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BORROWING ABROAD: THE DEBTOR'S PERSPECTIVE

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ABSTRACT

This paper addresses the question of external borrowing from the perspective of the borrowing country. The first section sketches a formal framework for optimal borrowing by a developing country, as seen from the planner's point of view. The next three sections use this framework for the development of three important limits on external borrowing: the problem of solvency, the problem of liquidity and the problem created by the possibility of repudiation. The fifth section relates external borrowing to macroeconomic management of the borrowing country, and the sixth section pulls together the many factors that suggest that external debt of a country should be subject to central management or at least surveillance. Following that, we offer some guidelines for limits to the magnitude of external debt, and then discuss the character or mix of external debt. In an appendix, we present various simulation exercises for optimal debt management in a discrete-time infinite-horizon setting.

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Introduction

External Debt has risen to the top of the agenda of international monetary economics in recent years. This is partly because developing countries have become much more dependent on external funding for their economic development during the past decade than they were before, and partly because a growing number of countries have experienced difficulties in servicing their external debts since 1981. This paper addresses the question of external borrowing from the perspective of the borrowing country, with a view to discovering principles or guidelines that might be helpful to such countries in managing both the level and the character of their external debt.

The plan of the paper is as follows. The first section sketches a formal framework for optimal borrowing by a developing country, as seen from a planner's point of view. The next three sections use this framework for the development of three important limits on external borrowing: the problem of solvency, the problem of liquidity and the problem created by the possibility of repudiation. The fifth section relates external borrowing to macroeconomic management of the borrowing country, and the sixth section pulls together the many factors that suggest that external debt of a country should be subject to central management or at least surveillance. Following that, we offer some guidelines for limits to the magnitude of external debt, and then discuss the character or mix of external debt. A brief concluding section pulls some of the strands together.

The first four sections are more formal and algebraic in their approach to the subject. That will appeal to some readers and offend others. It is offered here not merely to appeal to those who prefer a formal approach to a subject that lends itself to formal analysis. It also suggests a format that can be adapted to the formal planning models used by many developing countries. An appendix offers a numerical illustration of how the framework can be used. The final four sections are written to be accessible to a wider audience, and to offer some judgments on issues that are not fully covered in the more formal treatment. Our discussion throughout on the links of borrowing and monetary policies is necessarily brief, and we point the reader to Dornbusch's (1984) contribution in this volume for a detailed treatment.

Strategies for International Borrowing

We approach the management of international borrowing as a formal problem of dynamic resource allocation. (The formal approach taken here follows closely the treatment in Sachs, 1982a and 1984, wherein further details may be found.) Admittedly, a formal approach may neglect some aspects of the borrowing decision; we take up some of these in later sections. The formal approach, however, has the advantage of showing how a quantitative assessment of borrowing may be made using standard models of development planning. This section illustrates how such development models can be used.

All models of optimal borrowing have two features. First, they set out a dynamic budget constraint, which describes the country's long-term options with respect to foreign borrowing. Second, they specify a planning function or social welfare function, which describes in a dynamic setting the desirability of various possible paths for consumption and output over time. The borrowing problem is solved in a formal way by maximizing the social welfare function subject to the dynamic budget constraint.

We shall also insist upon a third feature, which is sometimes missing in borrowing models, namely optimal implementation of a borrowing strategy. The solution of a borrowing model typically yields a path of investment, consumption, and foreign indebtedness that maximizes the social welfare function. But, it may remain silent on what policies are needed to achieve that path. Will the path result from decentralized market forces, with direct private-sector access to foreign capital? Or does the path require active government intervention in the borrowing process? In sum, in addition to studying the correct path for borrowing, we must ask how that path may in fact be reached.

This section sets out the three key elements of the formal borrowing problem: the budget constraint, the welfare function, and the instruments for policy implementation. Later sections are devoted to a more refined treatment of these elements that address special features of the actual borrowing process.

A. The Dynamic Budget Constraint

Many features of an economy determine how much and on what terms it may borrow from the rest of the world. Potential lenders as well as equity investors must assess the country's future ability and willingness to service its external obligations. New credit may be limited because creditors doubt that the economy can ever earn sufficient foreign exchange to repay a new loan. In this case, the country is said to be rationed by a solvency constraint. Alternatively, the country may be deemed unsuitable for loans because of short-run difficulties, even though its long-run prospects are bright. In this case, the lending is bound by a liquidity constraint. Finally, the country may have foreign exchange earnings sufficient to honor its obligations, but may be deemed unwilling to do so, because debt repayment is too onerous or because it is holding out for some sort of debt relief. Lending may therefore be constrained by repudiation risk.

The country's capacity to borrow will therefore reflect creditors' concerns about solvency, liquidity, and repudiation risk. The interaction of these constraints determines the dynamic budget constraint facing an economy. For analytical simplicity, we consider each of these factors in turn. In truth, a full model of optimal borrowing must consider them together.

The Solvency Constraint

Even assuming no liquidity or repudiation risks, country borrowing is bound by its long-run capacity to service its debt. From the creditors' point of view, long-run solvency does not mean that the debtor nation must have the prospect to become a creditor nation in the long-run (i.e. actually repay its debt). All that is required is that the debtor have the future resources to service its debt, without the need to borrow forever in order to make interest payments. To take two extreme cases, a $1 million loan has a market value of zero if the debtor must forever borrow new money to service the loan, while the loan is worth a $1 million if the country always services the debt out of its own earnings, even though it never repays the principal.

The country's resources for external debt servicing each period may be measured by its trade surplus, TB_t (when $TB_t < 0$, the country is running a trade deficit). If the maximum discounted sum of current and future trade balances, $\max \sum_{i=t}^{\infty}(1+r)^{-(i-t)}TB_t$, is less than the current debt, the country can never service the debt out of its own resources (r is the real interest rate, assumed to be constant unless otherwise specified). It will have to borrow forever, and in an amount growing at the real interest rate, in order to continue debt servicing. Let D_t be the stock of debt at the end of period t-1, so that $(1+r)D_t$ is the debt due as of period t. The solvency constraint can be stated simply as the requirement that:

$$(1) \qquad (1+r)D_t \leq \max \sum_{i=t}^{\infty}(1+r)^{-(i-t)}TB_i$$

To gain some insight to (1), let us turn to the goods market. Suppose as a first illustration that the country produces a single tradeable good, with real GDP given by Q_t. Output is a function of the capital stock K_t, with $Q_t = F(K_t)$. K_t evolves according to the path of investment, with $K_{t+1} = (1-d)K_t + I_t$, where d is the rate of depreciation and I_t is gross capital formation (public plus private). The trade balance is $TB_t = Q_t - I_t - C_t$, where C_t is gross domestic

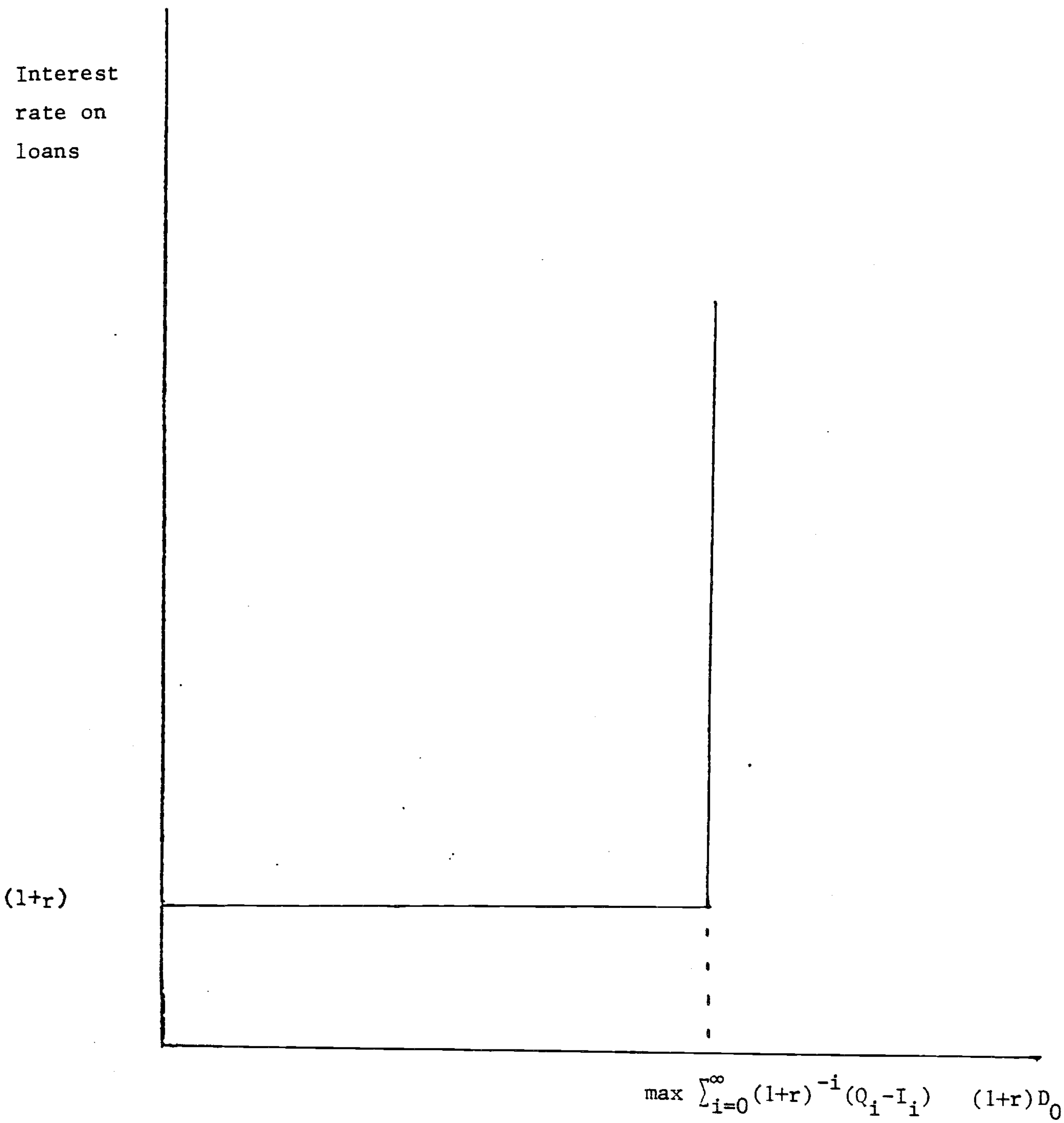


Figure 1. Loan Supply with No Liquidity or Repudiation Risk

consumption (public plus private). Let $\bar{C}_t$ be the subsistence or minimal level of consumption possible in period t, so that TB_t is maximized with $C_t = \bar{C}_t$.[1] Then, from (1)

$$(2) \qquad (1+r)D_t \leq \max \sum_{i=t}^{\infty}(1+r)^{-(i-t)}(Q_i-I_i) - \sum_{i=t}^{\infty}(1+r)^{-(i-t)}\bar{C}_i$$

The first term on the right-hand side of (2) is the maximum discounted sum of $Q_i - I_i$, and may be considered the productive wealth of the economy, in dynamic terms. The second expression is the discounted sum of minimum consumption expenditure. In words, the solvency constraint is that the economy's debt D_t must be less than or equal to productive wealth net of minimum consumption expenditure. For simplicity in the discussion that follows, we set $\bar{C}_t = 0$ in (2), and simply compare the external debt with the economy's productive wealth. Re-introducing $\bar{C}_t$ in the later discussion is straightforward.

If a country is always willing to repay its debt if it can repay it, and if it can always borrow freely subject to the condition that it remain solvent, then (1) or (2) defines the loan supply schedule to the country. In particular, it can borrow to the point where $(1+r)D_t$ just equals $\max \sum_{i=t}^{\infty}(1+r)^{-(i-t)}(Q_i-I_i)$ (ignoring $\bar{C}_i$). This loan supply schedule is shown in Figure 1. We return later to more refined measures of solvency, that take into account traded versus non-traded goods, and the public versus private sectors.

There are two important qualifications that must be added to equation (2) and Figure 1. Note that if $Q_i - I_i$ grows in the steady state at a rate n greater than r, then the economy faces no solvency constraint. The sum $\sum_{i=t}^{\infty}(1+r)^{-(i-t)}(Q_i-I_i)$ is infinite (i.e. the economy's productive wealth is infinite). Starting from <u>any</u> level of debt D_t, the economy has the future resources to repay the debt! Curiously, even if the borrowing country is not growing at a rate n greater than r, there may be no solvency constraint if lender countries are growing at n greater than r. This situation can arise if creditors are always willing to make new loans to debtors to enable the debtor to service its debt. In such a Ponzi scheme, the borrower's debt grows at the rate of interest (and becomes infinite), but since the lenders' economies are growing even faster, the debt remains a small (and even decreasing) fraction of the creditors' wealth. As long as the creditors' economies are always growing at $n > r$, such a Ponzi scheme is viable forever. The debtor cannot repay its debt but never has to! No creditor calls in his loan, on the belief that future lenders will keep the debtor afloat.[2]

Note, therefore, that a rise in the real interest rate r above the growth rates of debtor and creditor countries can have a profound effect on the debtor's solvency constraint. When r is low, there may be no solvency constraint on borrowing, while when r is high there surely is. Thus, the rise in real interest rates after 1979 may have severely jolted long-term expectations about the debtor country's capacity to repay debt.

The Liquidity Constraint

In some theories, solvent countries can always borrow up to the point of the solvency constraint. We suspect that a borrowing limit may be reached far below the solvency limit, because creditors fear liquidity problems of heavily indebted countries, and because they fear debt repudiation by these countries. A liquidity constraint may (but need not always) occur when a country owes more in a given period then it can service in the absence of new loans. Specifically, if α percent of outstanding debt is coming due in period t, amortization payments are αD_t and interest payments are rD_t, so that total debt servicing is $(r+\alpha)D_t$. It may well happen that $(r+\alpha)D_t$ exceeds Q_t (especially when Q_t represents tradeable goods alone rather than total GDP), even though $(1+r)D_t \leq \max \sum_{i=t}^{\infty}(1+r)^{-(i-t)}(Q_i-I_i)$. That is, the country faces a cash flow problem, though it is solvent by long-run criteria.

In normal periods, such a country will be able to borrow $(r+\alpha)D_t - Q_t$ in order to honor its current debt service obligations. However, the loan markets may not function well under a variety of circumstances, and the country may find itself unable to borrow. This rationing may result when each bank's lending decisions are importantly affected by the actions of other banks. For example, suppose that bank-capital regulations restrict each bank to make loans to the country in amounts L less than $\bar{L}$, where $\bar{L} < (r+\alpha)D_t - Q_t$. Then, no single bank can lend enough to the country to allow the country to honor its current debt servicing. Two things can happen. Perhaps n banks will each make loans L such that $nL \geq (r+\alpha)D_t - Q_t$. They should be happy to do so, because the country is fundamentally healthy (i.e. solvent).

On the other hand, if each bank suspects that other banks are not going to make new loans, a panic may ensue. Assuming that no other banks are extending loans, it is rational for each individual bank to stop as well since its loan of size $\bar{L}$ is not big enough to keep the country solvent. Thus, two equilibria are possible, one in which the country is able to refinance its debt and the other in which it is forced into arrears by the inability to obtain new lending.

Once the arrears appear, the banks may feel vindicated in their decisions to pull out of new lending. It may become ever more difficult for the country to attract new loans, and an eventual debt rescheduling or moratorium, injurious to creditor and debtor alike may, in time, be necessary.

There are several reasons other than bank-capital restrictions on new loans why a panic might arise, some of which have been spelled out in other papers (see Sachs, 1984). A bank might be willing, individually, to loan the requisite amount $(r+\alpha)D_t - Q_t$, but only at a new interest rate $\tilde{r}$ much above the existing rate r. The spread $\tilde{r} - r$ would be necessary to compensate a new lender for tying up a large fraction of bank capital. The rate $\tilde{r}$ might be so high, therefore, that a new loan at rate $\tilde{r}$ pushes the country over the brink of insolvency. Specifically, with a new loan $L_t = (r+\alpha)D_t - Q_t$ at rate $\tilde{r}$, indebtedness might rapidly rise above productive wealth. Once again, the individual bank would be unwilling to lend in the event that the other banks also stop making loans.

It is not hard to think of other reasons why banks may be happy to make small loans as part of a group, but not large loans when standing alone. For example, a syndicate may have stronger bargaining vis-a-vis a debtor country then a single bank alone. A bank may therefore fear to be the only lender because it realizes that its future bargaining position vis-a-vis the debtor may be weak. Also, banks may feel that they are more likely to enjoy central bank protection from default risk if other banks are also involved in loans to a defaulting country. The central bank might be content to let a single irresponsible bank fail, as an example to others, but not to jeopardize the banking system by letting several banks fail.

The upshot of liquidity risk is that credit rationing may be far more restrictive than the limits of Figure 1. Healthy countries with heavy debt-servicing obligations can suddenly find the spigot turned off, perhaps requiring them to make rather drastic short-run adjustments.

Repudiation Risk

Countries may be unable to obtain new loans because there is little confidence that the debtor will choose to repay the debt. To fix ideas, suppose that the debtor country owes D_t, and has productive wealth $W_t > D_t$. If the country defaults, the creditors receive a fraction γ of W_t, perhaps by direct confiscation of the debtor country's assets. Moreover, the creditors can impose sanctions on the defaulting country in the amount θW_t. These sanctions include the direct seizure of assets, γW_t, and other penalties that may be costly to the debtor without yielding direct benefits to the creditors. Generally, then, we may assume that the sanctions exceed the payments to the creditors ($\theta > \gamma$).

Consider the default decision. A repudiation of debt yields a gain of D_t and a loss of θW_t to the debtor, and a net loss to the creditor of $D_t(1-\gamma)$. For debtors and creditors within a closed economy, θ is generally near 1.0, since creditors can use the legal system to seize much of their debtors' assets in the event of a repudiation. When $\theta = 1$, debt repudiation will make sense only when $D_t > W_t$, i.e. when the debtor is insolvent. In the international setting, the seizure of assets on a large scale is very difficult and sanctions such as trade embargoes against a defaulting country may have only limited effect. Thus, θ is generally much smaller than 1.0, so that it may be true that

$D_t > \theta W_t$ even when D_t is much less than W_t.

The penalty function and institutional setting together determine the loan supply schedule to a debtor country. In one extreme case, closer to 19th century bond-financing than to 20th century bank-financing of LDC loans, there is little negotiation between creditors and debtors before a loan is defaulted. Debtors simply compare D_t and θW_t, and repudiate when $D_t > \theta W_t$. Farsighted creditors therefore restrict loans to assure that $D_t < \theta W_t$, and therefore shrink the loan supply relative to that of Figure 1.

When active negotiation is possible between creditors and debtors, the situation is far more complicated. Suppose that $D_t > \theta W_t$, so that the debtor has an incentive to repudiate the debt. Both creditors and debtors also have an incentive to agree to debt relief in lieu of a complete debt repudiation, since both sides can be left better off with debt relief instead of default. In the event of default, the creditor receives γW_t and the debtor loses θW_t, with $\theta > \gamma$. Clearly, if instead of default, an agreement is reached in which the debtor pays θW_t of the debt while the creditors agree to forego retaliation, the creditors are better off by $(\theta-\gamma)W_t$, and the debtor is left as well off. Alternatively, if the debtor agrees to pay γW_t to the creditor in exchange for no retaliation, the creditor is as well off as with repudiation, while the debtor is better off by the amount $(\theta-\gamma)W_t$. Any payoff by debtor to creditor between γW_t and θW_t, with no sanctions imposed by the creditors, therefore leaves both sides better off than with an outright repudiation.

Inevitably, then, in the event that indebtedness approaches or exceeds the repudiation threshold θW_t, there will be a strong incentive to negotiate. In general, economic theory cannot precisely specify the outcome of these negotiations, but standard models of bargaining can give us some indication of likely results. In the Nash bargaining solution, for example, there exists a so-called "threat point," which is the outcome if negotiations break down. Let us assume that debt repudiation occurs in the absence of successful negotiation, so that the creditor gets γW_t, and the debtor ends up with $(1-\theta)W_t$. A successful bargaining outcome is a payoff P, that leaves the creditor with P and the debtor with $W_t - P$, and in which the creditor agrees to impose no sanctions on the debtor. Let U be the utility level of the creditor, and V be the utility level of the debtor. The creditor's gain in utility from a successful negotiation is $U(P) - U(\gamma W_t)$, and the debtor's gain is $V(W_t-P) - V[(1-\theta)W_t]$. In the Nash bargaining solution, the product of the gains to the debtor and creditor is maximized, subject to $P \leq D_t$. That is:

(3) $$P \text{ maximizes } [U(P) - U(\gamma W_t)] \cdot \{V(W_t-P) - V[(1-\theta)W_t]\}$$

Suppose, for example, that both creditor and debtor are risk neutral, so that $U(P) = P$, $V(W_t-P) = W_t - P$, etc. Then, we maximize $(P-\gamma W_t)(\theta W_t-P)$ subject to $P \leq D_t$. The payoff schedule is then:

(4) $$P = D_t \qquad \text{for } D_t \leq (\theta+\gamma)W_t/2$$

$$P = (\theta+\gamma)W_t/2 \qquad \text{for } D_t > (\theta+\gamma)W_t/2$$

Thus, for small levels of debt, the country has no bargaining power, and the payoff equals the entire debt due. However, as D_t rises above $\theta W_t/2$, the country ends up paying only $(\theta+\gamma)W_t/2$. Note that the payoff rises with θ and γ. Thus, as the creditor is able to impose large penalties on the debtor (high θ) and to seize a large amount of assets (high γ), the creditor's bargaining power, and ultimate payoff, are raised.

Now, it makes sense to suppose that a potential creditor understands its prospects in the event of negotiations, so that it limits its debt exposure to levels that the country will choose to repay. In this case, the required debt servicing will be kept below $(\theta+\gamma)W_t/2$. Note that the lower is the creditor's ability to retaliate in the event of repudiation, as measured by θ and γ, the tighter is the lending limit that creditors will impose. At least in the absence of uncertainty, borrowers are better off with higher θ and γ, since the existence of large penalties for repudiation frees up capital inflows.

B. The Planner's Problem

We have so far discussed three aspects of loan supply to a borrowing country. While a country's ability to repay debt is probably a necessary condition for it to attract new loans, its willingness to repay, and ability to do so on a short-term basis are probably even more important. Our next task is to study the optimal borrowing choice in light of these constraints.

Suppose that the goal of debt policy is to maximize a social welfare function that depends on the consumption flow over time. Specifically, we write debtor utility V as:

$$V = \sum_{i=0}^{\infty}(1+\delta)^{-i}U(C_i) \tag{5}$$

C_i is real consumption (either per capita or aggregate) in period i, and $U(C_t)$ is an instantaneous utility in period t, with $U' > 0$ and $U'' \leq 0$. Intertemporal utility is given by a discounted sum of instantaneous utilities, where δ measures the rate of subjective time discount. A function like (5) is really an economist's presumption about what borrowing policy should be about, and much less a statement about the actual determinants of borrowing policies. The goals of planners or economic authorities might be much more concerned with the growth of GDP, the use of debt to stabilize a political regime, or even nationalist sentiments against foreign indebtedness, rather than a careful calculation of intertemporal consumption possibilities. Since our topic is an analysis of appropriate borrowing strategies rather than an empirical account of actual borrowing behavior, we choose to proceed with (5).

Under certainty, and with no liquidity or repudiation risk, the optimal borrowing problem is

(6) $$\max V = \sum_{i=0}^{\infty}(1+\delta)^{-i}U(C_i)$$

subject to:

(a) $K_{t+1} = K_t(1-d) + I_t$

(b) $Q_t = F(K_t)$

(c) $D_{t+1} = (1+r)D_t + (I_t+C_t) - Q_t$

(d) $\lim_{t\to\infty} (1+r)^{-t}D_t = 0$

(e) K_0, D_0 given

Condition (d) is a convenient way to impose the solvency constraint on borrowing. Implicitly, we are taking the case in which $n < r$, so that foreign borrowing is limited by the future capacity to repay debt. In that case, (d) is equivalent to the condition (2) described earlier. Rather than proceeding to a complete solution of (6), we shall simplify the problem further. (The complete solution is found numerically in the Appendix.) With optimal policies, the maximum value V is implicitly a function of K_0 and D_0. We write this value at time zero as $V = V(K_0,D_0)$. Similarly, if the economy enters any period t with an inherited capital stock K_t and debt D_t, optimal policies from that period onward will yield intertemporal utility of $V(K_t,D_t)$. Now, consider the planner's problem at time zero. He will choose values of C_0 and I_0, which then yield K_1 and D_1 via (6)(a)-(c). Thereafter, he will continue to borrow optimally, so that from period 1 onward, the economy achieves $V(K_1,D_1)$. From the perspective of period zero, utility is therefore $V(K_0,D_0) = U(C_0) + V(K_1,D_1)/(1+\delta)$. The infinite-horizon problem becomes a one-period problem as long as $V(K_1,D_1)$ is known.

More usefully, we shall work with a two-period variant of the problem in (6). We rewrite the planner's problem as:

$$\text{(7)} \qquad \max V(K_0,D_0) = U(C_0) + U(C_1)/(1+\delta) + V(K_2,D_2)/(1+\delta)^2$$

subject to:

(a) $K_{t+1} = K_t(1-d) + I_t \qquad t = 0,1$

(b) $Q_t = F(K_t)$

(c) $D_{t+1} = (1+r)D_t + (I_t+C_t) - Q_t$

(d) K_0,D_0 given

We shall assume that the function $V(K_2,D_2)$ is known, and study the optimal choices in periods 0 and 1. In fact, for many of our results we will not need to know $V(K_2,D_2)$. In general, $V(K_2,D_2)$ may be found by more powerful methods of optimal control or dynamic programming, or the infinite-horizon problem in (9) may be tackled head on, as in the Appendix.

Optimal Borrowing Without Liquidity or Repudiation Risks

In this section we study the optimal borrowing decision when borrowing is limited only by a solvency constraint. The solvency constraint is implicitly built into the $V(K_2,D_2)$ function. Let $W_2 = \max \sum_{i=2}^{\infty}(1+r)^{-(i-2)}(Q_i-I_i)$. W_2 is implicitly a function of K_2, so that the solvency constraint $(1+r)D_2 \leq W_2(K_2)$ is a constraint on debt relative to the capital stock. When $(1+r)D_2 = W_2(K_2)$, consumption must be zero forever into the future in order to service the debt, so that $V[K_2,W_2(K_2)] = \sum_{i=2}^{\infty}(1+\delta)^{-(i-2)}U(0)$, which is obviously a lower limit for V.

The optimal borrowing strategy is found by direct optimzation of (7). The first-order conditions are:

(8) (a) $U_0(C_0) = \lambda$

(b) $U_1(C_1)/(1+\delta) = \lambda/(1+r)$

(c) $F_K(K_1) = (r+d)$

(d) λ is the marginal utility of wealth

The results of the optimization are straightforward and well-known. With a perfect world capital market, borrowing and lending should be undertaken to smooth the marginal utility of consumption over time. The marginal utility of consumption in period i (MUC_i) is given by $U_i(C_i)/(1+\delta)^i$, where $U_i(C_i)$ denotes

$\partial U(C_i)/\partial C_i$. The present-value price of output in period i is $\pi_i = (1+r)^{-i}$, where π_i is the number of units of output which must be saved at time zero in order to yield one unit of the good in period i. The consumption smoothing rule is then:

(9) $\quad MUC_i/\pi_i = \lambda$ for all periods i

We have described the major implication of (9) in earlier work (Sachs, 1982b, and Sachs, 1984). Basically, it captures the old dictum "Finance a temporary shock, adjust to a permanent shock." When output is temporarily depressed, λ does not change much, and according to (9), the MUC should also remain unchanged. This involves maintaining a high rate of consumption in spite of temporarily low output, by accumulating debt. When output is permanently reduced, λ rises, so that MUC in every period should also rise. In effect, consumption is reduced in line with lower permanent income, and the country should not borrow in order to maintain a high rate of consumption.

(8)(c) expresses the second half of the standard borrowing strategy. Investments should be undertaken to the point where the marginal product of capital equals the world cost of capital, where the latter is measured as a world real interest rate plus the rate of depreciation. In more complex investment environments this rule would be re-stated as a rule to undertake all investment projects with positive present value at the world interest rate.

Suppose that these guidelines are to be adopted. By what set of policy rules can they be implemented? Under a set of restrictive conditions, the guidelines are those that would be adopted by value-maximizing firms and utility-maximizing households in a fully decentralized economy. The necessary assumptions are:

- perfect foresight (or rational expectations under uncertainty);
- the social welfare function V is also the representative household's utility function;
- unrestricted access of households and firms to the world capital market;
- no taxes on other distortions that cause the private marginal product of capital to diverge from the social marginal product of capital (F_K);
- no taxes or other distortions that cause the post-tax real interest rate to diverge from the world real interest rate.

If these conditions hold, then the laissez-faire approach to foreign borrowing will yield an optimal path of external indebtedness. When any of these conditions is violated, the case for laissez-faire is substantially weakened. Though much of the rest of the paper involves relaxing the assumptions needed to justify laissez-faire, it is useful to mention a few examples of how these assumptions may be violated. Some illustrative cases are described in Table 1.

We now turn to some key extensions of the basic model, still assuming the absence of liquidity and repudiation risk.

Traded versus Non-traded Goods

Suppose, now, that the economy produces non-traded as well as traded goods. Sectoral output is written as a function of sectoral capital stocks (labor input is supressed, but could be added easily): $Q^T = F^T(K^T)$ and $Q^N = F^N(K^N)$. Let P^N_t signify the relative price of non-tradeables in terms of tradeables in period t. Consumption is divided between N and T subject to an intertemporal social welfare function of the form $V = \sum_{i=0}^{\infty}(1+\delta)^{-i}U(C^T_i,C^N_i)$. For simplicity, all investment is assumed to use the traded good (here, too, extension to the general case is straightforward). Let I^N be investment made in the non-traded goods sector (using tradeable output) and I^T be investment in tradeable-goods production, so that $K^T_{t+1} = K^T_t(1-d) + I^T_t$ and $K^N_{t+1} = K^N_t(1-d) + I^N_t$. The trade balance is $Q^T - C^T - (I^T + I^N)$ and non-traded good equilibrium is $Q^N = C^N$.

From the point of view of the solvency condition, productive wealth must be redefined as productive <u>tradeables</u> wealth, max $\sum_{i=0}^{\infty}(1+r)^{-i}(Q^T_i-I^T_i-I^N_i)$. External debt debt cannot exceed the present discounted value of net tradeables production, since by definition only tradeables goods can be used for exports to service the external debt.

Let us now consider the two-period borrowing problem with tradeables and nontradeables:

(10) $$\max U(C^T_0,C^N_0) + U(C^T_1,C^N_1)/(1+\delta) + V(K^N_2,K^T_2,D_2)(1+\delta)^2$$

subject to:

$$D_{t+1} = (1+r)D_t + Q^T_t - C^T_t - (I^T_t+I^N_t)$$

$$Q^N_t = C^N_t$$

$$K^T_{t+1} = K^T_t(1-d) + I^T_t$$

$$K^N_{t+1} = K^N_t(1-d) + I^N_t$$

$$Q_t^T = F^T(K_t^T)$$

$$Q_t^N = F^N(K_t^N)$$

The solution to this problem is easily shown to be:

(11)(a) $U_{OT} = \lambda$

$U_{ON} = \lambda P_0^N$

$U_{1T} = \lambda(1+\delta)/(1+r)$

$U_{1N} = \lambda P_1^N \; (1+\delta)/(1+r)$

(b) $F_K^T(K_1^T) = (r+d)$

$P_1^N \; F_K^N(K_1^N) = (r+d)$

The main insight from this optimization is that current decisions regarding consumption and investment must involve forecasts of the future relative price of non-tradeables. At time zero, for example, the investment in non-traded goods should equate $P_1^N F_K^N(K_1^N)$ with $(r+d)$. It will likely be the case that P_1^N will not equal P_0^N, with the result that myopic expectations regarding P^N will result in a misallocation of investment expenditure. We provide a quantitative illustration of this point in the appendix.

Official Borrowing to Augment Private Savings

In many economies private investment is deemed insufficient to generate desired growth rates in the economy, and the public sector is regarded as an "engine of growth" through the role of augmenting the rate of capital

Table 1

Assumptions Underlying the Case for Laissez-Faire

Assumption	Examples of Violation
Perfect Foresight or Rational Expectations	Households or firms may incorrectly extrapolate current exchange rates and interest rates into the future, particularly since governments are fond of promising that there will be no exchange rate changes.
Social Welfare Function	The government's planning horizon and rate of time preference may differ from that of a "typical household." Ideally, governments may represent future generations that are under-represented in the interests of current households.
Access to World Capital Markets	Most LDC capital markets are highly segmented, so that "free" access to the world market may imply a sharply different degree of of access for different groups within the economy, and may therefore have perverse effects on resource allocation.
Equality of Social and Private Marginal Products of Capital	This assumption will be violated for public goods (e.g. physical infrastructure), providing a crucial reason for direct government intervention in the investment process.

Table 1, continued

Assumption	Examples of Violation
	Similarly, tariffs and domestic taxes may drive a wedge between market and shadow prices.
Equality of Domestic and World Interest Rates	Taxes and subsidies on capital, market segmentation and a noncompetitive financial sector may all contribute to a major divergence between the world cost of capital and the domestic interest rate.
	Also important, there may exist externalities in the borrowing process so that individual borrowers drive up the external cost of funds for others. In this case, interest rates will not equal the marginal cost of funds to the country as a whole.

accumulation. Underdeveloped domestic capital markets may cause private savings, and hence private investment, to remain low. Fiscal expenditures on investment goods may then form a significant share of total capital formation, with foreign official borrowing playing an important role in the finance of government investment, and taxes playing a crucial role in generating official resources for debt servicing. Not surprisingly, the optimal borrowing strategy must be re-computed under these circumstances, for debt-servicing capacity depends not only on national wealth but also on the public sector's ability to tax that wealth. When there are weaknesses (either political or economic) in the government's authority to raise taxes, governments must be especially cautious in their foreign borrowing. The following illustration underlines this need for caution. (This section relies heavily on Sachs, 1984).

Suppose that because of an underdeveloped capital market, the private sector in the developing country saves a _fixed fraction_ of post-tax income, rather than optimizing intertemporally. The government uses its taxing and borrowing authority to supplement private saving. (See Arrow and Kurz, 1970, Ch. VI, for a similar model of imperfect capital markets.) Private investors have no direct access to the international loan market. The government taxes domestic output at rate τ_t, which may change over time. This rate must be less than 1.0, and may be _less than zero_ if the government is making net income transfers to the private sector. There is no public consumption.

With domestic output given by Q_t, tax revenues are $\tau_t Q_t$, and private sector savings are $s(1-\tau_t)Q_t$. Private consumption is given by $C_t = (1-s)(1-\tau_t)Q_t$. In any period, the government borrows D_{t+1} and repays $(1+r)D_t$. Total investment in the economy is given by:

(12) $$I_t = \underset{\substack{\text{(private}\\ \text{savings)}}}{s(1-\tau_t)Q_t} + \underset{\substack{\text{(tax}\\ \text{revenue)}}}{\tau_t Q_t} + \underset{\substack{\text{(net foreign}\\ \text{resource}\\ \text{inflow)}}}{[D_{t+1}-(1+r)D_t]}$$

As written, it appears that all foreign borrowing is used for investment rather than consumption, but this is true only as an accounting matter. Suppose, for example, that the government wants to raise private consumption while holding investment levels fixed. It merely raises D_{t+1} while reducing τ_t sufficiently to keep I_t constant; in that case the borrowing finances consumption 100% on the margin.

Now, let us calculate the optimal financial policy of the government, assuming again that it tries to maximize an intertemporal utility function of the form $U(C_0) + U(C_1)/(1+\delta) + V(K_2,D_2)/(1+\delta)^2$.

(13) The Basic Public Finance Problem with International Borrowing

$$\max_{I_0,I_1,\tau_0,\tau_1} \quad U(C_0) + U(C_1)/(1+\delta) + V(K_2,D_2)/(1+\delta)^2$$

subject to

$$Q_t = F(K_t)$$

$$K_{t+1} = K_t(1-d) + I_t$$

$$C_t = (1-s)(1-\tau_t)Q_t$$

$$I_t = s(1-\tau_t)Q_t + \tau_t Q_t + D_{t+1} - (1+r)D_t$$

As long as tax rates are completely flexible, the solution to this problem is identical to the solution to (7), since the dynamic budget constraint facing the government is no different whether it chooses C_t and I_t as before or τ_t and I_t as here.

To find the tax rates corresponding to this optional plan, note that $C_i = (1-s)(1-\tau_i)F(K_i)$, so that $\tau_i = 1-[C_i/F(K_i)][1/(1-s)]$. Assuming that s is fixed, a typical optimal growth path will involve a rising τ. Low tax rates in the early period allow households to benefit early on from the growth that will be achieved in periods 1 and 2. Higher taxes later on are necessary to service the international debt.

Now let us introduce a simple yet crucial hitch into the model. Suppose that the government can only raise tax rates to a limit $\bar{\tau} < 1$, and that the constraint is binding in the sense that the optimal τ_0 and/or τ_1 exceeds $\bar{\tau}$. The first effect of the tax ceiling is to tighten significantly the solvency constraint in (2). Debt repayment now depends on taxing authority as well as national wealth. The new constraint is that D_t must be less than or equal to the maximum level of tax revenues net of government investment. Government investment is I_t minus private investment, $s(1-\tau_t)Q_t$. Thus,

$$(14) \qquad D_t(1+r) \leq \max_{\tau,I} \quad \sum_{i=t}^{\infty}(1+r)^{-(i-t)}[\tau_t Q_t - I_t + s(1-\tau_t)Q_t]$$

It is more likely that (14) rather than (2) holds as a binding constraint, since (14) does <u>not</u> imply that future consumption must equal zero when the constraint binds. Nonetheless, in the examples that follow, we do not consider the case in which (14) binds. We focus rather on the constraint $\tau = \bar{\tau}$, assuming D_t remains below the maximum level in (14).

Since the optimal tax path tends to involve rising τ, a natural case to consider is one in which the tax constraint does not bind in period 0 while it does bind in period 1. Thus, we assume $\tau_0 < \bar{\tau}$ and $\tau_1 = \bar{\tau}$. What are the implications of the tax constraint? Basically, first-period consumption C_1 remains "too high" relative to the plan that an unconstrained government would choose, since the fiscal authority would like to raise taxes in the first period but cannot do so. Therefore, the marginal utility of income in the first period is too low, and the returns to investment in period 1, namely $F_K(K_1)$, should be given a weight less than 1.0 in project analysis. After some algebra, we can prove:

(15) $$F_K(K_1) = (r + d) \cdot \varepsilon \quad \text{where } \varepsilon > 1.$$

We have the key result:

> Under a regime of constrained tax levies, the marginal product of capital should no longer be equated with the world market cost of capital but rather should be kept higher, to reflect a lower shadow value of first-period output.

If the government follows the standard rule $F_K(K_1) = r + d$, the country is led to over-borrow, with the result that social welfare is reduced.

Let us consider a graphic case of this issue that follows the analysis in Kharas (1981). Suppose that the government only cares about growth, in the sense that $u(C_0) \equiv u(C_1) \equiv 0$, and $V(K_2,D_2) = F(K_2) - (1+r)D_2$. The government is trying to maximize second-period national income (net of international indebtedness). If τ_t is not constrained, τ_0 and τ_1 should be set at 1.0, with government revenue plus net foreign borrowing used to equate $F_K(K_2)$ with $r + d$, according to the classical policy prescription.

Now suppose that $\tau_0, \tau_1 \leq \bar{\tau} < 1$. Since consumption has no weight in utility, it is optimal to set taxes at their maximum rate: $\tau_0 = \tau_1 = \bar{\tau}$. Then, D_2 and K_2 are given by:

$$D_2 = (1+r)\{I_0 - [s(1-\bar{\tau}) + \bar{\tau}]F(K_0)\} + \{I_1 - [s(1-\bar{\tau}) + \bar{\tau}]F[K_0(1-d) + I_1]\}$$

$$K_2 = K_0(1-d)^2 + I_0(1-d) + I_1$$

By setting $\partial V/\partial I_0 = \partial V/\partial I_1 = 0$, we find the optimal investment policy. After some algebra, we find:

$$(16) \qquad F_K(K_1) = \frac{(r+d)}{s(1-\bar{\tau}) + \bar{\tau}} > r + d;\ F_K(K_2) = (r + d)$$

Once again, the country should not invest enough to equate $F_K(K_1)$ and $r + d$.

This model provides a powerful indictment against foreign borrowing, <u>even for productive investment projects</u>, if the domestic fiscal system is not equipped to handle rising debt-service ratios. Figure 2 illustrates how aggregate growth is slowed by excessive borrowing in a tax-constrained regime, for specific parameter values of the model. In the unconstrained regime, optimal borrowing is at D_2^*, with growth at g^*. In the constrained case, with a low $\bar{\tau}$, the optimum is at $D_2^{**} < D_2^*$, with growth at $g^{**} < g^*$; and in the constrained case with a high $\bar{\tau}$, the optimum is at D_2^{***}, with growth at g^{***}. If the borrower with low $\bar{\tau}$ equates $F_K(K_1)$ with $r + d$, in spite of the tax constraint, the growth rate ends up at $\hat{g}$ (corresponding to D_2^*), which is lower than can be achieved with less foreign borrowing, g^{**}.

Optimal Borrowing with Liquidity Constraints

Debt crises almost never involve the strict solvency constraint in foreign borrowing. Well before consumption levels are driven to subsistence, countries typically repudiate their foreign debt or succeed in gaining debt relief. Often

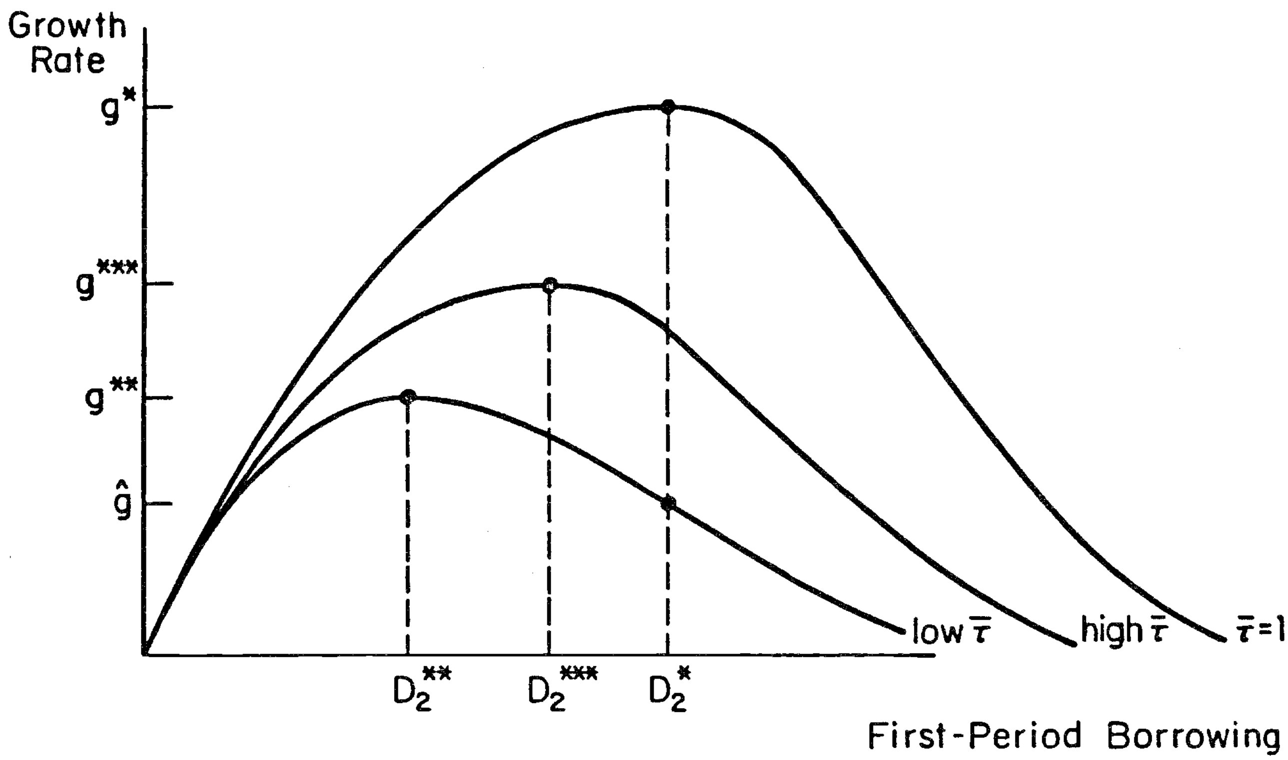


Figure 2. Foreign Borrowing and Growth in a Tax-Constrained Regime (Growth is measured by $F(K_3) - (1+r)D_3$, as in text)

a debt crisis has little to do with fundamental solvency considerations but rather turns on the short-run difficulties of debt servicing. In this section, we explore how borrowing strategies should be modified when short-run liquidity risks are present. We establish two principal results. First, the optimal level of borrowing depends importantly on the probability of a cutoff in lending. Second, the possibility of a lending cutoff increases the importance of the maturity structure of the debt. The standard prescription that long-term projects should be financed with long-term loans grows in importance as the probability of a lending cutoff rises.

We begin with an extremely simple version of the two-period model, with physical investment ignored. The goal of borrowing is to maximize expected utility.

(17) $$\max E(V) = E[U(C_0) + U(C_1)/(1+\delta) + V(D_2)/(1+\delta)^2]$$

subject to:

$$C_0 = Q_0 + D_1$$

$$C_1 = Q_1 + D_2 - (1+r)D_1$$

Borrowing constraint:

with probability π, $D_2 \leq 0$ (i.e. no foreign borrowing)

with probability $(1-\pi)$, D_2 not restricted

With probability π, the country is unable to obtain new finance D_2 in period 1, and the country must borrow D_1 without knowing whether D_2 will in fact be available. At this point, we assume that π is independent of the level of debt. Below, we introduce the more realistic assumption that π rises with D_1, i.e.

that high debt levels make potential creditors less likely to extend new debt.

Consider first the case when $\pi = 0$. Then from our earlier results we know that $U_0(C_0) = U_1(C_1)(1+r)/(1+\delta)$ and that $U_1(C_1) = -V_D/(1+\delta)$. When $\pi > 0$, we must consider two outcomes: either the economy is liquidity constrained (denoted by superscript L) or it is not (denoted by superscript N). D_1 is borrowed without knowing the outcome in the next period. Consumption turns out to be $C_1^L = Q_1 - (1+r)D_1$ if the borrowing constraint holds, and $C_1^N = Q_1 - (1+r)D_1 + D_2^N$ if it does not.[3] Clearly $C_1^N > C_1^L$. In case N, D_2^N is selected according to the standard criterion $U_1^N(C_1^N) = -V_D(D_2^N)/(1+\delta)$. In case L, we have $U_1^L(C_1^L) > -V_D(0)/(1+\delta)$. Parenthetically, D_2^N is an increasing function of D_1.[4]

By writing EV as $U(C_0) + \pi[U(C_1^L)/(1+\delta) + V(0)/(1+\delta)^2] + (1-\pi)[U(C_1^N)/(1+\delta) + V(D_2^N)/(1+\delta)^2]$, we find the optimal borrowing level D_1 as the solution to $d(EV)/dD_1 = 0$:

$$(18) \qquad d(EV)/dD_1 = 0 \Rightarrow U_0 = [(1+r)/(1+\delta)][\pi U_1^L + (1-\pi)U_1^N]$$

By totally differentiating this equation with respect to D_1, D_2^N, and π, we can find the dependence of D_1 on π. After some algebra, we can show[5]

$$(19) \qquad dD_1/d\pi < 0$$

Thus, as the probability of a second-period lending cutoff rises, optimum first-period borrowing should decline.

Liquidity Crises and Borrowing Externalities

Should governments regulate foreign borrowing if liquidity crises are possible? Under some special circumstances, the answer is no, though more generally this form of market failure does provide a case for intervention. The model we have just explored can justify laissez-faire, if the following assumptions hold:

- the private sector has rational expectations of a liquidity crisis;
- the probability π is not a function of the overall level of borrowing;
- the government can credibly commit itself to refuse to bail out private agents who find their credit cut off;
- the liquidity crisis causes no widespread bankruptcies, or if bankruptcies occur, they are handled efficiently, without social cost.

If these assumptions are maintained, then individual agents will choose their intertemporal plans such that $U_0 = E(U_1)[(1+\delta)/(1+r)]$, where $E(U_1) = \pi U_1^L + (1-\pi)U_1^N$. This is precisely the first-order condition found in (18).

All of these assumptions are highly suspect. Borrowers probably do not have a good understanding of financial crises (neither do economists or governments!), much less an ability to predict their occurrence. Moreover, though π is hard to forecast, it is likely that the frequency of a loan cutoff increases with the amount of debt outstanding. We have already argued that such a crisis arises when no single lender is willing to lend the country as much as it needs to remain current on debt servicing. That possibility cannot arise when D_1 is very low.

Third, when liquidity crises arise, governments are almost inevitably called upon to act to bail out debt-ridden firms. As Diaz-Alejandro has recently argued (1984, p. 19 and p. 22), based on the experience of Argentina, Uruguay, and Chile:

> Whether or not deposits are explicitly insured, the public expects governments to intervene to save most depositors from losses when financial intermediaries run into trouble. Warnings that intervention will not be forthcoming appear to be simply not believable....
>
> Foreign lenders take government announcements that it will not rescue local private debtors, especially banks, with non-guaranteed external (or domestic) liabilities even less seriously than depositors take the threat of a loss of their money....Foreign bank lending to both the public and private sectors of a country have considerable leverage to convince governments to take over _ex-post_ bad private debts, especially those of financial intermediaries.

If the government is always expected to bail out bad debts, moral hazard problems are rife. Debtors will no longer expect to feel the full brunt of the crisis, since losses will be socialized (i.e. spread among borrowers and non-borrowers throughout the economy). Obviously, over-borrowing may then arise.

The fourth assumption, that bankruptcies impose no social costs, is also likely to be far off the mark. In an ideal legal system, over-extended debtors would simply transfer their equity claims to creditors without a loss of production in those firms still covering variable costs. In practice, when firms go bankrupt, they often cease operations in the short or long run, leading to unemployment of resources. Indeed, it is precisely because bankruptcies impose heavy social costs that governments are obliged to extend debt relief.

It is not very easy to specify the appropriate borrowing strategy given the above complexities. It is, however, worthwhile to take just one of the issues and develop its implications analytically. Suppose that the model remains as in (17), but now with π an increasing function of D_1. When we recalculate the optimal borrowing level by setting $d(EV)/dD_1 = 0$, we find:

$$(20) \qquad U_0 = [(1+r)/(1+\delta)][\pi U_1^L + (1-\pi)U_1^N] + (d\pi/dD_1)[V_1^N - V_1^L]/(1+\delta)$$

where:

$$V_1^N = U(C_1^N) + V(D_2^N)/(1+\delta)$$

$$V_1^L = U(C_1^L) + V(0)/(1+\delta)$$

and $V_1^N - V_1^L > 0$

Compare the expressions for U_0 in (18) and (20). We see in (23) that U_0 is greater than $[(1+r)/(1+\delta)][\pi U_1^L + (1-\pi)U_1^N]$ by a term that reflects the effect of D_1 on π. Basically, (20) holds that _r does not reflect the marginal cost of external funds_, since an increase in D_1 also makes more likely a welfare-reducing liquidity crisis.

If the marginal borrower behaves as if π is given, the private marginal cost of funds (r) will fall short of the social cost, and over-borrowing will occur. Laissez-faire is no longer first best, even if all of the other necessary assumptions hold true. The optimal borrowing strategy is then to _tax_ foreign borrowing, so that private and social costs are aligned. The situation is formally equivalent to the Bhagwati-Srinivasan (1975) argument for a disruption-tariff when high export levels raise the possibility of foreign trade retaliation.

Liquidity Crises and Debt Maturities

The possibility of a loan supply cutoff provides an important reason for matching the maturity structure of the debt with the gestation period of physical capital investment. Suppose that an incremental investment opportunity dI_1 becomes available in the problem in (20). We call the investment "short-term" if it pays off in the next period and "long-term" if it pays off in two periods. For the short-term case, we assume that the yield is $(1+\theta)dI_1$, with $\theta > r$. For the long-term case, the yield after two periods is $(1+\theta)^2 dI_1$, again with $\theta > r$. We also assume the existence of short- and long-term loans, with the same interest rate per period. A short-term loan D_1^S requires repayment $(1+r)D_1^S$ in the next period. A long-term loan D_1^L requires repayment $(1+r)^2 D_1^L$ in two periods.

It is easy to prove the following results:

- For any π, the short-term project should be undertaken with short-term finance.
- For any π, the long-term project should be undertaken with long-term finance.
- The long-term project should not necessarily be undertaken with short-term finance. This is true even though the project has positive present value at the world interest. The project becomes more desirable the lower is π and the greater is θ relative to r.

The proof of these propositions is simple. Start at an equilibrium with no investment. When maturities of I and D are matched, it is easy to show that consumption plans can be left unchanged, and final indebtedness D_2 can be lowered, by undertaking the investment project. For the case of short-term finance for a long-term project, the demonstration is a little more involved. Basically, a liquidity crisis is more severe the larger is D_1. If $\theta = r$, then undertaking the investment yields no net benefits, but it does impose a cost by raising D_1 (and therefore raising the welfare loss in the event of a liquidity crisis). Therefore θ must be sufficiently above r to justify new borrowing.[6]

Generally, long-term debt reduces the costs of a possible lending cutoff. This is for two reasons. First, and most obvious, for a given external debt, the shorter is the maturity structure, the greater on average is the amount of principal repayment in a given period. Therefore, the larger is the required short-run cut in domestic spending if new lending suddenly ceases. Second, and perhaps more important, a judicious use of long-term borrowing with short-term lending (i.e., reserve accumulation) can help to obviate liquidity crises by reducing the need to borrow in a given period. Suppose that without fear of a debt cut off the optimal path of short-term borrowing would be D_1 in the first period and D_2 in the next. Using long-term loans, this pattern can be replicated without any second-period borrowing (assuming, as we have done, that both short-term and long-term loans have the same interest rate per period). The economy simply borrows $[D_1 + D_2/(1+r)]$ in long-term funds, and puts $D_2/(1+r)$ into reserves. The reserves have value D_2 in the next period, and these reserves are then drawn down to zero in the next period. Thus, it becomes irrelevant whether new lending is or is not available in that period!

The fact that countries hold substantial reserves provides good evidence that liquidity can be a serious concern. Governments borrow long-term to hold reserves even though the cost of long-term finance is higher than the returns to official reserves. This behavior makes sense if governments are willing to pay a premium to assure the availability of foreign exchange in a given period. Other evidence in this regard is that countries often pay commitment fees to guarantee the availability of loans at a future date.

Borrowing Strategies When Debt Repudiation is Feasible

Now we turn to the case in which countries can repay debt in both the short-term and long-term, but may be unwilling to do so (this section relies heavily on Sachs and Cohen, 1982). The key to modelling debt repudiation is an explicit assumption regarding its benefits and costs. The benefits are straightforward: the borrower saves the real value of the outstanding debt, which it no longer services. The costs are far more difficult to specify (see Sachs, 1982, for a discussion of the historical experience). One aspect of the costs may be a partial or complete inability to obtain new loans in the world capital markets, at least for some time after the repudiation occurs. Another aspect of the costs may be a direct seizure of the country's overseas assets, including bank accounts, foreign direct investments, ships and aircraft. A third and even more important cost may be a dramatic decline in the country's capacity to engage in trade, even if no net new borrowing is involved. Modern trade is built on a sophisticated system of revolving trade credits. Even if a country's net debt is zero, its gross stocks of trade-related financial assets and liabilities are likely to be large. Because a borrower would have difficulty arranging trade credits after a repudiation, the mechanics of trade would be made onerous. Moreover, merchandise at ports ready to be dispatched to the debtor country could be subject to seizure by creditors.

To introduce these elements, we assume that when a debt is repudiated the creditors retaliate by imposing two costs: in all future periods, the borrower's production is reduced, for given K, by a fixed fraction θ; and second, the borrower is excluded from all further borrowing. Importantly, we now assume that this retaliation yields neither costs nor benefits to the creditors (or that the costs and benefits cancel). In terms of the discussion in the first section, we set $\gamma = 0$.

As an easy start, we begin with a simplified version of the international borrowing model (we simply drop $V(K_2,D_2)$). The tax considerations are ignored, so that we implicitly assume that domestic tax levies are not constrained. Loans are made to the sovereign borrower in period 0. If they are not repaid in period 1, the penalty is enforced and output is reduced by θQ_1. The borrower makes the repudiation decision in period 1; there is no way that it can pre-commit itself to a decision before the period arrives. Moreover, in this section the possibility of a negotiated settlement is ignored. (The general principles of credit rationing are the same when <u>ex post facto</u> negotiations are allowed.) Since second-period utility is simply $u(C_1)$, the borrower compares consumption levels with and without repudiation. With repudiation, C_1 equals $Q_1 - \theta Q_1 = (1-\theta)Q_1$. (We denote this level as C_1^R.) With <u>no</u> repudiation, C_1 equals $Q_1 - (1+r)D_1$, which we denote C_1^N. The borrower defaults whenever C_1^R exceeds C_1^N, and thus whenever $(1+r)D_1 > \lambda Q_1$.

There are two choices with respect to the timing of loans. The level of credit D_1 may be extended before or after the investment decision I_0 is made.

We shall see shortly that it is a great advantage to the country to be able to choose I_0 before going to the capital markets, since I_0 may then be chosen to make the credit terms on a given loan more favorable, or to increase the total amount that the country can borrow. A more natural assumption, however, is that loans are arranged first and that the government then allocates them to consumption and investment. In this case the government will generally have an incentive to <u>renege</u> on a promised level of I_0 once a loan has been arranged, even if *ex ante* it would be better off to fix I_0. Thus, promises concerning I_0 will be unconvincing. We term the case in which I_1 is set first the "precommitment" equilibrium, and regard the other case as the "standard" assumption.

A linear model offers a vivid illustration of the effects of repudiation risk and of investment precommitment. Let:

(21) $$Q_0 = \bar{Q}$$

$$Q_1 = \bar{Q} + (1+\gamma)I_0, \qquad I < \bar{I}$$

$$V = C_0 + C_1/(1+\delta)$$

$$\delta > \gamma > \rho$$

According to (21), there is a quantity $\bar{I}$ of investment projects with a rate of return γ exceeding the world interest rate r. The rate of time discount δ is assumed to be greater than the world interest rate. In the no-repudiation model, utility V is maximized by setting $I_0 = \bar{I}$ (all investment projects are undertaken). Consumption is shifted entirely to the first period with <u>no</u> consumption in the second (since $\delta > r$ and utility is linear). In sum:

(22) The Case of No Repudiation

$$C_0 = \bar{Q} + [\bar{Q} + (1+\gamma)\bar{I}]/(1+\rho)$$

$$I_0 = \bar{I}$$

$$C_1 = 0$$

$$D_1 = C_0 + I_0 - \bar{Q}$$

Now, we turn to the "standard" case of the repudiation model. Once a loan D_1 is arranged, the borrower will choose to set $I_0 = 0$, since $\delta > \gamma$. Therefore $Q_1 = \bar{Q}$, and the debt ceiling is given by $\bar{D}_1 = \lambda\bar{Q}/(1+\rho)$. The complete solution is:

(23) The Standard Repudiation Case

$$C_0 = \bar{Q} + \lambda\bar{Q}(1+r)$$

$$I_0 = 0$$

$$C_1 = \bar{Q} - \lambda\bar{Q}$$

$$D_1 = \lambda\bar{Q}/(1+r)$$

Therefore, the presence of repudiation risk causes rationing of the borrower (note that D_1 is lower in (23) than in the previous equation). Investment is reduced (all the way to zero in this example!) and consumption is pushed to the second period. The presence of repudiation risk reduces the borrower's welfare by restricting capital inflows.

Finally, we turn to the precommitment case. It turns out that the borrower may be able to raise its welfare by promising a high level of investment I_0. Higher I_0 raises Q_1, and thus raises the penalty for repudiation, which equals θQ_1. When I_0 is high, creditors are therefore more willing to lend, and the credit constraint is eased. In this version, the borrowing country will choose to precommit to $I_0 = \bar{I}$ when γ is close to δ, and when δ is much greater than r. Specifically we find:

(24) The Pre-Commitment, Repudiation Case

$$C_0 = \bar{Q} + D_1 - I_0$$

$$I_0 = 0 \text{ for } (\delta-r)\theta(1+\gamma) < (\delta-\gamma)(1+r)$$

$$I_0 = \bar{I} \text{ for } (\delta-r)\theta(1+\gamma) > (\delta-\gamma)(1+r)$$

$$C_1 = Q_1 - \lambda Q_1$$

$$D_1 = \theta Q_1/(1+r)$$

Thus, the pre-commitment case _may_ be the same as the no-pre-commitment case, but might (and generally will) result in an equilibrium somewhere between the textbook model and the standard repudiation model. Pre-commitment makes sense when $\delta \approx r$ (that is, the rate of time discount is not too high), and when $\gamma \gg r$ (that is, investment is quite profitable). Pre-commitment allows greater borrowing, greater investment in profitable projects, and higher first-period consumption.

Repudiation Risk with Uncertainty

So far, an actual default never occurs in the model, though the threat of default has a profound effect on economic welfare and the nature of macroeconomic equilibrium. Once uncertainty is introduced into the model, debt repudiations will actually occur as random events. The presence of uncertainty has several effects. First, the loan supply schedule becomes upward sloping, rather than perfectly elastic, up to a maximum debt level $\bar{D}$. Second, and even more important, the incentive structure for macroeconomic management may become perverse in ways now described. A more complete treatment of debt repudiation under uncertainty may be found in Sachs and Cohen, 1982, and Sachs, 1984.

A recent theme of financial economics is that the various claimants on a firm's income stream (e.g., the shareholders, bondholders, workers) have differing interests regarding the firm's policies because alternative policies affect the relative valuation of the different claims. Thus, the shareholders may urge policies that raise shareholder wealth at the expense of bondholder wealth, as described in by Jensen and Meckling (1976). Or coalitions of the shareholders and banks may engage in policies at the expense of bondholders, especially in the context of bankruptcy actions (see Bulow and Shoven, 1978). A notable feature of these examples is that the firm may pursue inefficient policies that reduce the overall value of the firm, because some groups will benefit even though other groups will be hurt more. A related theme is that all groups are generally left better off, *ex ante*, if the firm can be constrained from pursuing inefficient policies.

Several direct analogies can be made to macroeconomic behavior by the borrowing country. Like a firm, the country also has various claimants on the income stream, including the government, domestic citizens, and international creditors. Like the firm, the country may be led to select inefficient policies to transfer income from the creditors to the "shareholders" (the government and domestic private sector). Generally, the country would like to foreswear these policies *ex ante* but may find it difficult to do so.

There are several areas of behavior in which timing and default risk interact to produce bad macroeconomic choices. The earlier discussion of investment pre-commitment can be thought of precisely in these terms. From an *ex ante* point of view it is best for the country to choose a high level of investment, because high investment relaxes credit ceilings. However, *once* a loan package is arranged, the country prefers to raise first-period consumption at the expense of investment. Since creditors understand this, they will tend to discount initial promises of high investment plans, and indeed they will be right.

A similar phenomenon occurs when countries borrow with long-term debt. When a country owes long-term debt, each *new* amount of borrowing tends to reduce the expected value of the original debt by making its eventual repudiation more likely. In many cases, the borrowing country would like to be able to promise a potential long-term creditor that it will not over-borrow once the long-term debt is arranged. Such a promise would reduce the risk premium on the long-term debt. However, there will generally be strong incentives, *ex post*, to do precisely the contrary. The result is, in general, that long-term debt will command a high risk premium *and* that, as expected, over-borrowing will occur.

Market participants search for ways to reduce these deleterious incentives. It may be the case that countries can establish reputations for maintaining macroeconomic policies in line with announced plans. There is a growing economics literature on establishing a reputation that may well give some insights in this direction. Other specific actions, such as relying on short-term borrowing rather than long-term borrowing, may reduce some of the incentive problems. In domestic capital markets, and to a much smaller extent in international lending, bond covenants can be used to pre-commit the borrower to a future line of action. Smith and Warner, 1979, provide an excellent survey of such covenants, indicating how they help to enforce an efficient borrowing and investment plan by corporate borrowers. For example, covenants often directly restrict dividend payments, which may be tantamount to requiring the shareholders to invest rather than "consume" their loans. Other types of provisions include restrictions on new borrowing, maintenance of the firm's existing assets, financial disclosure requirements, and restrictions on merger activity. Such provisions are typically unenforceable when foreign sovereign borrowers are involved and thus are not part of most (international) syndicated loan agreements.

Further Aspects of Managing Repudiation Risk

So far, we have derived the optimal borrowing behavior for an economy that has the option of repudiating its debt. As in earlier sections, we should now ask how these optimal borrowing policies can be implemented. What is the role of the government in managing repudiation risk?

There is a profound externality in the borrowing process under repudiation risk that leads governments into a central policy role. In many cases, a default or debt repudiation by an individual agent affects markets judgments regarding creditworthiness of the country as a whole. Most potential creditors are unable to discern the ultimate causes of a default, and in particular whether the action reflects a weakness of a particular debtor or is instead a signal about government policy and economic health in the whole debtor economy. An individual default raises subjective probabilities of structural weaknesses or widespread mismanagement in an economy, and so causes credit to tighten for all borrowers.

The implications of this spillover are immediate. First, governments -- even the most laissez-faire -- must assume some responsibility for honoring the external obligations of bankrupt firms in the private sector. Second, creditors act on the expectation of such actions, and indeed may withdraw credits from countries when such actions are not forthcoming. Naturally, therefore, governments must at the minimum undertake the prudential supervision of private-sector foreign borrowing in order to safeguard the economy's international creditworthiness. In some cases, it may be necessary to make government backing explicit to facilitate the appropriate levels of inflow.

Even when all lending is to the private sector of an economy, creditors will still be correct to aggregate the country's debt in assessing an economy's incentive to repudiate. This is because a government always has ability to nationalize a substantial part of the external debt, and bargain for the country as a whole vis à vis the foreign creditors. This has been the experience of several Latin American countries in recent years.

Since the risk of repudiation puts a limit on overall borrowing, the interest rate on international loans may be a poor measure of the marginal cost of funds to a borrowing country. Suppose that total lending is rationed at the point $D = \theta Q/(1+r)$. Those lucky enough to borrow at the world market rate will pay a price r, while borrowers on the domestic market will be forced to pay a higher price. The *shadow* price of capital appropriate for the marginal investment decision will be the higher rate. Interestingly, an interest equalization tax on foreign borrowing, raising its costs to domestic levels, would improve the microeconomic allocation of investment funds without necessarily increasing the overall supply of external credits.

We have already noted additional scope for active policies. Governments may have an incentive to spur investment projects for the purpose of enhancing creditworthiness. Another possibility is that governments act to change λ, the cost of repudiation. Outward-looking trade policies probably raise the costs of repudiation by making the country more vulnerable to trade embargoes, credit cutoffs, etc. Thus, a bonus to export-promotion policies may well be enhanced access to world credit markets. To a limited extent, governments may also be able to raise θ by offering to collateralize loans. There are cases in which planes and ships have been offered as collateral on trade financing.

The welfare effects of policy-induced changes in θ are not easy to discern. On the one hand, higher θ stimulates the inflow of capital by reducing the likelihood of repudiation. On the other hand, if an economy runs into severe macroeconomic difficulties, the benefit of default is compromised by a high value of θ. Analytical work suggests that there is likely to be an intermediate value $0 < \theta^* < 1$ that maximizes the debtor's expected utility under repudiation risk.

External Debt and Macroeconomic Policy

This topic is covered in detail by Dornbusch's (1984) paper in this volume. Here we will focus on the possible complications for macroeconomic policy that are created by: (1) the buildup of external debt; and (2) the presence of large external debt.

Despite the freedom that countries have to float their currencies under present international arrangements, most borrowing countries in fact fix their exchange rates -- to another currency or to a weighted average of other currencies. Often there are periodic adjustments of the central rate, but in the short run, the exchange rate is fixed by the central bank.

Under these circumstances external borrowing for local expenditure will lead to monetary expansion. If undertaken freely and extensively, either by the government or by private economic agents, it interferes with monetary control, since borrowing countries typically have little opportunity to "sterilize" inflows of foreign exchange through domestic sales of securities or by other means. Thus new external borrowing more or less directly increases the money supply. External debt that is acquired to cover directly the import of foreign goods or services do not have these internal monetary effects. It is the conversion to local currency at a fixed exchange rate that creates the complication.

Of course, the counterpart in the short run to external borrowing for local expenditure is an increase in international reserves, and these reserves are available to finance imports. As monetary and income effects work their way through the economy, the demand for imports will increase and reserves will be drawn down, reversing the monetary expansion that initially took place. But this corrective process is brought about by the monetary expansion itself, which it might have been desirable to avoid under some circumstances. For this reason, many developing countries operating under fixed exchange rates have found it desirable to limit the inflow of foreign capital, especially that which comes through the banking system. Unless their access to international credit is restricted, banks and private firms with access to the international market can escape the rigors of a tight domestic monetary policy. For example, a multinational corporation that is denied credit at the local bank because of monetary restriction can resort to borrowing from its head office or directly from the international market and thereby bypass the local restrictions. In sum, a commitment to a fixed exchange rate under these circumstances weakens monetary control; its restoration may require limitations on capital flows.

A high level of debt, not just its rate of change, can also create problems for monetary policy. This is especially true when it comes to rolling over a large external debt or correcting a misalignment in the exchange rate. Changes in the exchange rate under such circumstances can have important effects on the balance sheets of business and financial firms. In particular, a currency devaluation can transmute overnight a solvent firm into a technically insolvent one as the local currency value of external debt is raised.

This process is sometimes necessary and even useful. Firms may have overextended themselves with foreign credit on the basis of an overvalued currency. Their operating costs may have been artificially reduced, insofar as they have imported inputs, by the overvalued currency. Currency devaluation puts a halt to the process and introduces some useful economic discipline both for the debtors and for the foreign creditors, who under bankruptcy proceedings would normally share in some of the losses.

Governments are typically reluctant, however, to take steps that will throw firms, especially major firms, into bankruptcy. The presence of extensive external debt may therefore inhibit or force changes in exchange rates in order to limit the financial difficulties of large firms. In 1967, for instance, following the devaluation of sterling, Hong Kong at first devalued the Hong Kong dollar. Not to have done so would have badly weakened the balance sheets of some leading banks, which had assets in sterling, even though on other economic grounds the devaluation was not justified (and, indeed, the action was reversed after a few days when alternative methods for protecting the banks were worked out). Similarly, some countries have put their local development banks into technical insolvency by devaluing the currency. In this way also the presence of external debt serves to limit macroeconomic policy.

Finally, a large external debt of the government itself reduces the flexibility of fiscal policy. Large interest payments cannot be cut if the government desires to retrench. A government that has made total budget expenditures or the total budget deficit a target of eocnomic policy will have to put all the more pressure on domestic expenditures to the extent that external debt servicing is large. This is especially true following a currency devaluation, when the local currency counterpart of external debt denominated in foreign currency will rise in proportion to the devaluation. When framing national stabilization programs, on the other hand, it must be recognized that interest payments to foreigners do not stimulate the domestic economy. Thus, interest on foreign debt should be treated differently from normal government expenditures.

Is Laissez-Faire a Desirable Borrowing Strategy?

A useful reference point for evaluating the debtor's policies toward external borrowing is the complete freedom of all economic agents to borrow abroad without restriction by the borrowing country. This regime generally existed in the 19th century and continues to exist in some advanced countries today, e.g. Canada and the United States. Under these circumstances, creditors must assess and take the risks borrower by borrower, just as they do with domestic loans. If a particular loan cannot be repaid, the external creditors share the loss through bankruptcy without, in principle, affecting the creditworthiness of other (independent) borrowers in the same country.

Perhaps regrettably, there are a number of reasons why the laissez-faire approach is not at present likely to be suitable for most developing countries. First, their governments have almost universally taken a strong hand in economic management, including economic development. Government influence not only on the macroeconomic environment but also on resource allocation is pervasive, to the point where it is often difficult to say whether an enterprise's insolvency is due to bad judgment on the part of management or due to government actions. Under these circumstances, creditors will not view the individual projects as independent but will attach a heavy weight to the "country factor" as such.

Second, even under true laissez-faire, creditors may find it prudent to ration credit to individual borrowers because of the problem of adverse selection in the presence of imperfect information (Stiglitz and Weiss, 1981). If the borrowing is truly and persuasively decentralized, the rationing will be by individual borrower, not (in general) by country except insofar as there is identifiable countrywide risk. But insofar as there is country-risk, as there is bound to be for the first reason above, prospective debtors can enlarge their access to credit by taking steps to reduce the perception of country-risk. One part of this may be, paradoxically, to exert closer control over the external borrowing of economic agents.

Furthermore, many of the potential foreign borrowers in a country may be so important for the continuing functioning of the national economy that bankruptcy -- involving a write down of the foreign debt -- cannot in practice be contemplated. This is especially true of banks and of some other financial intermediaries, as we have already seen. Both the external reputation of the country and internal confidence in its institutions may be so closely tied to particular firms that in practice the government must guarantee their external debt or else avoid any actions that bring its servicing into question. External creditors of the leading banks are thus guaranteed, whether formally or not, by the national government, and their expectations reflect this fact. The same may be true of other important commercial enterprises, including especially government-owned enterprises. In short, bankruptcy of certain institutions would have strong negative reputational externalities for the debtor country. Knowing this, the government should monitor closely and perhaps even limit the external indebtedness of these institutions.

The general point is that countries acquire reputations -- for prudence or foolhardiness, for caution or boldness in economic planning, for market orientation or dirigisme, and so on -- that are important to creditors in assessing credit worthiness. Thus difficulties by some borrowers affect the supply-of-funds schedule to the entire country (and, in periods of rapidly moving crises, fraught by exceptional uncertainty, to neighboring countries as well). In short, there is an informational or reputational externality arising from the inability or unwillingness of lenders to make fine distinctions among borrowers. This occurs in domestic markets as well. For example, virtually all utility stocks are depressed in the United States due in part to the difficulties of those relatively few utilities with nuclear power plants under construction. These "pigeon-hole effects" dissipate over time as more information becomes available, but perhaps only after a liquidity crisis, discussed above, has occurred and much damage has been done -- which in turn can lead to self-fulfillment of pessimistic prophesies.

Direct Responsibility

There are three areas in particular where the government cannot really escape responsibility for external borrowing and therefore must make decisions on both the level and the character of external borrowing.

The first concerns borrowing by the government itself for the provision of public goods and services. Much traditional external borrowing has been for such purposes, and indeed the World Bank was created as a mediating lender in part for the provision of funds for public investments.

Some public infrastructure, such as railroads, is potentially revenue-producing. But much of it is not. The government must raise the debt service through general taxation, with all the implications discussed above. While the old borrower's guideline to match the maturity of the loan to the life of the project does not strictly hold when the project is not revenue-producing, it is a good rule nonetheless: long-term projects, whose contribution to GNP and hence to taxable income is spread over many years, should if possible be financed by long-term borrowing. Not doing so places more pressure on the on the internal terms of trade to generate the trade surplus necessary to amortize the debt rapidly.

The main point is that governments of developing countries are likely to be borrowing abroad to finance public infrastructure, and perhaps operating expenses as well, and they must take a position on the amount and character of their external debt.

A second reason is the widespread government ownership of revenue-generating commercial enterprises -- the so-called parastatals. Rare is the country that does not have some parastatals, and in many countries they generate over half the output of the modern sectors of the economy. The government, as chief or sole stockholder, cannot ultimately dissociate itself from the parastatals, although varying degrees of association are possible. At one end of the spectrum, parastatals can be chartered with a high degree of independence with respect to all business decisions, with a top management that has independent standing and is compensated in relation to profitability of the enterprise. Some British firms approach this model. It would make as clear as possible to lenders that they are dealing with a commercial enterprise with all the attendant risks, and that it does not have the full credit backing of the government. Even in such extreme circumstances, it is unlikely that a government-owner could allow such a firm to go into bankruptcy -- at some loss to its foreign creditors -- without damaging the reputation of the country and especially the government as a borrower. This kind of linkage is not limited to government-owned enterprises. Several U.S. banks went to considerable expense in the mid-1970s to bail out insolvent or weak real estate investment trusts under their sponsorship -- which were legally separate and could have been allowed to fail, as many did -- for the sake of perserving their overall reputation with both creditors and customers.

In any case most parastatals are not put at arms length from the government that owns them, managers are not given full autonomy, and managers are not typically compensated on the basis of profitability of the firm. These factors make it all the more difficult for a government to dissociate fully from the economic performance of its state enterprises.

In the first place, government often uses parastatals to pursue social goals other than profitability, so it is inapprorpiate to hold management responsible for profitability, as would be the case with a privately owned firm. Major investment plans must typically be approved by the relevant ministry, and employment levels and practices are subject to government guidance (as is also true, in lesser degree, of privately-owned firms in many countries). Secondly, management is typically on salary -- often very low salary, compared with compensation in privately-owned enterprises of comparable size -- and while salaries are occasionally augmented by incentive bonuses, the bonuses are typically not related to profitability. For these reasons, managers have no direct incentive to gauge their borrowing to the requirements of profitability. Indeed, since the main motivations of managers in parastatals in many countries is some combination of personal enrichment (other than through direct compensation) and political advancement, the principal incentive is toward enlargement of scale rather than profitability. Yet enlargement of scale, if not limited, is likely to lead to excessive external borrowing by the enterprise. The now classic case is the rapid expansion and diversification of the Indonesian national oil firm, Pertamina, in the wake of its enhanced borrowing power following the 1974 oil price increase (Wellens, 1976).

The divergence of interest between managers and owners is of course not limited to state-owned enterprises and can be found in large privately-owned firms as well. One study has shown that U.S. firms managed by owners, or under close control of owners, tend to be more profitable than those in which the role of owners is more remote (McEachern, 1975).

For this reason too, therefore, governments will want to monitor closely and perhaps even control directly the external borrowings of their parastatals. Their managers under prevalent arrangements cannot be assumed to borrow abroad to the socially optimal degree; in general, they will tend to over-borrow if left unrestrained.

A third area where the government cannot in practice escape responsibility for the level and character of external borrowing concerns the local banks, and perhaps other bank-like financial institutions. Banks are typically under heavy regulation, presumably for protection of the public. Banks are, furthermore, the repositories of public confidence in the functioning of an economic system. If a major bank fails, it has potential ramifications going far beyond the failure of one enterprise; both borrowers and lenders become much more cautious, a development that on occasion is welcome but generally results in economic recession and economic hardship. For this reason, governments must take an active interest in the smooth functioning of the major banks under their jurisdiction. This does not mean that they must protect bank managers against their mistaken judgment; management can be dismissed. It does mean that the mistaken judgments of bank management cannot be allowed to weaken the institution at the expense of depositors and creditors except at a cost that may go far beyond the institution in question. We are here speaking of the financial system as a whole, and its major components. Minor banks whose fate can be clearly separated from the financial system as a whole may be allowed to fail.

The reputation and fate of the banks can influence a country's reputation with foreign creditors as well. Chile in the late seventies was widely applauded in some circles for its return to a relatively unregulated, free enterprise system. Chilean banks had borrowed heavily in international markets for relending in the local economy. When in 1982 a private bank became insolvent, the government let it be known that the bank was private and creditors had lent to it at their own risk. External credits to Chile immediately dried up. Within a short interval the government felt obliged to reverse itself and guarantee the external liabilities of the bank. Creditors did not accept the dissociation of the government from the banks. Consequently, the government must perforce be concerned with both the internal and the external exposure of the banks. (Even a country as averse to government interference as Switzerland has let it be known that the three largest banks cannot be allowed to fail.)

Guidelines for External Borrowing

Given that the government should take a strong interest in the total level and character of external indebtedness, what would be its guiding principles? Unfortunately, it is difficult to lay down universally applicable quantitative guidelines for external debt. Because reputation so heavily influences the possibilities a country faces and the difficulties it is likely to encounter in international financial markets, and because reputation is based on history, experience, and prevailing ideological views in the borrowing country, each country confronts a distinctive set of issues and problems.

Indicators such as the debt/GDP ratio or the debt-servicing ratio are often used to signal when external debt is reaching dangerous levels. So long as such indicators are widely used, they of course become important in establishing creditworthiness. But unfortunately such indicators have little objective basis, in that they can vary widely with safety, depending on the circumstances.

Table 2

Debt, GDP, GNP, and Debt Service in a Steady State

Debt/GDP	Exports/GDP	Debt Service Exports	GDP (relative to pre-debt GDP)	GNP	Debt
0	0.2	0	1.0	1.0	0
0.5	0.25	0.2	1.08	1.03	0.54
1	0.3	0.33	1.18	1.06	1.18
2	0.4	0.5	1.43	1.14	2.86
3	0.5	0.6	1.82	1.25	5.46
4	0.6	0.67	2.50	1.50	10.0

Quantitative assumptions: Return on investment = .15

Interest on debt = .1

For instance, Table 2 sets out a series of debt/GDP ratios and their implied debt-servicing requirements, all on the assumption that the (constant) rate of return on investment is 15 percent and the (constant) cost of borrowing in world capital markets is 10 percent -- numbers that were plausible, even conservative, for many countries in the late 1970s.

The advantages of external borrowing so long as the return to investment exceeds servicing requirements are quite dramatic. For instance, if the yield on investment is 15 percent and the cost of borrowing is 10 percent a year, and if external borrowing is the sole source of growth in output, a country can increase its output to 2.5 times its initial level in steady state equilibrium (where the debt remains outstanding but does not grow further), by borrowing an amount equal to 4 times its post-borrowing GDP. Of course, under these circumstances interest payments on outstanding debt will be very high, 40 percent of total output. Moreover, if import requirements are 20 percent of GDP, the interest-servicing ratio (interest payments/total exports) will be two-thirds. However, even after these large payments of interest to foreigners, output available for the residents of the borrowing country (GNP) will be 1.5 times the initial, pre-debt level of GNP. This represents the net gains from borrowing abroad, which as indicated can be dramatic. In this example, while the final debt to GDP ratio is 4, total borrowings will be ten times the <u>initial</u> level of GDP. Lower levels of borrowing will of course result in lower debt/GDP ratios and lower debt-servicing ratios (see Table 2). The general point is that quite high debt ratios are sustainable in long-run equilibrium provided the country is not subjected to large uncertainty in output or exports.

A debt/GDP ratio of four, although sustainable on the assumptions given, is far higher than anything we actually observe. Actual debt/GDP ratios even of countries heavily in debt are in the vicinity of .6, well under unity. Israel has the highest observed debt/GDP ratio, at 1.6, and much of Israel's external debt is on concessional terms. Interest-service ratios as high as 50 percent can be observed but are still well below the two-thirds given in the illustration.

We may well ask why countries do not borrow even more than they have, for the illustration suggests much higher sustainable debt than we observe. One possible answer is that debt on a much larger scale would depress returns to investment, so that the assumption made here of a constant return is unrealistic. In fact, however, we have observed roughly constant returns to investment (abstracting from economic cycles) over a long period of time. If the debt is acquired quickly, diminishing returns are indeed likely to set in. But that is less likely to be true of investments made over several decades, unless the investment itself depresses the external terms of trade of the borrowing country.

A second possible answer is that the cost of borrowing will rise with the amount of outstanding indebtedness, or more generally, that countries are rationed in their total borrowing well before the solvency constraint is reached. This is particularly true if repudiation risk is a major concern of the creditors. Again the pace of borrowing is important; a rapid increase in debt is very likely to increase the cost to the borrowing country, but a slower, more gradual increase is less likely to do so. Nonetheless, for debt/GDP ratios much higher than is normal, a risk premium is likely to be added to interest rates even if the buildup is gradual, and after a given debt/GDP ratio is reached, the borrower may be frozen out of further borrowing.

A third possible reason is that debt must be serviced in tradeables, but debt is often acquired to finance investment in nontradeables (although some infrastructure investments -- e.g. feeder roads or port facilities -- are indirectly in tradeables, by lowering the domestic cost of getting exportables to market). Several factors are important in determining the amount of investment of external debt in nontradeables that is sustainable: the return on investment in tradeables relative to the cost of investment, the share of investment in tradeables as opposed to nontradeables, and the ability of the government to raise revenues in tradeables in order to service debt acquired to invest in nontradeables. If, as is likely, the investment in nontradeables will require a decline in the domestic prices of nontradeables relative to tradeables, the extent of decline that is tolerable may also influence the amount of debt that can be acquired for this kind of investment.

These points can be illustrated with a numerical example. Suppose, as was the case in Table 2, that the yield on investment is 15 percent in both the tradeable sector and the nontradeable sector of the economy, and that the cost of foreign borrowing is 10 percent a year. Suppose further that import requirements are 20 percent of GDP, domestic expenditure out of disposable income is initially evenly divided between tradeables and nontradeables, and the price elasticity of substitution between tradeables and nontradeables in domestic demand is -2, but that the structure of production is not influenced by relative prices. The government must raise revenues to service the external debt invested in nontradeables, and it does so through lump sum taxation. On these assumptions, and for the case in which external debt is twice GDP, Table 3 below shows the fall in the relative domestic price of nontradeables that must occur in order to service the external debt (the overall debt-service ratio is .5, from Table 2), given different shares of investment that is made in nontradeables.[7] For instance, if 60 percent of the external funds are used for investment in nontradeables, the relative price of tradeables will have to rise by 13 percent to release enough tradeables from domestic consumption to pay interest on the external debt. (An illustration of the time profile of the relative price of nontradeables in an optimizing model is given in the Appendix.)

If there are political limits to the permissible change in relative prices, that may in turn limit the amount of external debt that can be invested in nontradeables. On the assumptions here, the world price of exports and imports are unchanged. Therefore, alteration of the internal terms of trade will require either a currency devaluation, which will raise the local currency prices of tradeable goods, or a decline in the local prices of nontradeables. Either course poses difficulties of its own.

This illustration has assumed a debt/GDP ratio of two. A lower debt ratio will reduce the required change in relative prices simply because it requires a smaller increase in exports. This may be another reason for limiting external borrowing for investment in nontradeables even when it augments GNP. A lower demand elasticity of substitution will call for a larger change in relative

Table 3

Share of Investment in Nontradeables (percent)	Required Fall in Relative Price of Tradeables (percent)
0	-7
20	2
40	8
60	13
80	18
100	22

Note: See text and footnote 7 for assumptions.

prices, while allowing the composition of output to respond to relative prices (assuming investment decisions are made over a period time) will work in the other direction.

Finally, any practical limit to the taxing powers of government may in turn limit the amount of investment in nontradeables. For instance, if 100 percent of investment is in nontradeables in the example offered in Table 3, the government must tax 20 percent of GDP (and 25 percent of GNP), valued at pre-debt prices, in order to service the debt. If the practical limits on taxation are 10 percent of GDP, the country will be unable to service external debt if more than 50 percent is invested in the nontradeable sector.

A fourth possible answer to the question of why actual debt/GDP ratios are not higher than they are is that countries face uncertainty in their output and export receipts. If debt service takes priority and the country has exhausted its reserves and lines of credit, any shortfall in exports must be met by squeezing imports. In many developing countries this can be accomplished in the short run only by cutting production. The necessity of cutting production from time to time in response to unforeseen shortfalls in net exports in turn will reduce the optimal level of foreign indebtedness. Usually a less costly way of absorbing these shocks is to hold sufficient reserves to cover normal and even some extraordinary variations in net exports. Such reserves typically will earn a lower rate of return than could real investment under stable conditions, but they protect the country from large losses when conditions are not stable.

One method for hedging against uncertainty in output and export receipts is for foreign creditors to share the risks directly, as they would do with equity investments. We believe that most developing countries have paid too little attention to the advantages of foreign direct investment -- not only for sharing risks, but also for the technology transfer that they normally bring. More accurately, many countries have been equivocal in their official stance toward direct investment and ambivalence -- which is often understandable in historic terms -- does not provide the stable business environment in which foreign investment thrives. The political ambivalence is a reality in many countries, however; and so long as it is there, the scope for proportionately large inflows of direct investment will be limited.

This brings us to the final section, a discussion of the appropriate mix of foreign obligations.

The Mix of External Obligations

The discussion so far has been in terms of external debt in conventional form: interest-bearing debt with a fixed foreign-currency value at maturity. In practice, a borrower may face several different kinds of opportunity for drawing capital from the rest of the world: (1) concessional aid, including grants; (2) equity investment by foreigners, which may involve some managerial control by foreigners (direct investment) or simply minority foreign shareholders; and (3) interest-bearing fixed value obligations, which in turn may be directly linked with imports (trade credits), may involve shorter or longer maturities, and may be denominated in local or foreign currency. We offer some observations on each of these forms of obligation, and on the mix among them.

So long as domestic investment opportunities with expected rates of return exceeding the cost of foreign capital are available, a country can always raise its expected level of income by borrowing abroad, but it should be cognizant of the constraints that we have discussed in previous sections. In particular, it should take as much concessional aid as possible, provided certain conditions are met -- and leaving aside the question of political overtones that often pervade bilateral aid. First, the country is able to service the debt adequately from tax and other government revenues. Second, supplementary domestic financing of the aid-supported projects does not draw domestic savings away from investments that offer far greater returns to the country. Third, the aid is not so tied up with procurement and other conditions that it turns out to be much less concessional than it seems at first glance. Many governments seem to give much greater weight to obtaining low interest rates, if necessary at the expense of higher purchase prices or lower quality products, than is economically warranted. This can be a serious mistake, which arises in accepting medium term trade credits as well as aid-financed projects.

Foreign equity investments have the obvious advantage over interest-bearing obligations that they do not have to be amortized and that earnings are likely to be positively correlated with the general economic performance of the country. We believe that countries would be well advised to encourage direct foreign investment so long as the attraction to foreign investors is not due mainly to price distortions in the economy. In the presence of severe price distortions, however, foreign investment can actually make the country worse off (Brecher and Diaz-Alejandro, 1978). Given the high, selective import tariffs and other price distortions in many developing countries, this is a serious problem in evaluating all projects, not merely those undertaken by foreign investors.

Direct investment in general has advantages that go beyond the provision of foreign capital. It introduces technical know-how and useful managerial and marketing skills. It may also, in a world of imperfect capital markets, provide access to additional debt capital for the country. It has the final advantage that if the activity fails economically, there is no need to repay the capital, since the foreign investor bears the commercial risk.

Equity investments also have some disadvantages. First, while earnings will generally be high when the economy is doing well, remittances of earnings may not be so strongly correlated with domestic or export performance. They may actually be somewhat perverse, since earnings tend to be reinvested more readily when the economy is going well. More important, foreign investors' behavior -- like that of domestic firms engaged in foreign trade -- may aggravate a liquidity crisis by exporting capital if a devaluation of the currency (or the introduction of exchange controls) is thought to be imminent. This can be done either directly or by manipulating the timing of receipts and payments associated with exporting and importing. These swings can often be large relative to the equity stake of the foreign investor. The host country then faces a dilemma. Absence of exchange controls invites the speculative movement of capital, but the imposition of exchange controls damages the country's reputation as a debtor. If exchange controls are in place, they can be used to discourage speculative withdrawals of capital, but it is difficult to control firms that are heavily engaged in foreign trade.

Finally, it is a fact of life that foreign direct investment, involving management control and foreign ownership of land, is politically sensitive in many countries. Too much foreign investment may result in a political reaction that damages the country's overall reputation as a borrower. In some countries fear of arousing political sensibilities may be the most significant restraint on direct investment. And, of course, fear of expropriation is one of the factors inhibiting investment by prospective foreign investors.

Foreign purchases of non-controlling equity interests in indigenous firms carries some but not all of the disadvantages of foreign direct investment, and joint ventures are actively encouraged by many countries. But for a variety of reasons, including the lack of well-developed equity markets, the scope for equity investment in developing countries that does not involve some foreign influence on management is quite limited.

Our principal focus above has been on interest-bearing obligations, and there is little more to be said here. Trade credits, whether officially guaranteed by the government of the exporting country or not, are often considered as separate and distinct from bank term loans or other forms of interest-bearing investment. They represent, as it were, a somewhat separate "pool" from which borrowing can take place. Because they tend to be less centralized in the borrowing country, however, they can offer a troublesome surprise when they begin to dry up during a liquidity crisis. The country then senses, perhaps for the first time, how large the total of trade credit is and how difficult it is for the economy to function if such credits suddenly disappear. For this reason, countries that have heavy debt obligations should monitor their trade credits closely.

When it comes to debt maturity, we observed earlier that a serious mismatch between the maturity of credits and the maturity of the projects they are financing increases the exposure of a country to liquidity crisis. Having to repay a debt before the returns to the project can be realized can be costly. For this reason, the old banker's rule of thumb that debt maturity should be matched to maturity of the underlying investment is a sound one.

In principle, countries have the choice of borrowing in their own currency or in some foreign currency. Borrowing in the home currency shifts to the lender not only convertibility risk but also exchange risk, and he will extract a price for that. In reality, few developing countries have a practical possibility of borrowing abroad in their home currency on any scale in the absence of exchange rate guarantees. Indeed, even most developed countries are limited to borrowing abroad in one of the four or five leading currencies rather than their own.

Concluding Remarks

Actual levels of external borrowing by developing countries are considerably less than could in principle be serviced from productive investments. This may reflect restraint on the part of borrowers arising from concerns about their ability to raise the funds required for debt-servicing when the projects are government-sponsored or are in sectors of the economy that do not directly save or generate foreign exchange. It may also reflect concern about taking on fixed external obligations in an uncertain world when the capacity of the domestic economy to absorb shocks at low cost is limited.

But much of the reason for lower-than-sustainable external borrowing is no doubt due to constraints imposed by lenders who fear that (1) mismanagement of the borrowing economy may reduce returns on investments; (2) future difficulties may lead the authorities to repudiate the debt, in whole or in part, openly or (more likely) tacitly; or (3) waves of sentiment in world financial markets may lead to periodic liquidity crises that prevent an otherwise viable economy from servicing its debt. All these factors lead to a supply-of-funds schedule confronting each borrower that reflects borrowing costs that increase as a function of outstanding debt and current borrowing levels. Beyond some (on our calculation, modest) level, higher interest rates elicit no new lending at all.

From the perspective of debtors, with many productive investment opportunities, the task is to lower and to flatten the supply of external funds schedule that it faces. It can thereby increase its gross national product and per capita income after servicing external debt. How can it do this?

Since the main restraints on further borrowing seem to be concerns by lenders, borrowers must pay attention to these concerns. We offer some observations which flow from our earlier analysis of external debt.

First, the debtor can improve lender perceptions of its ability to pay by concentrating its external borrowing on productive investments (rather than on consumption -- even though, as we have seen, consumption loans are sometimes perfectly sensible), especially investments that will generate foreign exchange. To accomplish the latter aim, the pricing structure of the economy cannot be too far out of line with that prevailing in world markets. Where possible, the debtor should become thoroughly committed to the investments in question so that the scope for diversion of funds away from the project is limited. From this point of view, World Bank or regional development bank loans and even medium-term trade credits are seen as being in a different and (to the lender) more comforting category than are straight term bank loans not linked to projects or to procurement of project-related equipment.

Second, the debtor can improve lender perceptions concerning its willingness to pay by raising the visible costs to itself that would be incurred on non-payment. That could involve such traditional steps as offering central government guarantees, posting collateral (e.g. reserves), pledging particular export revenues, agreeing to third party arbitration or even to jurisdiction of courts in the lending countries, and so on.

Receptivity to foreign direct investment is taken as a positive general attitude toward foreign capital even when direct investment flows themselves are small. The country can over time establish a reputation for punctiliousness in servicing its debts. Since good reputation is itself an important asset, especially in the world of finance, loss of reputation is one of the visible costs associated with non-payment. Cooperation of international institutions such as the World Bank and the regional development banks in the investment planning and financing can also improve perceived willingness to pay, since each country's relationships with these institutions is a continuing one, and no government likes to be a pariah in organizations that they must deal with on a regular basis.

Finally, to reduce the harm from liquidity crises, and hence also the probability of a liquidity crisis, the country should recognize the advantage of longer maturities of debt, and balance these advantages against the higher costs of long-term debt. Similarly, the debtor should recognize the gains from diversifying the sources and character of its external financial support as much as possible. Although trade credits and direct investment are not immune to the forces involved in a liquidity crisis, as we have seen, they are influenced by somewhat different factors, and thus may help to forestall a liquidity crisis.

When it comes to bank term lending, on the other hand, having a strong lead bank whose leadership is accepted by other banks perhaps offers better assurance against a liquidity crisis than does borrowing from a larger number of unrelated banks. The former arrangement to some extent internalizes the externality that generates liquidity crises.

The conventional indicators of capacity to handle external debt, such as the debt-servicing ratio or the debt/GDP ratio, have little theoretical basis, at least in the vicinity where they are generally observed. Nonetheless, they have become important indicators in the eyes of lenders, with each borrowing country measured both against other countries and against the borrowing country's own past, and that makes them important to borrowers. A sharp increase in these indicators is taken as a warning signal even when they are relatively low. Expectations concerning appropriate levels can be altered only gradually, and in the context of other actions that persuade lenders of the soundness of the borrowing.

Appendix

Simulation Models for Optimal Borrowing

This appendix illustrates the use of simulation techniques to calculate optimal borrowing paths. While we rely on fairly simply dynamic models, the methods may be directly extended to more complicated, multi-sector models. Earlier studies using the techniques in this appendix include: Blanchard (1983), Sachs (1983), Bruno and Sachs (1983), Lipton and Sachs (1983), Blanchard and Sachs (1983).

We illustrate three models from the text: (1) the one-sector optimal borrowing model; (2) the two-sector (traded and non-traded goods) optimal borrowing model; and (3) the one-sector model with a public sector facing tax constraints.

We make only one amendment to the models in the text, namely that investment imposes adjustment costs on the economy, so that the marginal product of capital F_K should adjust slowly rather than instantaneously to equal the world cost of capital. In particular, following Hayashi (1982), we distinguish between gross capital formation J_t and total investment expenditure I_t which includes adjustment costs as well as the direct cost of capital goods. Specifically, let ψ be the per-unit adjustment cost, so that $I_t = J_t + \psi J_t$. Now, we assume that ψ is not constant but rather a linear function of the rate of capital formation, $\psi = (\phi/2)(J/K)$. Thus, rapid investment rates impose higher per-unit costs of adjustment than slow investment rates. The accumulation equation is: $K_{t+1} = K_t(1-d) + J_t$, where d is the rate of geometric depreciation. Since $I_t = J[1 + (\phi/2)(J/K)]$, we may derive that $J_t = -(K_t/\phi) + (K/\phi)\sqrt{1+2\phi(I_t/K_t)}$. Plugging this into the accumulation equation yields:

(A1) $$K_{t+1} = K_t(1-d) + f(I_t,K_t)$$

where $f_t = -(K_t/\phi) + (K/\phi)\sqrt{1+2\phi(I_t/K_t)}$

For later reference, we note that $f_{K_t} = -(1/\phi) + (1/\phi)\sqrt{1+2\phi(I_t/K_t)}$ $+ (I_t/K_t)/\sqrt{1+2\phi(I_t/K_t)}$. When I_t/K_t is small, $f_{K_t} \approx 0$.

The infinite-horizon, one-sector borrowing problem is shown in Table A1. The aggregate production function is $Q_t(K_t)$. Implicitly, labor is held fixed at $L_t = 1$. Note that for completeness government expenditure has been placed in the utility function. The entire system is set up as a Lagrangian and the first-order conditions are solved in Part III of the table. μ_t is the co-state variable (or dynamic Lagrange multiplier) attached to D_t, so it represents the marginal utility of wealth. λ_t is the shadow value of installed capital. In all, the system is a four-dimensional, non-linear difference equation system in λ_t, u_t, K_t, and D_t. We solve the system below, for particular numerical values.

It is easy to extend the model to include non-traded goods, with sector-specific capital and freely mobile labor. Thus, we introduce production functions $Q^T = F^T(K^T,L^T)$ and $Q^N = F^N(K^N,L^N)$. Full employment of labor requires $\bar{L} = L^T + L^N$. Capital in each sector is governed by an accumulation equation of the form $K^i_{t+1} = K^i_t(1-d) + f(I^i_t,K^i_t)$, where i = T,N. For simplicity, we treat all investment expenditure as drawing on the traded good (this can easily be modified). Thus, the market-clearing condition for non-traded goods is

Table A1

The One-Sector Model

I. Problem

$$\max_{G_t, C_t, I_t} \sum_0^\infty (1+\delta)^{-t} U(C_t, G_t)$$

such that:

(a) $D_{t+1} = D_t(1+r) + I_t + G_t + C_t - Q_t(K_t)$

(b) $K_{t+1} = K_t(1-d) + f(I_t, K_t)$

(c) $\lim D_t(1+r)^{-t} = 0$

(d) K_0, D_0 given

II. Lagrangian

$$£ = \sum_0^\infty (1+\delta)^{-t}\{U(C_t, G_t) + \mu_t[D_{t+1} - D_t(1+r) - I_t - G_t - C_t + Q_t(K_t)]$$

$$+ \lambda_t[K_{t+1} - K_t(1-d) - f(I_t, K_t)]\}$$

III. First-Order Conditions

(a) $\partial £/\partial C_t = 0 \Rightarrow U_C = \mu_t$

(b) $\partial £/\partial D_t = 0 \Rightarrow (1+r)\mu_t = (1+\delta)\mu_{t-1}$

(c) $\partial £/\partial I_t = 0 \Rightarrow \lambda_t f_{I_t}(I_t, K_t) = -\mu_t$

(d) $\partial £/\partial K_t = 0 \Rightarrow \lambda_t[1-d + f_{K_t}(I_t, K_t)] = \lambda_{t-1}(1+\delta)$

(e) $\partial £/\partial G_t = 0 \Rightarrow U_G = \mu_t$

$Q^N = C^N + G^N$, where C^N and G^N are real consumption expenditures falling on N. The debt accumulation equation is $D_{t+1} = D_t(1+r) + C_t^T + G_t^T + (I_t^T + I_t^N) - Q_t^T(K_t^T, L_t^T)$. The entire model, including Lagrangian and first-order conditions is shown in Table A2.

Note that θ_t is the co-state variable for the constraint that the non-traded goods sector clears. It is easy to show that (θ_t/μ_t) is the shadow price of non-traded goods relative to traded goods in the model. If the optimal solution is to be decentralized via market forces, θ_t/μ_t will be the ratio P_t^N/P_t^T. The entire system is now implicitly a six-dimensional nonlinear difference equation system in the variables K_t^N, K_t^T, D_t, λ_t^N, λ_t^T, and μ_t. All of the other variables may be expressed in terms of these six variables.

The final model we consider is the one-sector, tax-constrained economy, in which official borrowing is used to augment (sub-optimal) private savings, but in which the maximum tax rate is constrained to be below some rate $\bar{\tau}$. As explained in the text, private saving is assumed to be a constant fraction s of after-tax income $(1-\tau)Q_t$, so that private consumption expenditure is $C_t = (1-s)(1-\tau)Q_t$. Total investment expenditure is equal to private savings, $s(1-\tau)Q_t$, plus public savings, $\tau Q_t - G_t - rD_t$, plus new borrowing $D_{t+1} - D_t$ (in the text, government consumption expenditure was ignored). Thus, $I_t = s(1-\tau)Q_t + (\tau Q_t - G_t - rD_t) + (D_{t+1} - D_t)$. Since $s(1-\tau)Q_t = Q_t(1-\tau) - C_t$, we have $I_t = [Q_t(1-\tau) - C_t] + (\tau Q_t - G_t - rD_t) + (D_{t+1} - D_t)$, which after rearrangement yields the standard balance-of-payments identity $D_{t+1} = (1+r)D_t + C_t + I_t + G_t - Q_t$.

It is easy to demonstrate that if $\bar{\tau} = 1$, in other words tax rates are unconstrained, the optimization problem in which the government controls τ_t, G_t and $D_{t+1} - D_t$ amounts to precisely the same problem as in Table A1, where the

Table A2

The Two-Sector Model

I. Problem

$$\max_{G_t^N, G_t^T, C_t^N, C_t^T, I_t^N, I_t^T} \sum_0^\infty (1+\delta)^{-t} U(C_t^N, C_t^T, G_t^N, G_t^T)$$

such that:

(a) $D_{t+1} = D_t(1+r) + (I_t^N + I_t^T) + G_t^T + C_t^T - Q_t^T(K_t, L_t^T)$

(b) $Q_t^N(K_t^N, 1-L_t^T) = C_t^N + G_t^N$

(c) $K_{t+1}^i = K_t^i(1-d) + f(I_t^i, K_t^i) \qquad i = N,T$

(c) $\lim D_t(1+r)^{-t} = 0$

(d) D_0, K_0^T, K_0^N given

II. Lagrangian

$$\begin{aligned}
\pounds = \sum_0^\infty (1+\delta)^{-t} \{ & U(C_t^N, C_t^T, G_t^N, G_t^T) \\
& + \mu_t [D_{t+1} - D_t(1+r) - (I_t^N + I_t^T) - G_t^T - C_t^T + Q_t^T(K_t^T, L_t^T)] \\
& + \theta_t [Q_t^N(K_t^T, 1-L_t^T) - C_t^N - G_t^N] + \lambda_t^T [K_{t+1}^T - K_t^T(1-d) - f(I_t^T, K_t^T)] \\
& + \lambda_t^N [K_{t+1}^N - K_t^N(1-d) - f(I_t^N, K_t^N)] \}
\end{aligned}$$

III. First-Order Conditions

(a) $\partial\pounds/\partial C_t^N = 0 \Rightarrow U_{C^N} = \theta_t$

(b) $\partial\pounds/\partial C_t^T = 0 \Rightarrow U_{C^T} = \mu_t$

(c) $\partial\pounds/\partial G_t^N = 0 \Rightarrow U_{G^N} = \theta_t$

(d) $\partial\pounds/\partial G_t^T = 0 \Rightarrow U_{G^T} = \mu_t$

Table A2, continued

(e) $\partial \pounds / \partial D_t = 0 \Rightarrow (1+r)\mu_t = (1+\delta)\mu_{t-1}$

(f) $\partial \pounds / \partial K_t^i = 0 \Rightarrow \lambda_t^i[1-d - f_{K_t}(I_t^i, K_t^i)] = \lambda_{t-1}^i(1+\delta) - \mu_t Q_{K_t}^i \quad i = T,N$

(g) $\partial \pounds / \partial I_t^i = 0 \Rightarrow \lambda_t^i f_I(I_t^i, K_t^i) = -\mu_t \quad i = T,N$

(h) $\partial \pounds / \partial L_t^T = 0 \Rightarrow \mu_t Q_{L^T}(K_t^T, L_t^T) = \theta_t Q_{L^N}(K_t^N, L_t^N)$

government controls C,I, and G. In other words, when taxes are unconstrained, the economy can reach the first-best optimum of Table A1, even though private savings are set in an ad hoc way as a fixed fraction of disposable income.

The more interesting case occurs when the tax constraint $\bar{\tau}$ is binding, Let C_t^* and Q_t^* be optimal in the solution to the problem in Table A1. If C is controlled directly, C_t is simply set at C_t^*. If C is controlled via taxes, or $\tau_t^* = 1 - [C_t^*/(1-s)Q_t^*]$. If $\tau_t^* > \tau$, the first-best solution is no longer feasible when taxes are the control instrument. We now assume that for some period t, $\tau_t^* > \bar{\tau}$. Thus, we must find a second-best solution.

The tax management problem is shown in Table A3. It is convenient to re-write the tax constraint as a constraint on consumption, $C_t \geqslant \bar{C}_t$ where $\bar{C}_t = (1-s)(1-\bar{\tau})Q_t$. Then we rewrite the first-order conditions (a) and (e) and define a "notional" demand C^D such that $U_C(C_t^D, G_t) = \mu_t$. C_t^D is the level of consumption that would be chosen assuming that the tax constraint is not binding in the current period. Actual consumption is given by $C_t = \min(C_t^D, \bar{C}_t)$.

The problem in Table A3 presents a highly non-linear difference equation system in four variables: D_t, K_t, μ_t, λ_t. The other variables can all be expressed as functions of these four variables.

The Numerical Simulations

We now proceed to numerical simulations of these optimal borrowing models. For purposes of the simulations, we assume the following:

Table A3
Optimal Borrowing with Tax Constraints

$$\max_{G_t, \tau_t, D_t} \sum_0^{\infty} (1+\delta)^{-t} U(C_t, G_t)$$

such that:

(a) $D_{t+1} = (1+r)D_t + I_t + G_t + C_t - Q(K_t)$

(b) $C_t \geq \bar{C}$

(c) $\bar{C}_t = (1-s)(1-\bar{\tau})Q_t$

(d) $K_{t+1} = K_t(1-d) + f(I_t, K_t)$

(e) D_0, K_0 given

II. Lagrangian

$$\pounds = \sum_0^{\infty} (1+\delta)^{-t} \{U(C_t, G_t) + \mu_t [D_{t+1} - (1+r)D_t - I_t - G_t - C_t + Q(K_t)]$$

$$+ \lambda_t [K_{t+1} - K_t(1-d) - f(I_t, K_t)] + \gamma_t [C_t - (1-s)(1-\bar{\tau})Q(K_t)]\}$$

III. First-Order Conditions

(a) $\partial\pounds/\partial C_t = 0 \Rightarrow U_C(C_t, G_t) = \mu_t - \gamma_t$

(b) $\partial\pounds/\partial G_t = 0 \Rightarrow U_G(C_t, G_t) = \mu_t$

(c) $\partial\pounds/\partial D_t = 0 \Rightarrow (1+r)\mu_t = (1+\delta)\mu_{t-1}$

(d) $\partial\pounds/\partial K_t = 0 \Rightarrow \lambda_t(1-d) = \lambda_{t-1}(1+\delta) - \mu_t Q_{K_t} + \gamma_t(1-s)(1-\bar{\tau})Q_{K_t}$

(e) $\gamma_t = 0$ when $C_t < \bar{C}_t$ and $\gamma_t > 0$ when $C_t = \bar{C}_t$

(A1) In the one-sector model:

$$Q_t = K_t^{\alpha}$$

$$U(C_t, G_t) = \log[C_t^{\beta} G_t^{(1-\beta)}]$$

$\alpha = 0.5$ $\quad$ $r = .12$ $\quad$ $\bar{\tau} = 0.45$

$\beta = 0.67$ $\quad$ $\delta = .12$

$\phi = 10.0$ $\quad$ $d = .10$

In the two-sector model:

$$Q_t^T = (K_t^T)^{\alpha}(L_t^T)^{(1-\alpha)}$$

$$Q_t^N = (K_t^N)^{\alpha}(L_t^N)^{(1-\alpha)}$$

$$1 = L_t^T + L_t^N$$

$$U(C_t^T, C_t^N, G_t^T, G_t^N) = \log[(C_t^T)^{a_1}(C_t^N)^{a_2}(G_t^T)^{a_3}(G_t^N)^{1-a_1-a_2-a_3}]$$

$\alpha = 0.5$	$\delta = .12$	$a_2 = .41$
$\phi = 10.0$	$d = .10$	$a_3 = .13$
$r = .12$	$a_1 = .25$	$a_4 = .21$

Two simulations are performed. In the first, we begin with K_0 below the steady state level in the one-sector model and compare the adjustment costs in the tax-constrained ($\bar{\tau} = 0.45$) and tax-unconstrained model ($\bar{\tau} = 1.0$). Remember that the case $\bar{\tau} = 1.0$ in the model of Table A3 will give exactly the same outcome as the solution to the model of Table A1. In the second simulation, the process of capital accumulation in the traded/non-traded goods model is studied.

Figure A1 illustrates the basic proposition with respect to the fiscal constraint: with low $\bar{\tau}$, the country should not borrow as rapidly as on the unconstrained path. The solid line is the debt/GDP ratio for the unconstrained case, and the dotted line is the optimum path in the constrained case (the economy is assumed to begin in 1970 with D/Q equal to 0.38). When taxes are unconstrained foreign borrowing is more rapid and stabilizes at a much higher level of debt than in the tax-constrained case. Note that the optimal path in the unconstrained case involves a very high D/Q ratio, a point we made in the text in a static context. Figure A2 illustrates the path of physical capital in the two economies. The counterpart of the larger foreign borrowing in the unconstrained economy is more rapid capital formation and a higher steady-state capital stock.

The two-sector model simulation is illustrated in part in Figure A3. Once again, we assume that capital stocks (in this case both K_0^T and K_0^N) are sufficiently low so that rapid accumulation of capital should take place in both sectors. As shown in the Figure A3, the relative price of non-traded goods declines over time, as the initial current account turns into eventual balance and the initial trade deficit turns into long-run surplus. Figure A4 shows the paths of K^N and K^T. In the simulation shown, the optimal planner (or the market, in its decentralized interpretation) has perfect foresight of the long-run changes in P^N/P^T. In practice, however, it is likely that many agents will underestimate the necessary long-run decline in P^N/P^T, and thereby over-invest in the non-traded goods sector in the initial phase of adjustment. Such over-investment would eventually necessitate even larger declines in

Figure A1

A Comparison of Optimal Foreign Debt Accumulation in the Tax-Constrained and Unconstrained Models

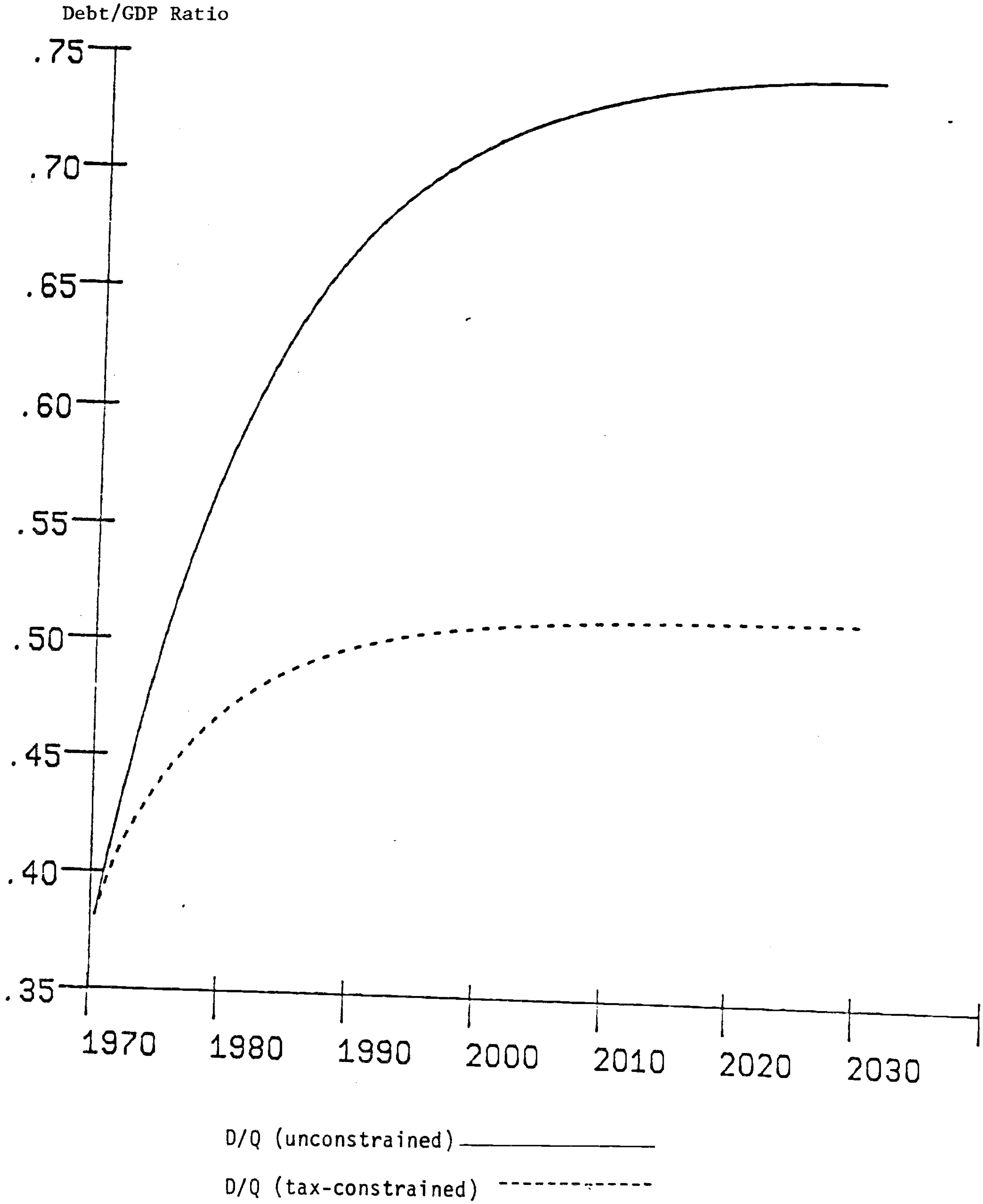


Figure A2

A Comparison of Capital Accumulation
in the Tax-Constrained and Unconstrained Models

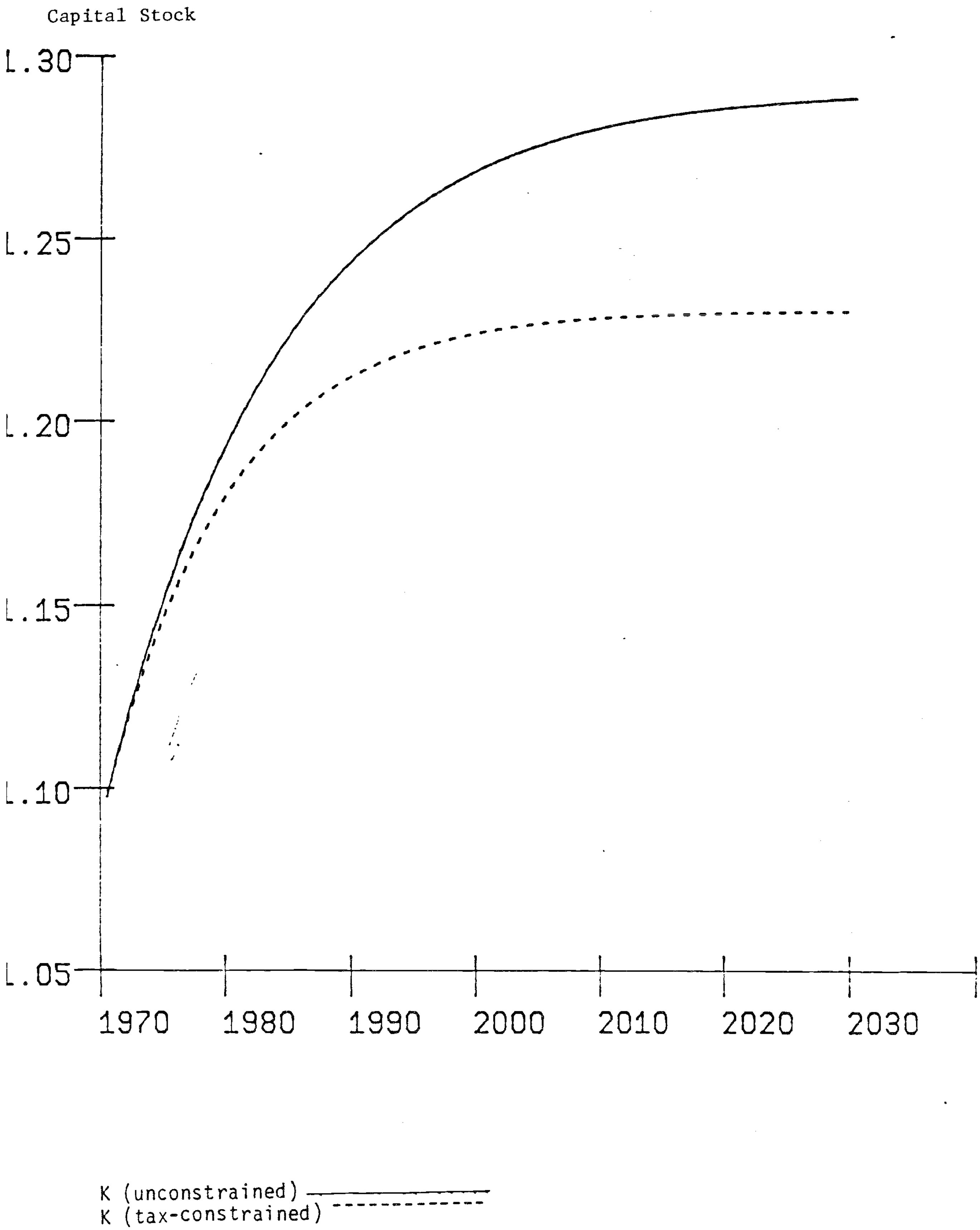


Figure A3

The Paths of the Current Account-GDP Ratio and P^N/P^T
(Percentage Deviations from a Constant Baseline)

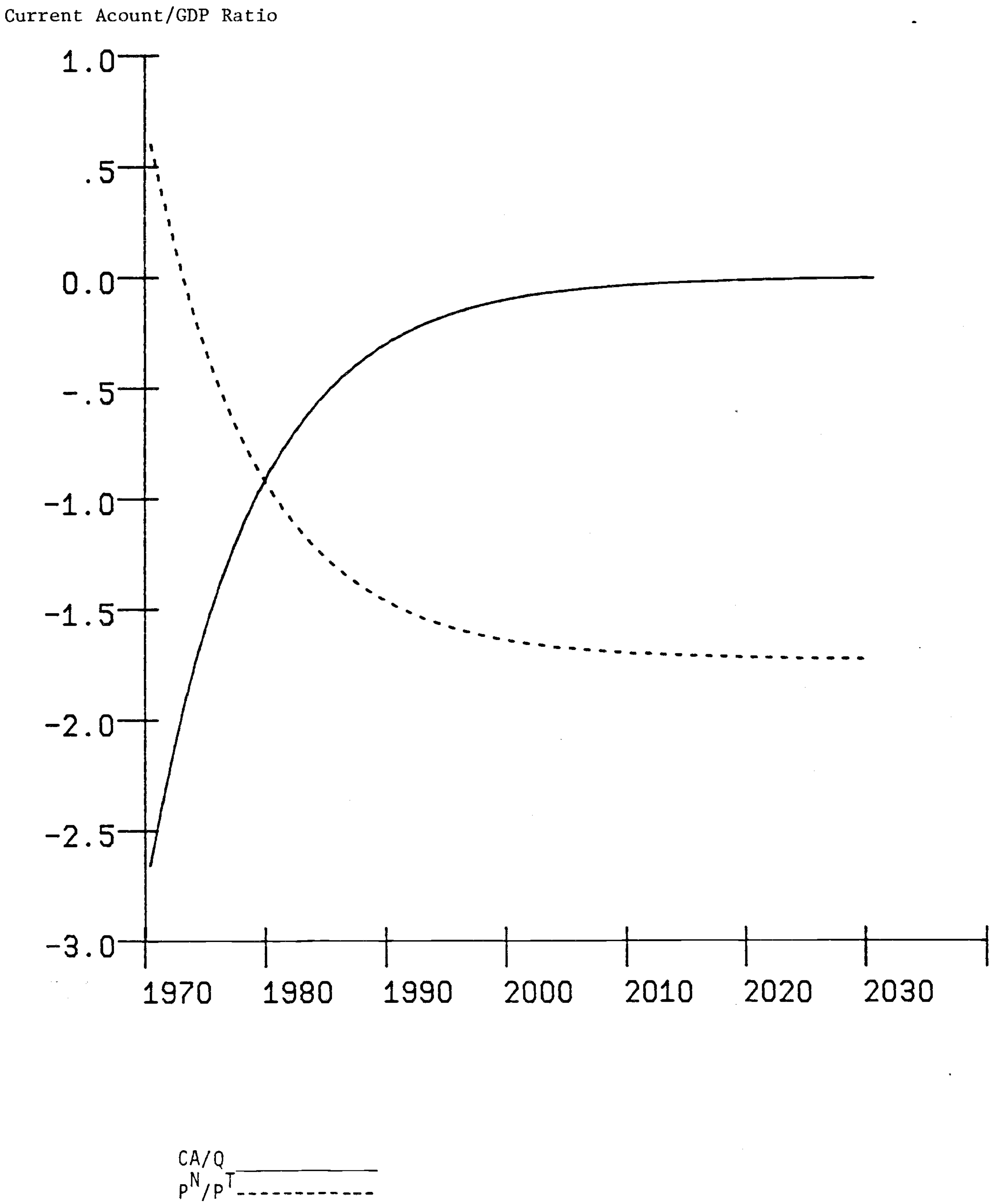
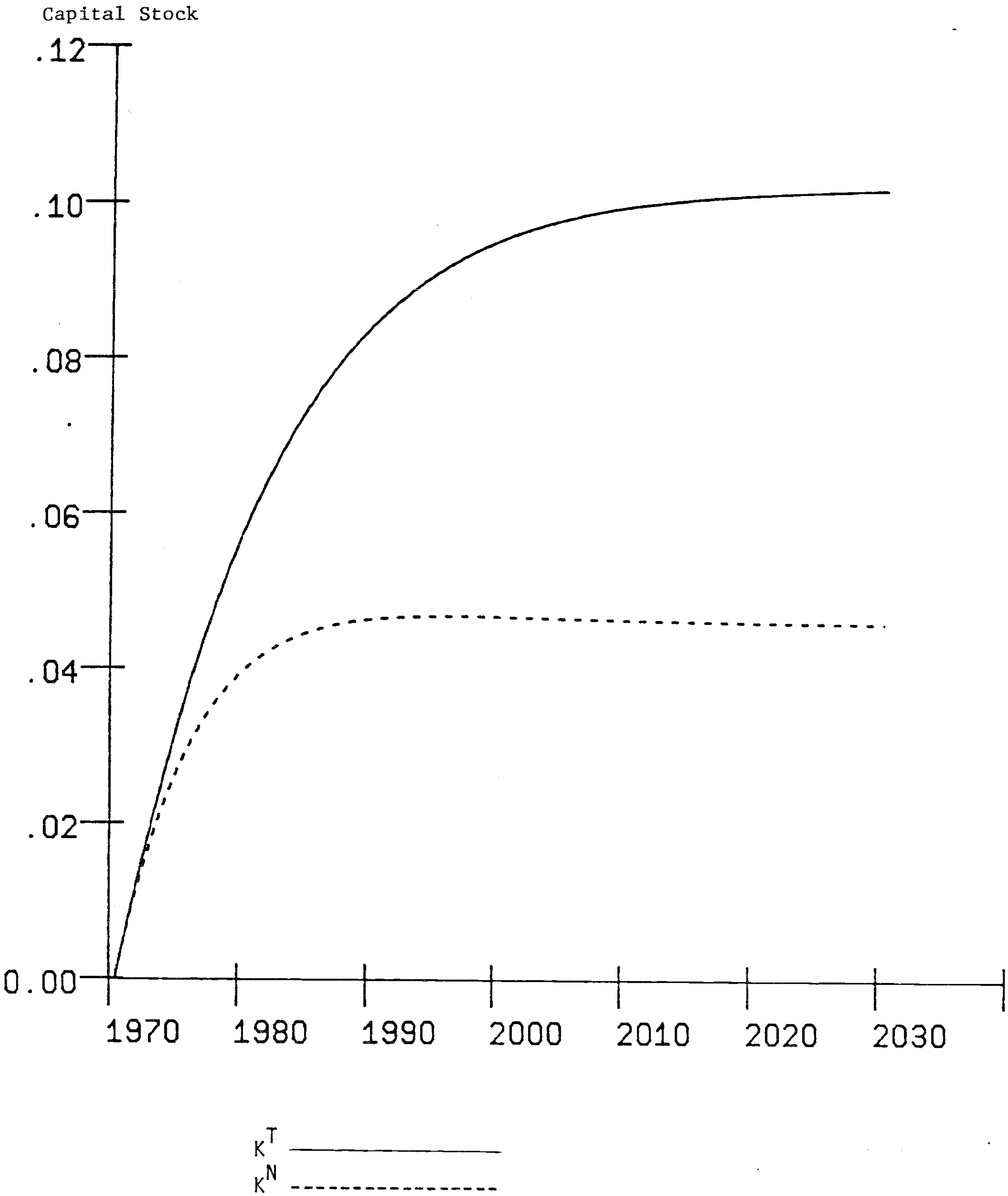


Figure A4

Paths of Capital Accumulation
for K^T and K^N
(Percentage Deviations from a Constant Baseline)



P^N/P^T along the adjustment path, in order to move capital and labor back to the traded goods sector.

The simulation techniques outlined here can be extended to larger and more realistic models that include Keynesian and monetary features not explored in this paper (see Blanchard and Sachs, 1983, for an example). Such models should prove fruitful in improving medium-term assessments of an economy's debt-servicing capacity and creditworthiness.

Footnotes

1. Equation (2) implicitly assumes that Q_t is independent of C_t each period, which is correct under the assumptions made. In more general models, with a variable labor supply or with work effort a function of C_t, we cannot simply maximize TB_t each period by setting $C_t = \bar{C}_t$.

2. Such a Ponzi scheme is called a "rational speculative bubble" in the finance literature, where it is shown that with $n > r$ the bubble can last forever. In a sense, the debt is an "unbacked asset" that maintains value because each creditor believes that future creditors will make the necessary loans to the debtor country.

3. Note that by writing $C_1^L = Q_1 - (1+r)D_1$, we are assuming that the borrower always repays D_1 and never opts to repudiate if credit rationing on D_2 in fact occurs.

4. By totally differentiating $U_1^N = =V_D^N/(1+\delta)$, we have $D_2^N/dD_1 = (1+r)U_{11}^N/[U_{11}^N+V_{DD}/(1+\delta)]$. Since U_{11}^N and $V_{DD} < 0$, $0 < dD_2^N/dD_1 < (1+r)$.

5. Specifically,
$$dD_1/d\pi = [(1+r)/(1+\delta)](U_1^L-U_1^N)/[U_{00}+\pi(1+r)^2U_{11}^L/(1+\delta) + (1-\pi)(1+r)\gamma U_{11}^N/(1+\delta)]$$
where $\gamma = (1+r) - dD_2^N/dD_1 > 0$

6. The proof is as follows. We start at an equilibrium with $U_1(C_1^N) = -(1+r)V_D(D_2^N)/(1+\delta)$ and $U_1(C_1^L) > -(1+r)V_D(0)/(1+\delta)$. Utility is given by $V_0 = U(C_0) + \pi\{U(C_1^L)/(1+\delta) + V(0)/(1+\delta)^2\} + (1-\pi)\{U(C_1^N)/(1+\delta) + V(D_2^N)/(1+\delta)^2\}$. The investment project has an income stream of $-dI_1$, 0, $(1+\theta)^2dI$, over the three periods, so that $dV = -U_0dI_1 - [\pi V_D(0)/(1+\delta)^2](1+\theta)^2dI_1 - [(1-\pi)V_D(D_2^N)/(1+\delta)^2](1+\theta)^2dI_1$. Now, by conditions of optimality,

$U_0 = (1+r)\pi U_1(C_1^L)/(1+\delta) + (1+r)(1-\pi)U_1(C_1^N)/(1+\delta)$. Substituting in the dV equation, we find $dV/dI_1 = -\pi[(1+r)U_1^L/(1+\delta) + (1+\theta)^2 V_D(0)/(1+\delta)^2] - (1+\pi)[(1+r)U_1^N/(1+\delta) + (1+\theta)^2 V_D(D^N)/(1+\delta)^2]$. Let $\gamma = U_1^L + (1+r)V_D(0)/(1+\delta)$. Then, by substituting in dV the relationships between U_1 and V_D, we get $dV/dI_1 = [\pi V_D(0)/(1+\delta)^2][(1+r)^2 - (1+\theta)^2] + [(1+\pi)V_D(D_2^N)/(1+\delta)^2][(1+r)^2 - (1+\theta)^2] - \pi(1+r)\gamma/(1+\delta)$.

For $r = \theta$, $dV/dI_1 = -\pi(1+r)\gamma/(1+\delta) < 0$. For $\theta >> r$, $dV/dI_1 > 0$.

7. Table 3 is calculated from the following model, using the notation of Appendix:

$$Q^T = Q_0^t + \rho K^T \qquad C^N = .5(P_N/P_T)^{\varepsilon}(Q-rD)$$

$$Q^N = Q_0^N + \rho K^N \qquad Q^N = C^N$$

$$Q = Q^T + Q^N$$

$$K^N = \gamma D \qquad K^T = (1-\gamma)D$$

where $\rho = .15$, $r = .10$, $\varepsilon = -2.0$, and γ is shown parametrically as the first column of Table 3.

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