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The Costs and Benefits of Foreign Borrowing: A Survey of Multi-Period Models

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This article surveys the literature on multi-period models of foreign borrowing to shed light on the issue of how much a country should borrow and under what circumstances there is a role for public intervention. It identifies the essential structural elements of multi-period models and draws out the ramifications of the alternative specifications adopted. It discusses the insights and shortcomings of three classes of models: non-optimising, optimising borrower and jointly optimising borrower and lender.

I

Economic theory predicts that less developed economies, with high rates of return on investment and high opportunity costs of increased national savings, should be net recipients of foreign capital. Indeed, over the last decade, the inflow of funds to developing countries has grown dramatically. The magnitude and composition of these capital flows, however, have been determined increasingly by market forces, rather than by institutional factors associated with flows of official capital and foreign aid. Private international lending has emerged as the dominant channel for intermediating global savings and investment between rich and poor countries.

In this environment, most developing country governments have sought to regulate capital inflows, both by control over the level of direct public borrowing and by influencing private borrowing behaviour through public guarantees, registration requirements, and domestic credit policy. This reflects the typical belief that unregulated private capital flows may retard growth by compromising creditworthiness or may otherwise hinder achievement of national objectives (for example, independence). The evaluation of such external debt policies requires consideration of the costs and benefits of foreign borrowing. The goal of this article is to provide a systematic account of these costs and benefits through an analytical survey of recent theoretical models of international borrowing. We are particularly concerned with highlighting the conditions under which government policy intervention may be desirable.

The article is not intended as an exhaustive treatment of debt manage-

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ment. Many important issues, particularly with respect to financial management of the currency and maturity composition of debt, are not covered. Nor do we discuss the empirical literature on debt servicing capacity, because these studies lack the underlying theory necessary to support their normative conclusions.[1] Rather, we confine the survey to multi-period models of foreign borrowing. These models view the accumulation of net foreign debt as the result of intertemporal choices determining savings and investment behaviour.[2] This involves the balancing of costs associated with decreasing consumption in the future to service the debt stock against the benefits of sustaining current consumption and investment in income generating assets.

The article is organised as follows. In section II, we identify essential structural elements of a multi-period model of foreign borrowing and survey the different specifications of these elements found in the literature. Section III discusses the characteristics of foreign borrowing paths and shows how they may vary substantially according to two major factors: first, whether borrowers optimise or not; and second, how the institutional structure of international capital markets (such as the absence of collateral, non-enforceability of contracts, information asymmetries) influences lender behavior. The concluding observations in section IV summarise the implications for policy intervention.

II

A developing country may choose to borrow in international capital markets for two broad purposes. It may borrow in order to finance the accumulation of physical capital or other assets. Foreign borrowing for this purpose furthers growth by enabling an expansion in productive capacity beyond what could be undertaken solely with national savings. Alternatively, a country may borrow to smooth domestic consumption levels in relation to the time pattern of its income. For example, if income fluctuates temporarily, undesired changes in consumption may be avoided by borrowing more when income is relatively low and then repaying the debt when income is relatively high. If income follows a permanent upward trend, higher current consumption may be financed through debt which is subsequently repaid out of future income. The use of foreign borrowing for these purposes must be balanced against the interest cost and creditworthiness effects of debt.

In order to analyse the costs and benefits of foreign borrowing, the essential structural elements of multi-period borrowing models are discussed in this section. These elements are: (a) a supply of foreign funds schedule which determines the cost of borrowing; (b) a consumption (savings) function; (c) a production function which determines the benefits; (d) a dynamic budget relation between national savings and the accumulation of domestic assets and external liabilities; and (e) a national objective function which evaluates the costs and benefits of borrowing over time.

As in most multi-period borrowing models, we will generally assume that the borrowing country produces a single good which can be consumed or invested. Where appropriate, the differences that arise in a two-good case will be indicated. We abstract from consideration of population growth, asset depreciation and debt amortisation since they do not affect the general interpretation of results.

Supply of Foreign Funds

In a competitive capital market, the supply of loans to a developing country will reflect the costs of funds to the lender plus a premium to compensate for the risk of non-repayment by the borrower. This premium increases as the probability of non-repayment rises and decreases when the correlation of the non-repayment possibility with that of other borrowers in the lender's portfolio is lower. How different specifications of the supply function reflect differences in formulation of the risk of default is discussed below.

The simplest models ([5] [7] [8] [12] [13] [18] [28] [31] [39] [43]) assume that the borrowing country is small in world capital markets and in lenders' portfolios and abstract from the risk of default ('countries don't go bankrupt'). Thus, the cost of funds to the lender and the interest charged are constant over the relevant range of amounts borrowed. In this instance the supply function of foreign borrowing is infinitely elastic and can be expressed as $i = \bar{i}$, where i is the interest cost on external debt.

Other studies ([3] [4] [6] [19] [26] [30] [33]), however, assume that as an individual borrowing country's (per capita) stock of debt, D, increases, the probability of default and, hence, the interest rate charged, rise. Thus, the country faces a less-than-infinitely elastic supply schedule: $i = f(D)$, $f'(D)>0$. In this situation, each individual borrower in a country imposes a negative externality on all other borrowers by worsening national creditworthiness and driving up the average interest rate. There is, therefore, a social benefit from a tax on borrowing.

A major criticism of this specification of the interest cost function is that the level of debt outstanding does not properly capture the risk perceived by lenders. A higher level of foreign debt *per se* may not be associated with higher default risk. On the contrary, it may be symptomatic of high returns to investment which reduce risk. This criticism has led to the use of alternative proxies for capturing default risk. Hanson [*1974*] and Katz [*1982*], for example, assume that the cost of borrowing is a positive function both of the level of debt outstanding and the debt/capital ratio, D/K.[3] This latter variable, it is argued, reflects the burden of debt relative to the productive capacity of the domestic economy and, hence, indicates the incentive of the borrower to default. With this specification, the use to which borrowed resources are put becomes important. Borrowing for investment rather than for consumption raises the capital stock and lowers default risk and, hence, the interest rate. There is again a wedge between individual and social costs that may be reconciled through government tax policy. Here, taxes on both foreign borrowing and on consumption would be appropriate.

More recent studies ([9] [14] [15] [35] [36] [37]) have argued that an interest cost function cannot be satisfactorily specified by incorporating *ad hoc* proxies for the risk of default but, rather, must be derived from an explicit consideration of when and why borrowers default.[4] If borrowers default when the perceived returns to such an action exceed the costs, then

all the factors that enter such a calculation must be incorporated into the lenders' supply function.

The returns to default stem from the savings of debt service payments. Clearly, the expected returns increase with the amount borrowed. This is particularly true if the interest rate is positively related to outstanding debt. An alternative interpretation is that the returns to default stem from political and social benefits associated with smoothing adjustment costs. Borrowers may have little flexibility in macroeconomic management. If meeting debt service obligations requires major adjustment (in tax rates, government or private consumption), it may be preferable to default rather than suffer the high costs of immediate adjustment.

The costs to default may arise from retaliatory action that lenders can undertake ([14] [15] [35] [36] [37]) or from the effects of exclusion from future borrowing in international capital markets ([9]). In the former case, costs take the form of a lump-sum penalty or of a given proportional fall in income caused by sanctions or trade embargoes lowering the efficiency of production. In the latter case, costs are associated with the loss of benefits that could have been derived from future foreign borrowing. Thus, for example, a more variable income stream, greater future investment opportunities, or a higher social time preference for consumption would raise the benefits derived from future access to foreign funds and, hence, the costs of default.

A defaulting country need not be completely excluded from future capital markets if new lenders can obtain preferred creditor status (perhaps by earmarking certain export revenues to service the new debt, in an enclave project, for example). In this instance, the cost of default may be reflected in an increase in the interest rate charged on subsequent loans ([13]). Again, the larger are expected future loans, the greater the cost of default.

One implication of viewing default as a choice variable is that there is likely to be a debt ceiling, $\bar{D}$, at which the supply schedule becomes infinitely inelastic.[5] Because both higher debt levels and higher interest rates raise the return to default, at a certain loan level lenders will perceive that the borrower's return to default always exceeds its cost and no increase in the interest rate would compensate them enough to bear the additional risk associated with extending more debt.In the extreme case when there are no costs to default because lenders cannot enforce contracts or retaliate in the event that they are broken, then borrowers would find it attractive to default on any private loan. Lenders would then impose a zero debt ceiling. As there usually exist some costs of default, in actuality the ceiling will be set at some positive level of debt.

The existence of a binding constraint on a country's foreign debt introduces additional externalities into the borrowing process. If one individual borrows, less credit is available for another. If the country rations the limited supply of loans to the most efficient users by allowing the foreign interest rate to rise, it pays a higher average interest without obtaining additional funds. If some non-price form of rationing is used, then the foreign interest rate will differ from the social discount rate and the marginal productivity of capital, and intertemporal choices determining the use of borrowed funds

may be distorted. As the ceiling applies to the accumulated stock of debt, borrowing today also limits future access to additional external inflows. Thus, the social cost of borrowing includes a shadow cost that reflects the opportunity cost of present and future borrowing crowded out by the binding credit constraint. Neither the average foreign interest rate nor, indeed, the private marginal cost of funds, give a true indiction of this social cost. Under these circumstances the government may intervene by an appropriate tax on borrowing that equates the interest paid by an individual borrower to the social cost of borrowing. Alternatively, it may act as the exclusive foreign borrower in the country, channelling the resources to the private sector via the domestic credit system.

A second implication of viewing default as a choice variable is that characteristics that influence the returns to and costs of default can be manipulated by borrowing countries to shift out the supply schedule they face. In particular, borrowing country governments may engage in activities that signal their intentions not to default by raising the costs involved. For example, they may subject themselves to international jurisdiction, they may become more dependent on trade and external trade financing, or they may subsidise domestic savings and investment so that foreign borrowing is associated with increased real (potentially expropriable or destructible) assets. The timing of the borrowing decision can play an important role in the effect of these policies ([14] [36] [37]). If borrowing can be postponed until after appropriate signals (for example, an expanded investment programme) have been given, then the debt ceiling may be further extended. Similarly, lowering the returns to default by demonstrating *ex ante* greater flexibility in macromanagement, for example, through increased government savings, by higher tax rates and/or cuts in consumption, can encourage lenders to supply more credit.

Measures to offset the externalities in the foreign borrowing market are one focus for policy intervention. But loans from commercial banks may also involve other externalities, through their effects on other sources of foreign funds. The total availability of foreign capital may, therefore, depend on its composition. Hanson [*1974*] and Feder and Regev [*1975*], for example, assume that foreign direct investment and foreign loans are imperfect substitutes. The supply of foreign direct investment, they assert, is negatively related to the ratio of foreign-owned to domestically-owned capital stock. As this ratio rises, the visibility of the 'foreign presence' in the domestic economy increases, thereby raising the incentive for the local authorities to expropriate the foreign assets. Thus, if external borrowing is used to expand domestically-owned capital then spillover effects on foreign direct investment can arise, stemming from changes in the return to capital and in visibility.

Takagi [*1981*] looks at this compositional issue from the viewpoint of private and public lenders. He argues that the flow of funds from private sources is positively related to the ability to service debt, which is a negative function of the stock of debt outstanding but positively related to the level of gross domestic product. The flow of funds from official sources is assumed negatively related to gross domestic product, a proxy for the level of

poverty. This specification, therefore, suggests that an expansion of private borrowing, through the increase in income and reduction in poverty engendered, crowds out public aid, diminishing the net benefit from commercial borrowing. These spillover effects among different sources of foreign capital provide further justification for policy intervention.

Consumption Function

One of the uses of foreign borrowing is the finance of additional domestic consumption. Most foreign borrowing models ([5] [6] [7] [9] [14] [15] [18] [19] [25] [26] [29] [33] [36] [37]) treat consumption as a decision variable whose path over time is determined as a result of optimising behaviour. Some studies, however, particularly those concerned with tracing potentially explosive borrowing paths, specify explicit behavioural consumption functions.[6] The most common assumption, following the neoclassical tradition ([4] [20] [31]) is that consumption, C, is a constant fraction of national income, Y: $C = cY$. Since national income is defined as domestic output net of interest payments on foreign debt, $Q-iD$, this specification implies that consumption occurs *after* interest payments on debt have been made. The reverse possibility, that consumption demand pre-empts resources generated by production, before allowance for debt service payments, is excluded. Thus, models which treat consumption as a fraction of income are not useful for analysing the causes of debt crises where interest obligations may not be met.[7]

To circumvent this limitation, Solomon [*1977*] assumes that consumption is a constant proportion of domestic output: $C = cQ$. This permits an explosive growth in the debt burden unless the output growth rate is sufficiently high. In contrast with the neoclassical specification, the implication of this consumption function is that government policy to increase growth is a critical determinant of creditworthiness.

Other studies ([17] [22] [41] [44]) specify consumption as a function of new borrowings, $\dot{D}$, as well as of output and interest payments (based in part on empirical observation, for example, [16] [45]):

$$C = c_q Q + c_d \dot{D} - c_i iD;\ c_q, c_d, c_i > 0$$

In general, all these parameters are important determinants of debt crises. However, this may not be so under certain behavioural assumptions. Kharas [*1981*], for example, differentiates between a private sector that consumes out of disposable income but does not undertake any foreign borrowing and a government sector that borrows from abroad, incurs debt service obligations, raises revenues through taxation, and spends a constant fraction of its net cash flow on consumption. Hence, although new foreign borrowing by the government leads to increased consumption, interest payments on outstanding debt have an offsetting effect ($c_d = c_i$). Kharas shows that in this case the propensity to consume out of net new foreign resources, c_d, is irrelevant to the possibility of unbounded debt paths (see section III). This specification points to the government's ability to raise national savings rates (lower c_q), through, for example, tax rate adjustment, as critical to the avoidance of debt crises. On the other hand, Takagi assumes that capital

inflows enter consumption exactly like income ($c_d = c_q = c_i$). Wasow [*1979*] allows for separate parameters on new borrowing and interest payments ($c_q = c_i \neq c_d$). In the latter model, the parameter, c_d, which reflects the allocation of borrowing between consumption and investment, does play a critical role in determining the possibility of explosive debt paths.

The impact of borrowing on consumption has also been linked, in classical tradition, to factor income shares. Katz [*1982*] argues that the marginal propensity to consume out of labour income, Y_l, is higher (equal to one) than out of capital income (assumed equal to zero). To the extent that capital flows are invested, the share of labour in national income rises. New borrowing thus raises the share of consumption in national income. Capital owners are assumed to consume proportionate to their net wealth, W, defined as the sum of physical capital and money holdings less external debt. Aggregate consumption is then given by:

$$C = c_l Y_l + c_w W;\ c_l, c_w > 0$$

This specification focuses attention on the relative shares of labour income and returns to capital. It suggests that an evaluation of the impact of external borrowing on growth must take into account the effect on labour income and on the accumulation of wealth.

The impact of foreign borrowing on the consumption/saving decision may involve an externality that requires policy correction. If savings are sub-optimal, a common stylized fact of developing countries, higher foreign borrowing may be welfare reducing because of the worsening of the impact of the original distortion on the intertemporal allocation of consumption. Thus, policies to correct the sub-optimality of savings would be desirable.

Production Function

Foreign borrowing may be used for investment as well as for consumption. Multi-period models permitting investment must specify a production function to describe how new borrowing leads to increased future income via additions to the real capital stock. The common neoclassical assumption ($Q = f(K,L)$) allows for diminishing returns to investment. This serves to give a closed solution to the level of foreign borrowing. When the marginal productivity of capital, MPK, initially exceeds the marginal cost of foreign funds, MCF, rising borrowing and investing will cause MPK to fall and MCF to rise (if the supply of funds schedule is less than perfectly elastic) until they are equated. Where two sectors are considered ([5] [6] [12] [15] [25] [43]), the return to capital is a function of the relative price of the two goods produced. This in turn depends on the stock of both capital and debt. Equality of MPK and MCF is then attained through changes in relative price over time.[8] Other models use a fixed-coefficient production function, $Q = bK$ ([1] [2] [17] [22] [23] [39] [44]). Here, foreign borrowing has an effect on output and growth via the process of capital accumulation, but the marginal productivity of capital remains constant.[9] These models generally assume constant interest rates as well. Thus, they contain no automatic mechanism to dampen the demand for additional borrowing over time.

Uncertainty in the parameters of the production function may influence both the level and terms of foreign borrowing ([9] [37]). If the retaliatory power of lenders is linked to the borrowing country's output [37], then unanticipated shortfalls in output reduce the cost of default, weaken the lenders' bargaining power and can precipitate a rescheduling of debt terms or an outright repudiation. Here, a higher variance of output lowers the amount of debt offered by raising the probability of a bad output year which could trigger a default. On the other hand, where a more volatile output stream raises the demand for borrowing to smooth consumption [9], the opportunity cost of default, from exclusion of the borrower from capital markets, is higher. This reduces the likelihood of default, and thus raises the amount of lending offered. Thus, the effects on foreign borrowing of government actions to reduce output variability, by promoting diversification, for example, are unclear.

Dynamic Budget Relation

Foreign debt accumulation must necessarily satisfy the dynamic budget condition that new foreign borrowing equals the difference between asset accumulation and net national savings. Most studies focus on the allocation of savings and borrowing solely towards physical capital accumulation. Some ([21] [22] [29]) permit reserves and money balances to be accumulated as well. Others ([9] [26] [30]) assume that all foreign borrowing is allocated to consumption and no asset accumulation occurs.

Where there are two sectors in the economy, the allocation of physical capital between sectors becomes an issue. Studies which distinguish between traded and non-traded goods ([6] [15] [25] [43]) demonstrate that if the relative price of the non-traded good is falling over time (that is, the real exchange rate is depreciating over time), there is a capital loss on real assets used in the production of non-traded goods. A similar property characterises models that distinguish between domestically produced consumption and investment goods ([5] [12]).[10]

Satisfaction of the dynamic budget conditions emphasises that, for a given level of national savings, the accumulation of domestic assets must match that of net external liabilities if the debt burden is not to become overwhelming. As knowledge of both the current level and future path of the exchange rate is important in evaluating the return to acquiring domestic assets, relative price distortions may have substantial effects on creditworthiness. If a future depreciation of the real exchange rate is not anticipated, or if the present price of non-traded goods is maintained at an artificially high level by some market distortion, then individuals will underestimate the real return to capital and slow down the pace of asset accumulation. The government thus may need to bolster national savings to maintain investment.

National Objective Function

The structural elements discussed above give rise to dynamic equations describing the movements of capital and foreign debt over time. Some studies concern themselves only with the various feasible paths of adjustment of capital and debt from initial levels towards their steady state levels

([12] [21] [31] [41] [44]). These studies give insight into the different paths capital and debt may follow over time and, in particular, into the conditions under which foreign debt is sustainable and converges towards some equilibrium level. However, they do not address the issue of what characterises the optimal dynamic paths of capital and foreign borrowing over time.

Determination of optimal paths requires specification of a multi-period objective function. Following in the tradition of neoclassical growth models, most optimal borrowing models assume the objective of policy planners is to maximise the discounted sum of the utility of per capita consumption flows over the planning horizon ([5] [6] [7] [9] [13] [14] [15] [18] [19] [26] [33] [36] [37] [43]).

An alternative specification used by Bardhan [*1967*] assumes that planners maximise the discounted utility of per capita consumption net of the social disutility associated with the level of debt. This disutility, it is argued, arises from a nationalistic dislike of 'dependence' on foreign ownership of domestic physical capital. Bade [*1972*] assumes that the country maximises the undiscounted sum of per capita consumption flows themselves. This specification presumes that the marginal utility of consumption is constant and that the discount rate is zero.[11]

III

In this section, we turn to discussion of the general results of multi-period models of foreign borrowing. We focus in particular on the potential causes of debt crises and highlight the scope of possible policy intervention. Differences in the results of these models are related to the way in which borrowers and lenders are assumed to behave. Non-optimising models are addressed first. Next, we discuss models with optimising borrower behaviour, but where the lenders' supply of funds curve is exogenous. Last, we cover models with optimising behaviour on the part of both borrowers and lenders in an environment in which lenders are assumed to take account explicitly of the threat of default.

Non-Optimising Models

Non-optimising models specify deterministic paths for output, consumption, investment and debt levels over time, given initial conditions. Attention is focused on describing these paths and on determining the circumstances under which a borrowing economy would accumulate unsustainable amounts of debt.[12] Such paths are termed infeasible since lenders presumably should quickly stop lending to an economy following them. The role then for the policy-maker is to maintain the economy on feasible paths.

In order to describe the varying criteria for feasible debt paths, we refer to the debt accumulation relation (below), which states that new borrowings in each period, $\dot{D}$, are equivalent to the difference between gross investment, I, and national savings, $S - iD$:

$$\dot{D} = I - S + iD$$

Rewriting this in terms of debt per unit of output, $d = D/Q$, gives

$$\dot{d} = \left(\frac{I}{Q} - \frac{S}{Q} \right) + (i - g)s$$

where $g = \dot{Q}/Q$ is the growth rate of output.

In some models ([17] [39] [44]), independent behavioural equations are specified for investment and savings. These determine the gap to be filled by new borrowings and, hence, the time path of the debt/output ratio. It will be unbounded if $\dot{d} > 0$, $\ddot{d} > 0$ in every time period.[13] Boundedness is a necessary (but not sufficient) condition for maintaining creditworthiness. The criteria that ensure boundedness depend critically on the assumed form of the consumption function, in particular.

As discussed in section II above, the general form of the consumption function used in non-optimising models is

$$C = c_q Q + c_d \dot{D} - c_i i D$$

Substituting in for $S = Q - C$, gives

$$\dot{d} = \left(\frac{I}{Q} + c_q - 1 + [(1 - c_i)i - (1 - c_d)g]d \right) / (1 - c_d)$$

In the simplest model [39], $c_d = c_i = 0$ and I/Q, g are constant. Solving the differential equation for d shows that it will converge to a finite level $(I/Q + c_q - 1)/(g - i)$, as long as $g > i$. It should be noted, however, that this conclusion – that the growth rate of output must exceed the interest rate [14] – cannot be taken as a sufficient condition for a feasible debt path; it results in an implicit violation of the lender's intertemporal budget constraint imposed by rational lenders that the expected present value of net resources flows $(\dot{D} - iD)$ to the borrower over time should be zero. As d tends to its asymptotic value from below, $\dot{d} > 0$ always, so $\dot{D} > D\dot{Q}/Q = gD$. But if new borrowings, $\dot{D}$, are greater than gD and output growth exceeds the interest rate, then they must also be greater than interest payments, iD. Thus, net resources flows are positive in each period and cannot have zero present value.

Specifying consumption as a function of income rather than output, $c = c_q = c_i$, $c_d = 0$, the criterion for boundedness becomes $g > (1 - c)i$. In contrast with the simple criterion above, this implies that the intertemporal budget constraint is satisfied as long as $i > g$. Note that with a fixed-coefficient production function, $Q = bK$, I/Q equals gb, or equivalently, g/MPK, where MPK is the marginal productivity of capital. The growth rate consistent with the steady state level of debt is then given by $(1 - c)(1 - id)MPK/[1 - dMPK]$. Thus, $g > (1 - c)i$ reduces to the familiar condition that $MPK > i$.

If consumption out of foreign borrowing occurs at a rate different from that lost by interest payments, $c \neq c_d > 0$ [16], then the condition becomes more stringent:

$$(1 - c_d)g > (1 - c)i \text{ or } MPK > i/[1 - c_d(1 - id)]$$

Here, the amount that is consumed out of foreign borrowing, c_d, is an additional determinant of a feasible path.

A key feature of these models is that the growth rate of output is assumed exogenous and the equation of motion of the debt/output ratio can be

expressed as a single linear equation in d. Its stability, then, depends only on the sign of the coefficient on d, and not on initial conditions. In other models, however, movements in d cannot be described in such a simple form. In this latter group of models, investment and (through the production function) output are determined endogenously with debt. Depending on the solution given by the joint determination of debt and the capital stock, unstable paths may ([22] [23] [41] or may not ([22] [23]) exist.

In Kharas [*1984*], unstable debt paths may exist for particular initial conditions. In his model the government borrows from abroad but invests in infrastructure or social service projects where the returns accrue to the private sector. Revenue for debt service must be obtained from general taxes because of the lack of an established domestic market for government securities. If there is a ceiling on the maximum tax rate, then the government's debt servicing capacity depends on its ability to borrow additional funds from abroad and on current income levels. He finds that, provided the initial capital stock of output is high and the marginal propensity to save out of physical capital is sufficiently greater than the rate of interest on foreign loans, then d will be bounded, regardless of its initial value. If, on the other hand, the initial value of d is high, and initial capital and savings are low, then domestic savings may not suffice to pay interest on debt. Accumulating further debt can send the economy along a path with an ever-increasing debt/output ratio.

Takagi also finds that infeasible paths may exist when the supply of official aid is negatively related to output. If the initial value of d is low, however, d will approach a stable equilibrium. In a second case, in which new private borrowings are negatively related to the stock of debt, he shows the economy may cycle through different phrases of growth and contraction before reaching the steady state.

Models with neoclassical consumption and production functions ([12] [31]) generally have a globally stable equilibrium steady state. Infeasible debt paths do not exist, regardless of initial conditions. This is because the marginal productivity of capital never falls below the interest rate and consumption is always less than national income. These studies are useful for tracing out possible stages of the borrowing process: a country with an initially low capital stock may progress from being a borrower, when the low capital stock and high marginal productivity of capital draw in foreign funds, to a final state as a creditor when the desire to save at the given world interest rate exceeds the funds required to maintain the capital stock in the steady state.[15]

The non-optimising models discussed in this section identify debt crises as emerging when an economy starts to follow an unsustainable path of debt accumulation. They show that this may occur as a consequence of a rigid imbalance in key parameters, especially the savings rate and capital productivity, that precludes normal economic adjustment back to a sustainable path. The conditions under which crises occur are, therefore, extremely sensitive to *ad hoc* specifications of behavioural relationships, such as the consumption function. Different models highlight the importance of the marginal savings rate, the growth rate of output, the marginal productivity

of capital, the marginal propensity to consume out of foreign borrowing, the rate of interest, and the initial values of debt and capital.

The policy conclusion of these models is that the authorities should ensure that these economic parameters bear an appropriate relationship to one another through adjustment in public finance instruments, for example. Higher tax rates, lower government consumption, cost recovery in public investment and increased efficiency in public investments are possible policies. In addition, creditworthiness may be enhanced by raising private savings (perhaps through domestic interest rate policy) and the productivity of private investment (by reducing tariffs and other production distortions). The analyses of these models, however, do not discuss precisely the interrelated impact of policy instruments on all parameters. For example, a higher tax rate may raise national savings but lower the marginal productivity of capital, or a higher growth rate of output may lead to a higher marginal propensity to consume. As these interactions are unlikely to be similar for all countries, propositions that are generally valid concerning the avoidance of debt crises are difficult to identify.

Optimal Borrower Models

Several models ([3] [4] [18] [19] [33]) avoid the problems associated with an *ad hoc* specification of consumption by assuming that a consumption programme is chosen to maximise intertemporal utility. These models are concerned with the properties governing the optimal path of consumption, foreign borrowing and investment as the economy moves towards a steady state. They explicitly evaluate the costs and benefits of borrowing and highlight the fact that along an optimal path the marginal benefit of borrowing in each of its alternative uses for investment or consumption must equal its marginal cost. Thus, the marginal productivity of capital, MPK, should be equated to the social discount rate, SDR (defined as the pure rate of time preference minus the rate of change in the marginal utility of consumption), with both equal to the marginal cost of borrowing, MCF.[16]

A necessary condition for ensuring that all three marginal elements are equated to each other is that at least two are endogenous to the growth/borrowing process. Generally in optimal borrower models, all three are endogenous. For example, Pitchford [*1970*] specifies an interest cost function that rises with the level of foreign debt. Thus, the MCF increases over time as debt is accumulated. With a neoclassical production function, growth and capital accumulation drive down the MPK. The marginal utility of consumption and the SDR decline as the level of consumption rises. Hence, with capital accumulation and output and income growth, the demand for new borrowing falls over time until a steady state is reached. A country will be a net debtor or creditor in this steady state according to whether its rate of time preference exceeds or is lower than the international rate of interest.

The steady state equilibrium is globally stable by virtue of the forces determining new debt accumulation. If, at the steady state output level, debt is too high, then the MPK will be below the MCF and domestic investors will substitute foreign for domestic assets, lowering net indebtedness. If, at the steady state debt level, the capital stock and output level are too low, then new borrowing and domestic savings will raise investment and output, such that debt temporarily rises but then falls back. This stability property precludes explosive debt paths and ensures that even in the face of exogenous variations of income (resulting, for example, from export fluctuations [26]), the marginal optimality conditions will imply a borrowing path that returns the economy to equilibrium. For example, a random fall in income leads to a temporary increase in borrowing and lower savings. By contrast, in the non-optimising models discussed above, where explosive debt paths can occur, the marginal optimality conditions will not all be met because at least two of the three key variables – the MPK, SDR, and MCF – are constant.

Optimising behaviour on the part of individual agents in a small economy without externalities results in precise satisfaction of the marginal conditions that must obtain along the optimal path. A household would only borrow from abroad to finance consumption if its discount rate exceeded the rate of interest it faced. Similarly, it would only lend to firms (invest in their stock) if the marginal productivity of capital exceeded the discount rate. Thus, the behaviour of an optimising household ensures optimal borrowing. A parallel argument may be made for an optimising firm.

If individual optimising behaviour precludes explosive foreign borrowing, then the key role for government is in ensuring that individual costs and benefits reflect social ones. The most common reasons for divergence have been outlined in section II. The risk of default may imply that the marginal social cost of borrowing is greater than the interest rate ([3] [4] [19] [33]). The marginal social benefit of investment may exceed the marginal productivity of capital because of a perceived net reduction in risk of default associated with physical capital accumulation, and the resulting fall in interest rates charged by lenders ([11] [20]). There may be social disutility to dependence on foreign capital [4]. Foreign bank borrowing may have spillover effects on the supply of other forms of foreign capital ([11] [20]). In all these cases, there will be some government tax/subsidy policy that is necessary to compensate for externalities to maintain the economy on an optimal growth path.

One-sector models make no differentiation between foreign and domestic goods. Bruno [*1976*] and Dornbusch [*1983*], however, both use models with distinct traded and non-traded sectors and emphasise that the costs and benefits of external loans depend on the movement of the real exchange rate over time. Bruno assumes that both goods may be invested or consumed and that the foreign interest rate (in traded goods terms) rises with the level of debt. Along the optimal path in such an economy, he finds that the marginal productivity of capital in the traded good sector should equal (i) the marginal cost of foreign debt, (ii) the rate of time preference, and (iii) the marginal productivity of capital in the non-traded good sector plus the rate of change of the relative price of non-traded goods, that is, the real exchange rate.

This model implies that in order to make appropriate savings, investment, and borrowing decisions, each individual must act with knowledge not only of his future income, as in one-sector economies, but also of the future path

of the real exchange rate. If the exchange rate is depreciating over time along the optimal path, then the marginal cost of borrowing in home goods terms will be greater than the marginal cost of borrowing in traded goods terms. Similarly, the marginal return to investment in home goods terms in the (non-) traded sector will be (less) greater than the marginal product of such investment in traded goods terms. Myopic individuals who expect no change in the current exchange rate would believe loans to be cheaper then in *ex post* reality and may overborrow. Similarly, myopic investors may overinvest in non-traded goods. A government with better information than individuals on the path of the exchange rate would need to intervene to restore growth to an optimal path.

The importance of full information to agents in a borrowing country has been further underscored in models which analyse the response of the optimal consumption/borrowing path to various disturbances.[17] Dornbusch [*1983*] and Obstfeld [*1981b*] assume a constant interest on debt and no capital accumulation to focus clearly on the consumption effects of these disturbances. Dornbusch finds that in a framework with traded and non-traded goods, the response of foreign borrowing to an output shock depends on whether the shock is permanent or transitory. A permanent rise in non-traded goods production generally leads to an increase in current borrowing to allow a balanced rise in traded goods consumption, as well as in order to smooth intertemporal consumption. The extent of this smoothing is higher the greater the rate of time preference and the lower the share of non-traded goods in consumption. Conversely, a temporary output rise leads to a fall in foreign borrowing in order to distribute the gains more evenly over time.

Obstfeld finds a similar distinction between the effects of transitory and permanent terms of trade changes. He assumes that planners maximise an intertemporal utility function in which an imported good is a partial substitute for a single domestically produced good in consumption. Faced with a transitory terms of trade loss, the country temporarily increases borrowing to cushion consumption until normal times return. If the terms of trade loss is expected to be permanent, however, there is no change in current borrowing; consumption declines by the full amount of the fall in income. This result shows that it is insufficient to justify additional borrowing when the terms of trade worsen permanently on the basis of the desire to smooth consumption over time. Real costs of adjustment, due perhaps to short-run rigidities in substitution possibilities in production and consumption ([25]), must be explicitly identified.[18]

Optimal borrower models offer several insights. First, they emphasise the role of initial conditions in determining whether a country will be a borrower or lender. Capital scarce developing countries initially have a high marginal productivity of capital. Poor countries with low consumption levels but good growth prospects have a high social discount rate. These factors provide a rationale for foreign borrowing which diminishes as income and consumption rise. In these models, planners seek to guide the economy from its initial state towards a long-run equilibrium along optimal paths of borrowing and investment.

Optimal borrower models also indicate the importance of the government's ability to offset deviations from the optimal path due to the actions of atomistic agents within the economy. We have shown how such deviations may arise if (i) there are uncorrected externalities, (ii) individuals have incomplete information as to the permanent or transitory nature of output or terms of trade shocks, or (iii) individuals have myopic expectations about the real exchange rate. Optimal borrower models implicitly or explicitly assume that such deviations do not inexorably lead to sub-optimal or un sustainable growth-cum-debt paths. Planners, possessing full knowledge of economic conditions, are presumed to correct all deviations from the optimal path due to private behaviour and exogenous shocks. The possibility of unsustainable debt and actual default is never considered in these models. Implicitly, debt crises may arise only if non-optimising behaviour by the planner creates systematic deviations from the optimal path. For example, if poor project evaluation leads to investments with a lower marginal productivity than interest cost, or if governments with high discount rates mortgage the future by overconsumption, a crisis may eventually result when lenders are no longer willing to extend credit.

Optimal Borrower and Lender Models

As discussed in section II, the specification of the supply of funds schedule in an *ad hoc* fashion severely limits the applicability of optimal borrower models to the analysis of debt crises. Faced with the threat of default, rational lenders are unlikely to provide an infinitely elastic supply of funds at a given interest rate. Furthermore, charging higher rates is unlikely to fully offset the adverse effect on borrower creditworthiness of extending greater credit. Several authors ([9] [13] [14] [15] [36] [37]), therefore, derive the supply of foreign loans explicitly from optimising lender behaviour when there is a threat of default. These studies suggest that supply curves based on the assumption that interest costs are simple functions of debt or debt/capital ratios, as in domestic loan models, pay inadequate attention to the institutional framework within which international capital flows occur. In particular, lack of collateral in sovereign lending, non-enforceabilty of contracts and absence of seniority on loans distinguish international from national lending, leaving the threat of default and time inconsistency in borrower actions as major problems facing lenders.

Optimising, competitive lenders will extend credit until the expected utility from additional loans equals their cost of funds. They must, therefore, take into account the likely future actions of the borrower and other lenders. These considerations imply that total credit will be bounded by a ceiling, beyond which no rise in interest can compensate for the greater losses expected as the risk of default grows. In the presence of uncertainty, higher debt levels will be positively related to the interest rate up to the debt ceiling, to the growth rate of output[19] and to institutional arrangements for monitoring behaviour and rescheduling contracts ([39]).

Because the supply of funds depends on country characteristics and behaviour, traditional results of optimal borrower models may be weakened or reversed. First, there may be a wedge between the marginal productivity of capital, the real social discount rate, and the marginal cost of funds along

the optimal path. The MPK will not reflect the full social benefit of investment, because it does not take account of investment's role as a signal of honest future intentions, which may shift out the debt supply schedule ([14] [15] [36] [37]). The MCF will not include the shadow cost associated with a binding debt constraint. Second the standard proxies for default risk, the level of debt or the debt/capital ratio, may actually be negatively related to the likelihood of default, in so far as they could reflect lenders' raising of the debt ceiling in response to greater output growth expectations ([9] [13]). Third, the optimal borrowing response to exogenous shocks will depend not only on the permanent/transitory nature of the change but also on whether the debt ceiling is binding or not ([14] [15]). For example, Glick [*1985*] shows that a temporary traded good output rise results in a loosening of the debt constraint, permitting a rise in current borrowing, when the debt ceiling is initially binding, but leads to a fall in current borrowing when there is no credit constraint.

Although the threat of a default is explicitly considered in these models, under conditions of certainty lenders can always take actions (for example, impose a credit ceiling) to ensure that there is no incentive for this to occur. Only when there is uncertainty about random events which may adversely affect the borrowing country's future income can defaults actually occur. In models with uncertainty ([36] [37]) foreign borrowing takes the form of an insurance contract where a premium (the spread over LIBOR) is paid in good years while in bad years a default yields a payoff (not having to service debt) that helps smooth consumption across good and bad states of nature. This focus points to a potential link between foreign borrowing and other risk-sharing contracts, such as direct foreign investment.

Optimal borrower and lender models highlight the role of lenders in limiting the credit line to an amount that they perceive borrowers will repay. This amount depends on the characteristics of the economy, the behaviour of borrowers and the magnitude of any shocks to which the economy may be subject. Lenders need to have adequate information both on the stock of all debt outstanding and on the parameters governing borrower and other lender behaviour. Dissemination of information and signalling activity as to future prospects and actions by the authorities in the borrowing country are especially important in ensuring maximum access to credit. Intervention to incorporate the impact of individual actions on the country-wide supply of credit into individual costs and benefits will also be required to guide the economy along an optimal path.

IV

This study has surveyed analytically the literature on multi-period foreign borrowing models. The determination of whether a country is over- or under-borrowing requires an evaluation of the benefits and costs of foreign borrowing. Evaluation of the costs of borrowing is, of course, closely linked with determining the capacity for debt service and the likelihood of debt crisis.

Section II identifies five essential structural elements contained in multi-period borrowing models and explores the implications of differences in their specification. Several externalities, which drive a wedge between private and social costs and benefits, are highlighted. First, individual borrowers may be faced with a rising interest rate because of the risk of default associated with the aggregate stock of the country's debt or the debt/capital ratio. A tax on borrowing and/or consumption would then be welfare improving. Default risk may also result in a credit ceiling imposed by lenders. In this case, the shadow price of relaxing the constraint must be added to the marginal interest rate to obtain the social cost of borrowing. If the tax necessary to equate social with private costs is difficult to calculate, the authorities may alternatively borrow the maximum amount directly, curb private foreign borrowing, and channel the funds through domestic capital markets.

A second important externality in the foreign borrowing process is associated with its impact on consumption/savings decisions. If borrowing is used to reduce domestic saving, which is initially too low due to some distortion, then the welfare cost of foreign borrowing is raised above the marginal interest cost. Other reasons the governments may choose to alter the level of borrowing from the amount that atomistic agents would undertake include: the preservation of national independence (implying foreign debt *per se* may yield social disutility); the impact on availability of cheaper public aid; substitutability with direct foreign investment; and the incorporation of better information on future real exchange rate developments.

Section III turns to an evaluation of the sustainability of debt paths over time. Although the costs of a debt crisis are inadequately understood (either taken as an exogenous penalty, rise in future costs, or exclusion from future capital markets), it is important to examine the potential causes of such crises. Three different approaches in the literature are examined. In non-optimising models, borrowing in each period depends on technological and behavioural relationships with rigid structural parameters. The magnitudes of these parameters, therefore, are crucial determinants of whether the economy will proceed along explosive or sustainable debt paths. Government policies, therefore, should be directed towards changing the parameter values (in particular, savings, investment and output growth rates) to ensure a configuration that generates feasible debt paths.

Optimising borrower models normally depict economies as progressing towards a stable equilibrium, characterised by equality between the marginal productivity of capital, the social discount rate and the marginal cost of funds. Explosive debt paths, or debt crises, do not occur in such models. They stress the role of planners in guiding the economy along the optimal path towards the steady state. Where decision-making is decentralised, intervention is required to offset the impact of externalities and incomplete information available to individual agents. Although sub-optimal paths would result from a lack of intervention, these are, nevertheless, feasible and not necessarily a prelude to a crisis. The implicit conclusion is that debt problems must be attributed to non-optimising behaviour, perhaps by governments or public enterprises not subject to competitive pressures,

lack of appropriate project evaluation leading to poor investments, or lack of information concerning the time horizon of a shock or the expected future path of real exchange rates. For this to occur, however, lenders must be prepared to overlend.

Overlending is excluded, *ex ante*, in the third category of models considered in section III, by explicitly assuming optimising lender behaviour where credit is rationed so that the borrower never has an incentive to default. Here, the government should engage in activities that directly signal its intentions not to default in the future by lowering the returns and raising the costs to such an action. This may be done directly through adoption of new institutional borrowing arrangements, for example, and indirectly by encouraging individual agents to engage in positive signalling activities (through investment subsidies, perhaps). In these models, debt crises only occur as a result of uncertainty over the future state of the world. The conclusion is that a greater set of contingent contracts is necessary to avoid the mutual costs to borrowers and lenders if a bad state of the world precipitates a debt repudiation. Less costly mechanisms, such as direct insurance against shocks, or investment in reducing the impact of random shocks may be desirable as well. These models also emphasise the role of disseminating information and formulating appropriate contracts.

The wide-ranging effects of foreign borrowing that we have presented point to the need to integrate external debt management into a more general framework of macroeconomic management. They indicate that governments may well have an active role to play in guiding the economy along optimal borrowing paths. A systematic and empirical evaluation of the externalities associated with foreign borrowing highlighted in this paper is a clear prerequisite.

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NOTES

1. The main results have been surveyed by McDonald [*1982*].
2. There is a substantial body of analysis, originating with Avramovic [*1958; 1964*] and continuing through multi-sectoral computable general equilibrium models, that looks at foreign borrowing as the difference between exports and imports in each time period. These models are, however, static in the sense that anticipated future events have no bearing on current borrowing decisions. They are particularly useful as exercises to provide a consistent set of accounts from which to make informed judgements, rather than to provide a welfare analysis of borrowing.
3. Hamada [*1966*] uses a similar rationale for assuming that debt cannot exceed an exogenously fixed fraction of the capital stock.
4. Saunders [*1986*] discusses how models in the domestic corporate finance literature which view default as a rational decision can be applied to the analysis of sovereign default risk.
5. Even when there is no risk of default, Sachs [*1984*] shows that the intertemporal budget constraint (equality between the present value of amounts lent and debt service received) implies a debt ceiling no greater than the present value of future output of the borrower. This ceiling may not, of course, be binding. Such non-binding debt ceilings are assumed in Bade [*1972*] and Pitchford [*1970*].
6. Here, there is an implicit assumption that there exists some distortion that precludes achievement of optimal consumption.
7. In models which do not consider default as an option for the borrower, lenders can always forestall a debt crisis by lending more. They will be prepared to do so, as long as the intertemporal budget constraint is not violated. This is the case as long as consumption is held below national income and the latter is positive.
8. Fischer and Frenkel [*1974*] formulate a two-sector model in which the interest rate is assumed constant and always equal to the return to capital.
9. There has been discussion of the impact of foreign borrowing on the marginal productivity of capital. Some have argued that foreign capital inflows are associated with large-scale, capital-intensive investments and a lowering of b; others, that foreign inflows raise b by providing necessary foreign exchange and improved technologies.
10. Katz [*1982*] also distinguishes between consumption and investment goods, but assumes that only the former is produced domestically; the latter are imported. Thus, the relative price is exogenously determined.
11. Obstfeld [*1981a*] incorporates real money balances into the utility function to drive the asset accumulation of foreign-exchange reserves. Katz [*1982*] and Kharas [*1981*] also include money balances in their models but assume they are driven directly by capital stock accumulation.
12. Domar [*1944*] first defined an unsustainable debt level in terms of the tax rate that would be required to service national domestic debt. He showed that a necessary condition for this rate to be bounded was that the debt/income ratio should be bounded.
13. The debt/income ratio, $D/(Q-iD)$, is simply $d/(1-id)$. It is easy to see that the condition under which this is bounded is that d should be bounded.
14. In some studies (for example, [2]) debt accumulation is specified as the difference between exports and imports of goods and services. There, the key variable is the debt/export ratio, rather than debt/output. Identical mathematics yields the result that the growth rate of exports must exceed the interest rate (known sometimes as the 'Simonsen' formula) for bounded debt/exports. The same qualifications apply to this result as to the conclusion that output growth must exceed the interest rate. This point is also noted by Reidel [*1983*].
15. In non-optimising models the condition for creditor status in the steady state is that the rate of time preference is less than the interest rate. Bazdarich [*1978*], however, demonstrates that a borrower who optimises will always remain a net debtor.
16. Hanson [*1974*] and Feder and Regev [*1975*] examine the properties only of the steady state, not the optimal path towards it.
17. Svensson and Razin [*1983*] provide an interesting analysis of terms of trade effects and briefly survey this literature. In the context of oil price shocks, see also [24] [25] [43].
18. Katz [*1982*] also addresses the effects of terms of trade shocks. In his model, however, only consumption goods are produced domestically and the terms of trade are exogenous. He shows that a fall in the terms of trade normally leads to a rise in the steady state debt stock.
19. The impact of higher growth of output on the debt ceiling may be ambiguous. Eaton and Gersovitz [*1981*] show that under certain conditions, with high risk aversion, a rise in the expected growth rate of future output may lower the debt ceiling.

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