the high level of real interest rates in all countries, particularly those that are attempting to reduce inflation, such as Argentina, Brazil and Mexico. Given the interest rate differential with the rest of the world, discounts obtained are not enough to make debt swaps a fiscally attractive proposition.[25] The only case where domestic real interest rates have been low relative to regional standards is Chile, but even there the "stability" condition fails to hold.[26] To some extent these exorbitantly high rates are probably a transitional phenomenon, associated with high and variable inflation and repeated (but failed) stabilization attempts.[27] If that is so, it may be prudent to conclude that --if at all-- swaps should only take place after the domestic monetary situation has been stabilized.

Consider the dynamic adjustment of only one case, that in which $\dot{b}>0$ initially. We assume, as is common in the literature, that there is an exogenously given upper bound to the quantitiy of real bonds that the public will willingly hold.[28] Therefore, if bonds begin accumulating agents will expect that at some point in the future a corrective measure will be

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24 Notice that an external discount ($\alpha<1$) would tend to move the $\dot{m}=0$ locus up for reasons discussed in Section II. A discount would raise national feasible consumption and, *ceteris paribus*, equilibrium real balances. Such an additional change would threfore make it less likely that the system will overshoot its steady state. Our computations in Table 2 may therefore overstate the possible dangers of swap operations.

25 Another argument against such swaps [see, for instance, Meyer and Bastos-Marquez (1988)] focuses on the maturity structure of domestic debt. In many of these countries government domestic borrowing is extremely short term (essentially overnight for the bulk of Brazilian debt) and subject to very volatile rates. In such a case a swap is tantamount to a sharp reduction in the average maturity of total outstanding government debt.

26 Furthermore, real domestic interest rates have risen in Chile in the first half of 1989.

27 For a discussion of why stabilization based on "exchange rate management" may help explain these high real rates, see Velasco (1988).

28 That assumption is equivalent to ignoring the results of McCallum (1984), who showed that the stock of domestic debt can tend to infinity without violating the government's solvency condition. That result will hold as long as all interest income received by the public can be taxed away in a lump-sum fashion. In reality, of course, there are perceived limits to such lump sum taxation and debt accumulation. If bonds seem to be growing without bound, the public will likely expect an attempt at stabilization in the future. This is the conjecture adopted in Sargent and Wallace's classic (1981) paper, and in Liviatan (1984) and Drazen (1984).

taken. This could involve lowering net transfers (g) or increasing the rate of money creation (μ). In turn, agents' perceptions about what measures will eventually be taken will affect the dynamic behavior of the system in the transition.[29]

Figure 4a depicts the case in which agents correctly anticipate that the fiscal imbalance will be corrected by cutting spending when bonds reach a threshold level b*. It is clear from (24) that changes in g affect the $\dot{b}=0$ locus but not the $\dot{m}=0$ locus. Therefore, the final equilibrium must be at the same initial level of real balances. Given the dynamics of the system, furthermore, if the system ever departs from the $\dot{m}=0$ it can never return to it. Therefore, to avoid this instability the economy moves horizontally until the time when b* is reached. At that point the authorities lower g as anticipated and lock the system into a steady state. Along the way inflation and real balances are unchanged, as are domestic interest rates and the parallel exchange rate.

The behavior of the system is very different if agents anticipate that increased money creation will eventually be used to stop the growth of domestic debt. Inspection of (24) reveals that a higher μ will shift the $\dot{m}=0$ schedule down. The $\dot{b}=0$ locus will move to the right in the "normal" case in which an increase in steady state inflation increases government revenue. This requires that the elasticity of money demand with respect to the inflation rate be smaller than one. In this "normal" case, the new intersection will be to the south east of the original one. Substituting (24a) and (24c) into (24d), and recalling the initial stock of foreign debt has been repurchased, we obtain

$$\delta b + g = [\frac{v'(m)}{u'(c)} - \delta]m \tag{25}$$

which shows the combinations of m and b that place the economy in a stationary state. The locus appears as MM in Figure 4b. Suppose the public correctly anticipates that the government will let bonds accumulate until they reach the level b*. At that point, it will increase μ as much as necessary to restore budget equilibrium. Foreseeing this, agents understand that the system must find itself on MM the moment money creation inceases, in order to ensure that the steady state is attained.

29 Such two-step policies have been recently analyzed by Helpman and Drazen (1986) and Drazen and Helpman (1987).

With the help of a few additional observations we can determine the path of the economy in the transition.[30] Notice that along a path in which $\dot{q}=0$ (as will be the case here), $\dot{a}=\dot{m}+\dot{b}$. Adding (21) and (22), and recalling $d_o=0$, we obtain

$$\dot{a} = rb + g - \pi m \tag{26}$$

Hence, MM also corresponds to the $\dot{a}=0$ schedule. Along any path above MM the quantity of real assets must be increasing, so that the slope of the path will be smaller than one in absolute value. The opposite holds for any path below MM, where total assets must be decreasing.

The dynamics of the system between the time of the swap and that of the change in monetary policy depend on the slope of the MM schedule, which equals the elasticity of money demand with respect to the nominal interest rate. If the interest elasticity of the demand for real balances is unity, then only a path that starts on MM itself can ensure convergence. In that case the system will jump down to MM and move along that schedule until the time when b=b*.

If the relevant elasticity is less than unity in absolute value, so that MM is flat, then the system must initially jump to a point such as c, above MM. It will then move along a trajectory whose slope is less than one but greater than that of MM in absolute value. The magnitude of the initial downward jump will be given by the need that the path cross MM through point e at the right time. Conversely, if the interest elasticity is greater than one (MM steep), the initial jump will take the economy all the way to a point such as d below MM, starting a southwesterly trajectory immediately thereafter.

In all cases real balances will decrease on impact, implying a step depreciation of the exchange rate. Inflation will also rise at the time of the swap, and will converge to its permanently higher level just as bonds reach their threshold b*. Real balances will be falling throughout. We conclude that if money is used to finance the budget deficit generated by the swap, there is good reason to believe the policy will have inflationary consequences.

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30 This analysis follows Drazen (1984).

V. Summary and Conclusions

This paper provides a simple framework in which to analyze the macroeconomic effects of debt swaps. The framework combines some formal elements of recent optimizing models in international finance with some realistic institutional features of the Latin American case. Four main conclusions emerge from our analysis.

First, the macroeconomic effects of swaps cannot be analyzed without specifying how the government will gain control of the domestic resources to be given to creditors in exchange for the debt. Typically the external debt being retired is public, while the domestic resources belong to the private sector. This important aspect of debt conversion schemes has, thus far, been ignored in the literature.

Second, the kind of domestic liability that the government employs to finance the swap matters very much. When the budget is continuously balanced, debt-for-bonds swaps have no impact beyond that of a private sector debt repurchase.[31] Debt-for-money swaps, on the other hand, can have significant effects: an initial excess supply of money --which is likely to happen, according to our numerical calculations-- will depreciate the parallel exchange rate and induce a transitional current account deficit.

Third, in the more realistic case in which the government can run sustained deficits, the fiscal side provides the key link through which swaps have macroeconomic effects. If domestic real interest rates are higher than in the rest of the world, debt-for-bonds swaps can have destabilizing fiscal effects even in the presence of a discount captured by the government. Preliminary evidence suggests this effect probably has great practical relevance.

Fourth, expectations of how any resulting fiscal disequilibrium will be financed affect the course of macroeconomic variables in the short run. Some countries have managed to avoid possible inflationary effects by relying mostly on debt-for-bonds swaps. But if this leads to an accumulation of domestic debt which the public expects will be monetized eventually, the domestic rate of inflation will immediately begin to rise.

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31 See the first conclusion above.

Appendix 1

The 3X3 model in c,m and q presented in Section II can be expressed in matrix form as

$$\begin{bmatrix} \dot{c}_t \\ \dot{m}_t \\ \dot{q}_t \end{bmatrix} = \begin{bmatrix} \delta+\pi & -(1/\sigma)(\delta+\pi) & 0 \\ -1 & 0 & 0 \\ q(\delta+\pi)\dfrac{u''(c)}{u'(c)} & -q(\delta+\pi)\dfrac{v''(m)}{v'(m)} & \delta \end{bmatrix} \begin{bmatrix} c_t-\bar{c} \\ m_t-\bar{m} \\ q_t-\bar{q} \end{bmatrix} \quad \text{(A1)}$$

Consequently, the system has eigenvalues given by

$$\lambda_i = (1/2)(\delta+\pi) \pm (1/2)[(\delta+\pi)^2 + 4(1/\sigma)(\delta+\pi)]^{(1/2)} \qquad i=1,2$$

$$\lambda_3 = \delta$$

where $\lambda_1>0$, $\lambda_2<0$ and $\lambda_3>0$. Since the number of negative eigenvalues is the same as the number of predetermined variables, the system is locally stable. The general solution is given by

$$\begin{bmatrix} c_t-\bar{c} \\ m_t-\bar{m} \\ q_t-\bar{q} \end{bmatrix} = \begin{bmatrix} x_{11} & x_{12} & x_{13} \\ x_{21} & x_{22} & x_{23} \\ x_{31} & x_{32} & x_{33} \end{bmatrix} \begin{bmatrix} k_1(\exp)(\lambda_1 t) \\ k_2(\exp)(\lambda_2 t) \\ k_3(\exp)(\lambda_3 t) \end{bmatrix} \quad \text{(A2)}$$

where the k's are constants to be determined by initial conditions. Along any perfect foresight equilibrium convergent path the endogenous variables must therefore be connected by the following relationships:

$$[c - \bar{c}] = (x_{13}/x_{23}) \; [m - \bar{m}] \tag{A3a}$$

$$[c - \bar{c}] = (x_{13}/x_{33}) \; [q - \bar{q}] \tag{A3b}$$

$$[m - \bar{m}] = (x_{23}/x_{33}) \; [q - \bar{q}] \tag{A3c}$$

where the x's are the elements of the eigenvector corresponding to the negative characteristic root of the linear approximation to the system. The overbar, as usual, denotes the steady state levels toward which the system is travelling. It is also straightforward to show [see Obstfeld (1981)] that

$$(x_{23}/x_{13}) > 0, \;\; (x_{13}/x_{33}) > 0, \;\; (x_{23}/x_{33}) > 0 \tag{A4}$$

Therefore, when m is above its steady state level so are c and q. Since all roots are real, it is also true that m, c and q increase or decrease together toward the steady state.

Appendix 2

This appendix derives the exact behavior of consumption and real balances in response to an unanticipated swap that takes place at a time when external debt sells at a discount as a result of an expected writedown.

The expected writedown is of magnitude $\alpha\phi d_o$, where the definitions of α and ϕ are as in the text. It is expected to take place at time t=T, and this expectation becomes generalized at t=0. Consider first, and in the absence of any swaps, how the debtor's economy will initially react to this expectation. The dynamics appear in Figure A1. In the new steady state, the expected debt writedown shifts the $\dot{m}=0$ line up by the distance $\Delta\bar{c} = r^*\alpha\phi d_o > 0$, and leaves the $\dot{c}=0$ schedule unchanged. Since the discount increases the sustainable level of consumption, c jumps on impact and then continues to increase, moving according to the dynamics of the initial system until it reaches the new saddle path at time T. Between 0 and T the economy is consuming more than its current resources permit, so that we observe a current account deficit and a decrease in reserves and in real balances. This trend is reversed after the writedown becomes effective.

The paralell exchange rate q must also be increasing after T. Since its steady state level is unchanged, it follows that q must have jumped down initially: the news causes the parallel exchange rate to appreciate, and to remain above its "normal" level as long as the economy is out of steady state equilibrium. Recalling (3), it also follows that the domestic real rate of interest is above its long-run level throughout the transition.[32] In short, the country experiences some desirable effects, which follow from the fact that an anticipated future debt reduction constitutes a transfer from the rest of the world to the domestic economy.

Observing that its own external debt trades at a discount after time 0, the government of the home country might be tempted to try to repurchase it in the secondary market. Suppose that --unexpectedly and at some time τ-- the government induces a repurchase of its foreign obligations, by commanding[33] the private sector to swap its capital or foreign bond

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[32] This can also be inferred from (8). Since we know that c is increasing throughout, it must be the case that $r>\delta$ throughout as well.

[33] Such a command could be made palatable to private agents by promising in turn to buy the external debt back from them, as is done in the text.

holdings for foreign debt.[34] Algebraically, $\Delta f_0 = p_t \Delta d_0 = p_t \phi d_0$ where assume, as in the text, that all debt subject to a discount is retired.

How will the domestic economy react to such a transaction? The swap is tantamount to bringing forward in time the benefits of the future debt reduction. In a world with perfect capital mobility in which real rates of interest were equalized, the swap would have no real effects. Under perfect foresight the discount captured today would simply equal the present value of the discount available tomorrow, and consumption and the current account would be unchanged by the announcement of such an operation. However, that is no longer the case when restrictions in capital mobility drive a wedge between the steady state rates of discount at home and abroad. The matter is further complicated by the fact that such swaps could only seem attractive while the debt sells at a discount --in the time between the announcement of the debt reduction and its realization. During that period the economy is out of steady state, and the relevant rate of interest faced by domestic agents is changing over time.

Figure A2 shows the dynamics of the system in reaction to a swap. The timing of the swap will determine the final resting position of the $\dot{m}=0$ schedule. From (14b) we know that the market price falls as we approach time T. Depending on the actual time of the swap, the country will get a different price for its debt, and hence will place itself on the path to an eventual steady state with a different level of sustainable consumption. Define $\tilde{c}_\tau$ as the steady state level of consumption a country could attain if it swapped all of its discounted debt at time τ.[35] Then for every τ, and every corresponding $\tilde{c}_\tau$, there will be a saddle path to which the economy will have to jump at the time of the swap. In what follows we show that consumption will always find itself below this saddle path at τ. Equivalently, consumption will always jump up at the time of the swap.

To prove that result we must solve the system analytically. For simplicity we deal only with the 2X2 system in c and m, which can be solved independently. Excluding q, system (A1) becomes

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34 The results would be the same if: a) The government taxed away the private assets and used them to retire debt directly; b) Official reserves earned interest and the government used them to finance the transaction.

35 This variable is defined formally in equation (A6) below.

$$
\begin{bmatrix} \dot{c}_t \\ \dot{m}_t \end{bmatrix} = \begin{bmatrix} \delta+\pi & -(1/\sigma)(\delta+\pi) \\ -1 & 0 \end{bmatrix} \begin{bmatrix} c_t - \bar{c} \\ m_t - \bar{m} \end{bmatrix} \qquad \text{(A 1')}
$$

The matrix of partial derivatives has eigenvalues given by

$$\lambda_i = (1/2)(\delta+\pi) \pm (1/2)[(\delta+\pi)^2 + 4(1/\sigma)(\delta+\pi)]^{(1/2)} \qquad i=1,2$$

where $\lambda_1>0$ and $\lambda_2<0$, just as before. The corresponding eigenvectors are

$$[1 \quad -(1/\lambda_1)]' \qquad [1 \quad -(1/\lambda_2)]' \qquad \text{(A5)}$$

Therefore, the general solution is

$$
\begin{aligned}
c_t-\bar{c} &= k_1 \exp(\lambda_1 t) + k_2 \exp(\lambda_2 t) \\
m_t-\bar{m} &= -(1/\lambda_1)\, k_1 \exp(\lambda_1 t) - (1/\lambda_2)\, k_2 \exp(\lambda_2 t)
\end{aligned} \qquad \text{(A6)}
$$

where once again the k's are constants that depend on initial conditions.

The next step is to solve for k_1 and k_2, which will determine the evolution of the system between times 0 and T. Since m is a predetermined variable, we know that $m_0-\bar{m}=0$. Combined with (A6), this yields our first constraint on the k's:

$$k_2 = -(\lambda_2/\lambda_1)\, k_1 \qquad \text{(A7)}$$

Using (A7), we can write the position of the system at t=T as

$$
\begin{aligned}
c_T-\bar{c} &= k_1 \exp(\lambda_1 T) - (\lambda_2/\lambda_1)\, k_1 \exp(\lambda_2 T) \\
m_T-\bar{m} &= -(1/\lambda_1)\, k_1 \exp(\lambda_1 T) + (1/\lambda_1)\, k_1 \exp(\lambda_2 T)
\end{aligned} \qquad \text{(A8)}
$$

What happens once the shock is realized at T? Along the saddle path that the system must reach after time T, it must be the case that $k_1=0$. Therefore, for all $t \geq T$,

$$c_t-\bar{c}' = k_2 \exp(\lambda_2 t)$$

$$m_t-\bar{m} = -(1/\lambda_2)\, k_2 \exp(\lambda_2 t) \qquad (A9)$$

where a prime denotes the new steady state to be attained after debt reduction. It follows that

$$c_t-\bar{c}' = -\lambda_2 [m_t-\bar{m}'] \qquad (A10)$$

In that new steady state, recalling (A1) and (A2) and the definition of σ, consumption and real balances will be given by

$$\bar{c}' = y + \rho(f_o+k_o) - \alpha r^*\Delta d_o$$

$$\bar{m}'-\bar{m} = \sigma[\bar{c}'-\bar{c}] = \sigma\alpha r^*\Delta d_o \qquad (A11)$$

which enables us to rewrite (A10) as

$$c_t-\bar{c} = -\lambda_2 [m_t-\bar{m}] + [1+\sigma\lambda_2]\, \alpha r^*\Delta d_o \qquad (A12)$$

Notice that $[1+\sigma\lambda_2]>0$.[36] Combining (A7), (A8) and (A12) we find

$$k_1 = \frac{[1+\sigma\lambda_2]}{[\lambda_1-\lambda_2]} \lambda_1 \exp(-\lambda_1 T)\, \alpha r^*\Delta d_o$$

$$k_2 = -\frac{[1+\sigma\lambda_2]}{[\lambda_1-\lambda_2]} \lambda_2 \exp(-\lambda_1 T)\, \alpha r^*\Delta d_o \qquad (A13)$$

Putting (A6) and (A13) together yields the general solution of the system for all time between 0 and T:

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[36] Proof: The λ's are given by the characteristic equation $\lambda^2-(\delta+\pi)\lambda-(1/\sigma)(\delta+\pi) = 0$. Hence, $\lambda_1+\lambda_2 = (\delta+\pi)$ and $\lambda_1\lambda_2 = -(1/\sigma)(\delta+\pi)$, implying $[1+\sigma\lambda_2] = -(\lambda_2/\lambda_1) > 0$.

$$c_t - \bar{c} = \frac{[1+\sigma\lambda_2]}{[\lambda_1-\lambda_2]} \exp(-\lambda_1 T) [\lambda_1 \exp(\lambda_1 t) - \lambda_2 \exp(\lambda_2 t)] \alpha r^* \Delta d_o$$

$$m_t - \bar{m} = -\frac{[1+\sigma\lambda_2]}{[\lambda_1-\lambda_2]} \exp(-\lambda_1 T) [\exp(\lambda_1 t) - \exp(\lambda_2 t)] \alpha r^* \Delta d_o \tag{A14}$$

Consider now the effects of a possible debt swap effected some time before T. During that period, the secondary market price of one unit of debt, denoted by p_τ, must be given by

$$p_\tau = 1 - \alpha \exp[-r^*(T-\tau)] \tag{A15}$$

for all τ before time T. The market price falls as we approach T. Recall $\tilde{c}_\tau$ denotes the steady state level of consumption a country could attain if it swapped all of its debt at some time τ. By (A2), it must be the case that

$$\tilde{c}_\tau = y + \rho(f_o+k_o) - r^* p_\tau \Delta d_o \tag{A16}$$

and, recalling (A15) and the definition of σ,

$$\tilde{c}_\tau - \bar{c} = \exp[-r^*(T-\tau)] \alpha r^* \Delta d_o$$

$$\tilde{m}_\tau - \bar{m} = \exp[-r^*(T-\tau)] \sigma\alpha r^* \Delta d_o \tag{A17}$$

At that time τ, the system would jump to the saddle path leading to the steady state characterized by (A16). Therefore, using (A10) we have

$$c_{\tau+} - \tilde{c}_\tau = -\lambda_2 [m_{\tau+} - \tilde{m}_\tau] \tag{A18}$$

where the subscript "τ+" denotes the values taken on by the variables in the instant after the swap is announced at time τ. But, since m is a predetermined variable, it must also be true that $m_{\tau+} = m_\tau$. Combining this fact with (A17) and (A18) we arrive at

$$c_{\tau+} - \bar{c} = -\lambda_2 [m_\tau - \bar{m}] + [1+\sigma\lambda_2] \exp[-r^*(T-\tau)] \alpha r^* \Delta d_o \tag{A19}$$

We can use (A14), evaluated at $t=\tau$, to substitute for $[m_\tau - \bar{m}]$:

$$c_{\tau+} - \bar{c} = \frac{[1+\sigma\lambda_2]}{[\lambda_1-\lambda_2]} \lambda_2 \exp(-\lambda_1 T) [\exp(\lambda_1 t) - \exp(\lambda_2 t)] \alpha r^* \Delta d_o$$

$$+ [1+\sigma\lambda_2] \exp[-r^*(T-\tau)] \alpha r^* \Delta d_o \qquad \text{(A20)}$$

This last expression yields the level to which consumption would have to jump in the instant after the swap is carried out at time τ. By contrast, we know from (A14) (once again evaluated at $t=\tau$) the level consumption must have found itself at the moment of the swap. Subtracting (A14) from (A20) yields

$$c_{\tau+} - c_\tau = [1+\sigma\lambda_2] [\exp r^*(\tau-T) - \exp \lambda_1(\tau-T)] \alpha r^* \Delta d_o \qquad \text{(A21)}$$

It follows that

$$\text{sgn}\,[c_{\tau+} - c_\tau] = \text{sgn}\,[\lambda_1 - r^*] \qquad \text{(A22)}$$

Hence, consumption will have to jump up at the time of the swap if λ_1 is greater than r^*. But this condition always holds if $\delta \geq r^*$ --that is to say, if the domestic steady state rate of interest is at least as large as the world rate, as we earlier assumed.[37]

Returning to Figure A2, consumption would have reached point b along its unstable trajectory just before the swap is announced at τ. Consumption must therefore jump to point a on the saddle path that leads to $\tilde{c}_\tau$ and the corresponding $\tilde{m}_\tau$. The distance of the jump given by equation (15) is ba.

The intuition for this fundamental result is simple. When the world rate of interest (r^*) is small, creditors do not discount the future debt reduction very much. Hence, the purchase price of the debt at the time of the swap is low, and the attainable level of (post-swap) steady state consumption is high. We know that the domestic steady state rate of

37 This result, of course, depends crucially on our assumptions of no uncertainty and perfect foresight. With uncertainty about the magnitude of the debt reduction, and different attitudes toward risk among creditors and debtor, this result need not hold. The same is true of situations in which the debtor country hopes to default, and has private information about the likelihood of this event.

interest is at least as large as the world rate and that (in the absence of a swap) the domestic rate of interest is above its long run level during the whole transition between times 0 and T. Hence, domestic agents must have been discounting the future debt reduction heavily up until time τ, and consuming less than they would have if their discount rate were r^*.[38] Consumption therefore has to jump up at the time of the swap.

With this result in hand, one can proceed to the analysis of bond versus money financing, in a fashion analogous to that in the text.

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38 Equivalently, the swap enables domestic residents to borrow from abroad at the rate r^*, which they could not do before.

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Table 1

Likelihood that Excess Supply of Money will Prevail after Swap

	σ	r^*	α	β	$[(1-\beta)-\sigma\alpha r^*]>0$
Argentina	0.5	0.052	0.581	0.505	[0.495-0.030]=0.465
	1.0	0.052	0.581	0.505	[0.495-0.015]=0.480
	1.5	0.052	0.581	0.505	[0.495-0.045]=0.450
Brazil	0.5	0.052	0.110	0.096	[0.904-0.003]=0.901
	1.0	0.052	0.110	0.096	[0.904-0.006]=0.898
	1.5	0.052	0.110	0.096	[0.904-0.018]=0.886
Chile	0.5	0.052	0.138	0.118	[0.882-0.004]=0.878
	1.0	0.052	0.138	0.118	[0.882-0.008]=0.874
	1.5	0.052	0.138	0.118	[0.882-0.012]=0.870
Mexico	0.5	0.052	0.136	0.118	[0.882-0.004]=0.878
	1.0	0.052	0.136	0.118	[0.882-0.008]=0.874
	1.5	0.052	0.136	0.118	[0.882-0.012]=0.870

Sources: σ: Mankiw and Summers (1986) estimate σ to be unity. The values 0.5 and 1.5 are alternative assumptions.

r^*: Average real LIBOR for July-December1988, plus the 13/16 spread normally charged on Latin American loans.

β: Average discounts captured by the public sector on debt-equity swaps. For Argentina from Rodríguez (1989), for Brazil from Bodin de Moraes (1988), for Chile from Larraín and Velasco (1989) and for Mexico from Sanginés (1989).

α: Average discounts captured by the country as a whole on debt-equity swaps. For Chile from Larraín and Velasco (1989). For the other countries data is not publicly available, so α is assumed to be 15% higher than β.

Table 2

Likelihood that Swap will Cause a Fiscal Inbalance

	r*	r	β	[(1-β)-(r*/r)]>0
Argentina	0.052	0.429	0.505	[0.495-0.121]=0.374
Brazil	0.052	0.190	0.096	[0.904-0.274]=0.630
Chile	0.052	0.059	0.118	[0.882-0.881]=0.001
Mexico	0.052	0.299	0.118	[0.882-0.174]=0.708

Sources: β: See Table 1

r*: See Table 1

r: Annualized real domestic interest rates on government bonds. Average for July-December 1988. Ex-post rates used when no indexed bonds exist.
Argentina: Central Bank of Argentina (Period used corresponds to September 1988-January 1989). Ex-post rate.
Brazil: Central Bank of Brazil. Rate corresponds to overnight Central Bank Bills. Ex-post, although the nominal rate is adjusted in line with inflationary official inflacionary expectations, aiming at one percent real interest per month.
Chile: Central Bank of Chile. Rate on long-term, indexed Central Bank bonds.
Mexico: Banco de México. Ex-post rates on 30-day CETES (Certificados del Tesoro).

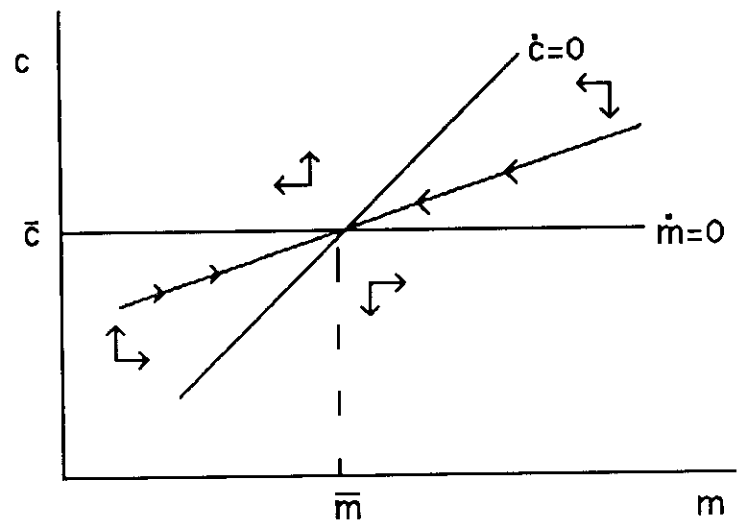

Figure 1

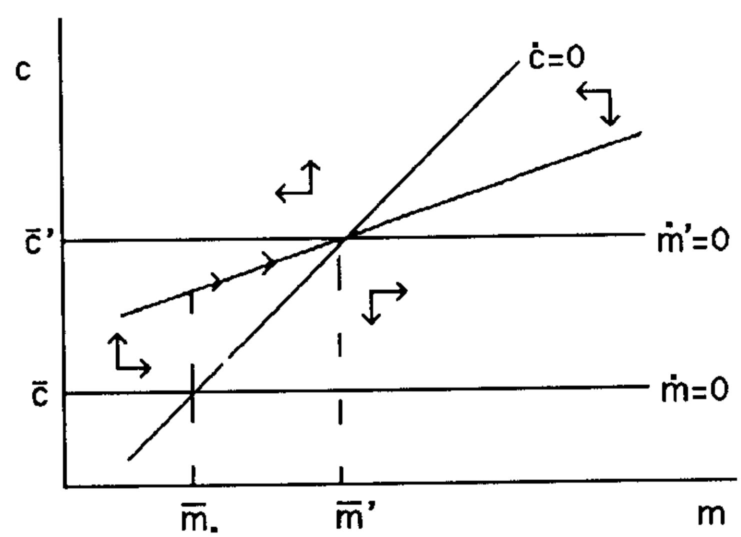

Figure 2

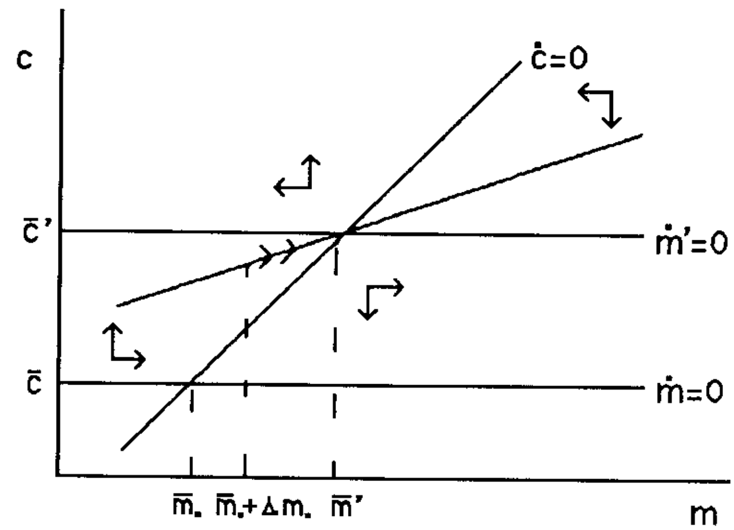

Figure 3a

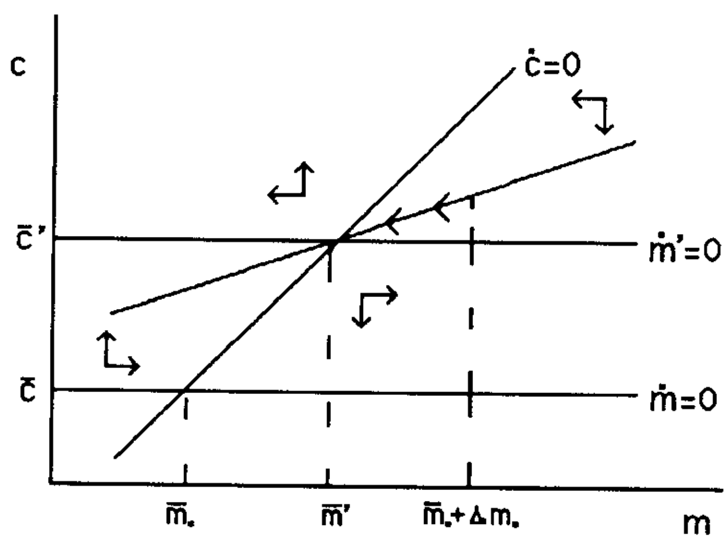

Figure 3b

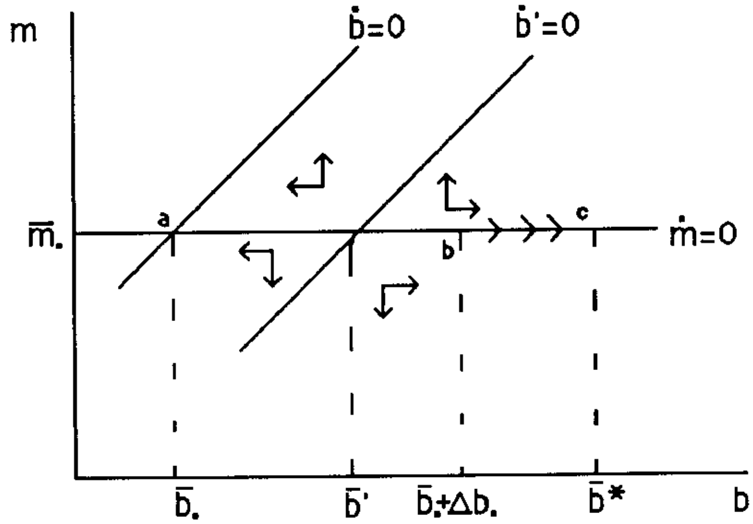

Figure 4a

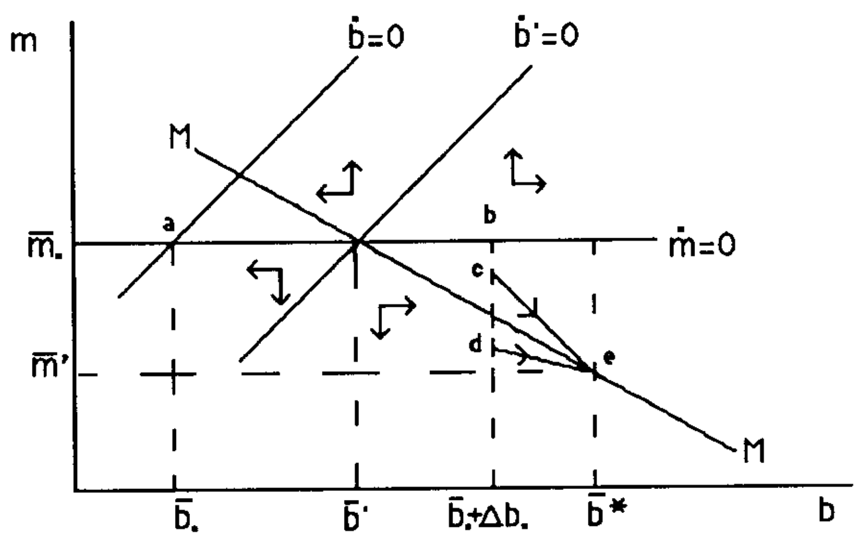

Figure 4b

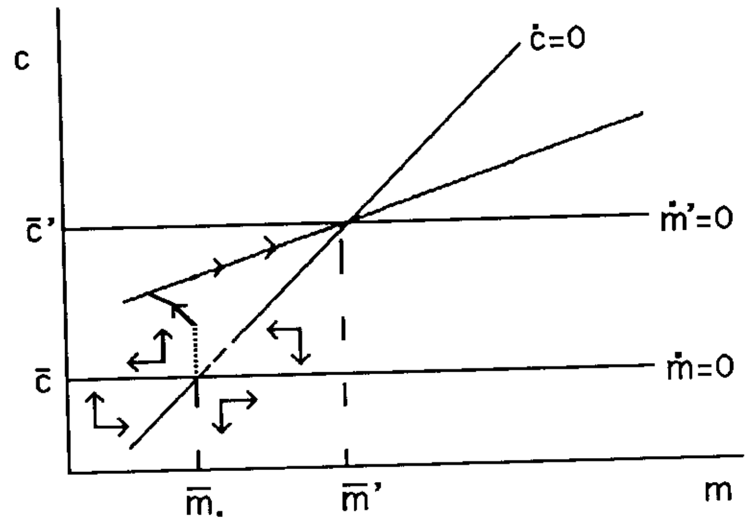

Figure A1

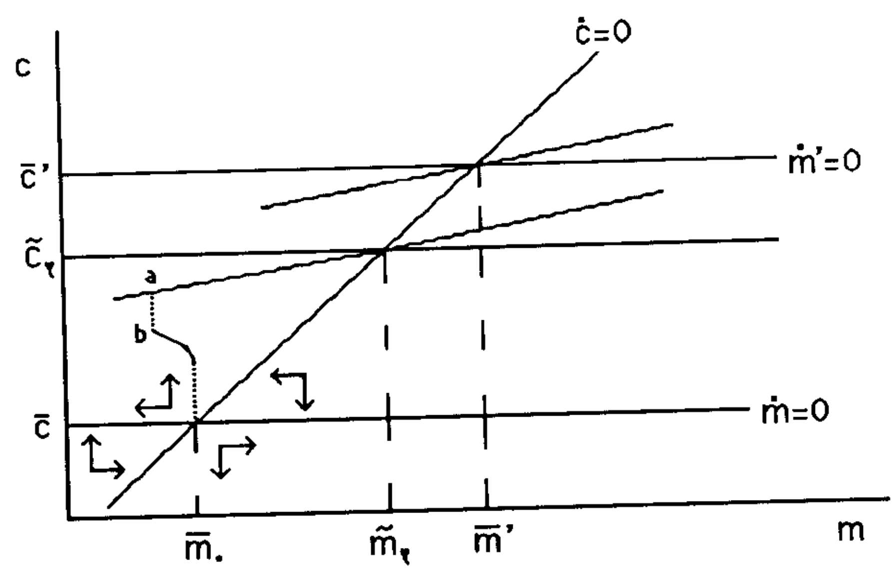

Figure A2