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Debt Overhang, Credit Rationing and Investment

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Abstract

This paper evaluates the effect of foreign debt on investment in a heavily-indebted country, using numerical simulations of a simple rational expectations growth model. Two particular effects are distinguished. First, the effect due to "debt overhang" of past accumulated debts; and second, the effect of "credit rationing" or inability to obtain new financing. The results from the simulations indicate the credit rationing may be a powerful disincentive to investment. This suggests that in order to maximize the impact on productive investment, debt reduction plans need to be accompanied by additional foreign lending.

JEL Classification:

433, 443

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I. Introduction

Since 1982, investment rates have fallen dramatically in most debtor countries. For the group of 15 heavily indebted countries, the average investment to GDP ratio in 1982-87 was 18 percent, compared to a 24 percent average ratio in 1971-81. Among the reasons that could have caused this sharp drop in investment, the foreign debt situation is certainly a prime suspect. In fact, it has even been suggested that the disincentive effect of foreign debt is so strong that there exists a situation in which a reduction in foreign debt would generate such a strong improvement in the debtor's economy that debt repayments would actually increase (see, for example, Krugman (1988)).

This paper distinguishes two channels through which foreign debt may affect investment, which can be termed the "debt overhang" channel and the "credit rationing" channel. The debt overhang arises in a situation in which the debtor country benefits very little from the return to any additional investment because of debt service obligations. When foreign obligations cannot be fully met with existing resources and actual debt payments are determined by some negotiation process between the debtor country and its creditors, the amount of payments can become linked to the economic performance of the debtor country, with the consequence that at least part of the return to any increase in production would in fact be devoted to debt servicing. This creates a disincentive to investment from the point of view of the global interest of the debtor country. For the same reason, the debt overhang is also likely to discourage government efforts to undertake adjustment policies and, through actual or expected economic policies, it is likely to spread to the private sector, affecting its incentives to invest or accumulate domestic assets.

The second channel is more indirect and arises from the higher domestic interest rates that prevail in a debtor economy as a consequence of its unfavorable standing in international financial markets. This second channel is the credit rationing effect. It may arise from the fact that a highly indebted and non-performing debtor is unlikely to obtain any foreign borrowing beyond the involuntary rollover of interest and amortization payments that are not met. But in fact, credit rationing describes any situation in which the domestic interest rate exceeds the international rate, because of constraints faced by the debtor in international financial markets.

It is interesting to note that the two effects, although usually associated with each other, may not necessarily be present together. Even though a debtor suffering from a debt overhang situation would normally be credit-constrained as well, it is conceivable that it may not be credit-constrained despite the past debt overhang. For example, consider the case in which the country can obtain new loans that are (explicitly or implicitly) senior to the previously outstanding debt, and it uses these resources for economically sound investments. Then, the debtor country might have good access to foreign borrowing despite its debt overhang. It is also easily possible that a country is credit constrained but does not have a debt overhang. For example, the risk of debt repudiation could be high despite a moderate current level of indebtedness via contagion effects, with the consequent scarcity of additional credit flows.

The purpose of this paper is to isolate and obtain an order of magnitude for both the debt overhang and the credit rationing effects on investment. The paper starts by highlighting the debt overhang and credit rationing effects on investment in simple two-period models. Later, numerical simulation of simple rational expectations growth models are utilized to evaluate the relative orders of magnitude of the investment disincentives.

The results from the simulations indicate that credit rationing may be a powerful disincentive to investment. Debt payments should involve a very significant fraction of GDP in order to generate an investment response similar to that which is caused by plausible changes in interest rates brought about by credit rationing. The simulations permit also to trace out the anticipated repayments for different levels of debt. In this way, it is possible to identify situations in which a cut in outstanding debt, i.e. reducing the debt overhang, would bring about an increase in total repayments by the debtor country. Once again, this possibility becomes relevant only when debt service involves a very significant fraction of GDP.

II. Debt Overhang and Economic Incentives. A Recapitulation

Paul Krugman defines a debt overhang situation as one in which the expected repayment on foreign debt falls short of the contractual value of debt (Krugman (1988a)). For example, take the case in which debt would be paid in full if a favorable state of nature occurs, but it would be paid in less than its full contractual value if a less favorable state occurs. In this case, it is likely that foreign debt generates a negative incentive effect on investment, or on productive and adjustment efforts in general. The reason is that the debtor does not benefit fully from an increase in production because part of it must be devoted, in "bad" states of nature, to service past accumulated debts. This affects the relevant margins considered for investment and production decisions.

Consider the following example. 1/ The country is carrying over from the past certain level of debt (D). In the next and final period, this debt must be repaid. Creditors can enforce repayment up to some extent. Let us assume that there is some fixed amount of output $\bar{c}$ that the debtor country can always keep for consumption, but the rest of the output may be claimed by the creditors. Therefore, repayment is given by:

1/ See Dooley (1986), Krugman (1988a,b), Froot (1988), and Sachs (1988) for more complete treatment of this issue.

(1) $R = \min(D, y-\bar{c})$

where R is repayment, and y is output. This is sometimes called a "gunboat" technology. Two states of nature are possible: a good state G and a bad state B, where in the good state productivity is higher and a larger amount of output is available. Let y be a function of investment carried out in the first period and of the state of nature:

(2) $y^S = \theta^S f(I)$

for s = G, B. It is assumed that there is physical upper limit to investment, $\bar{I}$, and that the two states are so different that there is no overlap of output, i.e. $\theta^B f(\bar{I}) < \theta^G f(0)$. Therefore, a debt overhang exists in this context if $D > y^B - \bar{c}$ because debt cannot be fully serviced in the bad state. It is clear that in this framework, the debt overhang creates a disincentive effect on domestic investment. Consider the case in which $y^B - \bar{c} < D < y^G - \bar{c}$. In this case, in the good state of nature debt is paid in full, but in the bad state of nature repayment takes place only up to the available output minus the part that the debtor may keep for consumption. From the point of view of the debtor country, the expected marginal return to an additional unit of investment is only $P\theta^G f_I$, where P is the probability of the good state. By contrast, in the absence of debt overhang, the expected marginal return to an additional unit of investment is the larger value: $P\theta^G f_I + (1-P)\theta^B f_I$. Furthermore, in the case in which $D > y^G - \bar{c}$, the return to investment is actually zero, so the debtor will carry out no investment at all.

Although the above example is perhaps more illustrative, a similar concept can be developed in terms of a model with full certainty, which is closer to the one used in the simulations in the next section. Consider the case in which the debt situation is such that a given fraction of GDP must always be devoted to payment to external lenders. This could be considered a sort of certainty equivalent approximation to the above example. Alternatively, the slice of the debtor's country output that is taken away by its creditors can be considered as the outcome of a bargaining process between the debtor country and its creditors; it will be assumed that such a portion is fixed and exogenously determined. 1/

This paper first develops a simple benchmark example of an open economy without debt overhang or credit constraints. Then, in order to distinguish the direct incentive effect from the interest rate effect, it will sequentially consider each of the possible combinations: debt overhang

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1/ This analysis therefore ignores the strategic motivations for investment that arise in a bargaining framework. That is, the debtor could manipulate its investment level in order to strengthen its bargaining position vis-a-vis the creditors, as in Aizenman and Borensztein (1989). See also Bulow and Rogoff (1989) and O'Connell (1987) for a different bargaining model in the context of debt negotiations.

with and without credit constraints, and credit constraints without debt overhang. In all cases, a simple two-period framework is employed to illustrate the effect of debt on investment when consumption and investment in the debtor country are chosen in an optimal way.

The benchmark unconstrained economy is described by a completely standard problem in a two-period framework without initial debt. The levels of consumption, investment, and international borrowing are chosen in order to maximize the following objective function:

$$(3) \quad V = \max u(c_1) + \beta u(c_2)$$

$$\text{s. t.} \quad c_1 = y_1 - I_1 + B$$

$$c_2 = F(I,.) - B(1+r)$$

where c stands for consumption, β for the discount factor associated with time preference, I for investment, B for foreign borrowing, r for the international rate of interest, and F(I,.) for the production function, which may also be a function of other predetermined variables. The utility and production functions have the usual concavity properties, which will assure that an interior solution exists for non-negative consumption levels such that:

$$(4a) \quad F_I = \frac{u'(c_1)}{\beta u'(c_2)} = 1+r^d$$

$$(4b) \quad 1+r^d = 1+r$$

where r^d is the domestic interest rate. This economy satisfies the familiar equalizations of the marginal product of capital with the domestic interest rate, and of the domestic interest rate with the international interest rate. Consider now the problem of an economy facing a debt overhang problem, and unable to obtain any additional lending in period one:

$$(5) \quad V = \max u(c_1) + \beta u(c_2)$$

$$\text{s. t.} \quad c_1 = y_1 - I$$

$$c_2 = (1-b)F(I,.)$$

where b is the fraction of output that goes to pay for the debt overhang, as explained above. Investment decisions for this economy will be made to satisfy:

(6) $$F_I = \frac{1}{1-b} \frac{u'(c_1)}{\beta u'(c_2)} = \frac{1}{1-b} 1+r^d$$

Note that the domestic interest rate r^d will always be higher than the international rate as long as the country would be a borrower in international markets if it were unconstrained. Therefore, the two effects contribute to an increase in the equilibrium marginal product of capital and, therefore, a reduction in investment.

Consider now the case of an economy with a debt overhang problem but without international credit constraints. This would be the case, for example, in which the country can obtain new senior credits at the interest rate r, but old creditors maintain their claim to a fraction b of output. This means that senior creditors are paid in full but old creditors are paid only up to a fraction b of output. In this case, investment would be chosen in the following way:

(7) $$V = \max u(c_1) + \beta u(c_2)$$

$$\text{s. t.} \quad c_1 = y_1 - I_1 + B$$

$$c_2 = (1-b)F(I,.) - B(1+r)$$

which yields:

(8) $$F_I = \frac{1}{1-b} \frac{u'(c_1)}{\beta u'(c_2)} = \frac{1}{1-b} 1+r$$

Therefore, although the domestic interest rate equals the world interest rate, investment is still depressed by the debt overhang problem. The intriguing question of the possibility of a debt Laffer curve can be easily answered in this case. For a decrease in b to generate an increase in debt service, it is required that:

$$y_1 + b \frac{F'^2}{(1-b)F''} < 0$$

For example, if $y_1 = I^{\gamma}$*, this is equivalent to:*

$$b > 1 - \gamma$$

Finally, consider the case of no debt overhang but credit constraints. Taking a limiting case once again, this case would be equivalent to a closed economy:

$$(7)\quad V = \max\ u(c_1) + \beta u(c_2)$$
$$\text{s. t.}\quad c_1 = y_1 - I$$
$$c_2 = F(I,.)$$

which gives rise to:

$$(8)\quad F_I = \frac{u'(c_1)}{\beta u'(c_2)} = 1+r^d$$

The order of magnitude of the two effects and their combinations will be evaluated through numerical simulations in the next section. This will help answer the question of which constraint has a bigger impact on the debtor country's performance, and thus serve to orientate policy initiatives.

III. Simulation Results

It will be assumed that investment and consumption decisions are made according to an optimal program from the point of view of a representative consumer in the debtor country. That is, the debtor country is treated as a single rational entity. Some issues arising from the interaction of the public and private sector, such as distortions emerging from the tax system and capital flight, are discussed later. For the time being, the assumption is that the government has sufficient instruments to provide incentives for the private sector to undertake a path of investment and consumption that is optimal from the point of view of the global interest.

Consumption is derived from standard intertemporal utility maximization with time separable preferences, over an infinite time horizon. The utility function is logarithmic. Production takes place according to a Cobb-Douglas production function, with constant returns to scale and with capital and labor being the only factors of production. Capital is subject to an adjustment cost to capital of the standard type (see the survey by Abel (1988)), which makes investment a forward-looking and slowly-adjusting function. Population (equal to labor supply) grows at a fixed exogenous rate. Alternatively, this growth rate can be interpreted as Harrod-neutral technological progress. There is perfect foresight of the values of the relevant variables. This basic framework is, therefore, the same as in Blanchard (1983) or Cooper and Sachs (1985).

1. The Benchmark Economy

As a reference point, it is worthwhile to start by considering a benchmark economy that does not face any restrictions on its foreign borrowing, and that does not consider the possibility of default. The consumption and investment decisions are then obtained as the solution to the following problem:

$$(9)\quad V(K_0,D_0) = \max \sum_{t=0}^{\infty} \beta^t L_t u(c_t)$$

$$\text{s.t. } K_{t+1} = (1-\delta)K_t + I_t$$

$$Y_t = F(K_t,L_t)$$

$$D_{t+1} = (1+r)D_t - Y_t + L_t c_t + I_t + h(I_t,K_t)$$

where K is the capital stock, D is the stock of foreign debt, c is per capita consumption, L is the number of consumers and workers, I is investment, h(I,K) is the output loss due to the adjustment cost of capital, and Y is GDP. The parameter β is the discount factor associated to the rate of time preference, and δ is the depreciation rate of capital.

Population (or labor productivity) grows at a constant rate n. For concreteness, the adjustment cost function is assumed to have the following form:

$$(10)\quad h(K,I) = \psi \frac{I^2}{K}$$

Defining $q_t = V_{K_t}/u'(c_t)$, the shadow price of installed capital measured in marginal utility units, the first order conditions for this system can be written as:

$$(11)\quad u'(c_t) = \beta(1+r)\, u'(c_{t+1})$$

$$(12)\quad \frac{I_t}{K_t} = \left(\frac{q_{t+1}}{1+r} - 1\right)/2\psi$$

$$(13)\quad q_t = F_K(K_t,L_t) + \psi\left(I_t/K_t\right)^2 + \frac{1-\delta}{1+r} q_{t+1}$$

In this case, there is complete separation between the consumption and investment decisions. Investment depends only on the international interest rate and technological conditions. From equation (12) investment is set in proportion to its shadow value q, and from equation (13) the dynamic evolution of q is determined.1/ The dynamic path of per capita consumption is given by equation (11). The starting value of consumption

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1/ By recursive substitution it can be shown that q equals the present discounted value of the sum of the marginal product of capital, and the adjustment cost savings associated with an extra unit of capital.

is determined by applying the transversality condition $\lim_{t\to\infty} D_t/(1+r)^t = 0$ to the debt accumulation constraint in (9).

The values of the parameters used in the simulation are detailed in Table 1. It is initially assumed that the rate of time preference is equal to the interest rate, so that per capita consumption is constant and aggregate consumption grows at rate n. The production function exhibits constant returns to scale, with a capital share of 40 percent. The adjustment costs to investment are equivalent to about 3 percent of GDP in the steady state. These parameters are roughly consistent with some rules of thumb often applied. For example, (in steady state) the capital-output ratio is slightly above 3.5 and the investment to GDP ratio is slightly above 22 percent.

The problem at hand involves rational expectations, which means that the current value of some of the endogenous variables depend on all the future values of themselves and of the rest of the variables. This requires special solution techniques, such as those developed by Blanchard and Kahn (1980) and Buiter and Dunn (1982) for linear models. The model is, however, nonlinear. The methodology followed to solve it consisted in solving first a linear approximation to the system and using this solution as a basis for tackling the nonlinear problem. The nonlinear problem was solved as a single simultaneous equation system comprising all the necessary equilibrium conditions and all time periods, basically treating the values of each variable at different points in time as different variables. This method, which follows the suggestion by Hall (1985), is similar in spirit to, but more efficient than, the more popular extended path algorithm (Fair and Taylor (1983)).

The results of the simulation of this benchmark economy are displayed in Chart 1. In the initial period, the capital-labor ratio is about 75 percent of its steady state value. Investment is therefore relatively heavy in the first years and declines gradually, from over 27 percent of GDP to about 22 percent in the steady state. Adjustment costs derived from the investment process consume about 6 percent of GDP initially but only about 3 percent in the steady state. Consumption grows continuously at the same rate as population, which implies a declining share in GDP starting off as 78 percent of GDP and stabilizing at about 71 percent. With zero initial foreign debt, the consumption and investment paths imply a stationary level of foreign indebtedness equivalent to 1.4 times GDP. Servicing this stock of debt requires a trade surplus of about 3.6 percent of GDP. 1/

1/ This large accumulation of foreign debt is a consequence of the process of capital accumulation and is consistent with the order of magnitude of results in Blanchard (1983).

Table 1. The Benchmark Economy

Utility Function

$$\sum_{t=0}^{\infty} L_0 \, (1+n)^t \, \beta^t \, \ln(c_t)$$

$L_0 = 1; \quad n = 0.02; \quad \beta = 1/1.05$

Production Function

$Y = \Omega K^{\gamma} L^{1-\gamma}$
$\Omega = 0.25; \quad \gamma = 0.4$

Costs of Installation of Capital

$\psi(I^2/K)$
$\psi = 2.5$

Other Parameters and Ratios

$\delta = 0.04$ (depreciation rate of capital)
$r = 0.05$ (world interest rate)

$K/Y = 3.70$ (steady state)
$I/Y = 0.222$ (steady state)
$\psi(I^2/K)/Y = 0.033$ (steady state)

$D_0 = 0$
$(K/L)_0 = 0.75$ of steady state K/L

2. Debt Overhang and Credit Rationing

In this case, the external debt situation can be described in the *following way. First, payments are not expected to cover the contractual* value of debt in full. Second, the actual amount of debt payments is the result of negotiations between the debtor country and its creditors. This bargain, which is taken as exogenous and unchangeable, implies that the debtor country must pay a fixed proportion b of its output as debt service every year. And third, the debtor country cannot obtain new loans because it would not be able (or willing) to service them, thus facing a "credit rationing" situation.

Under these assumption, the dynamic behavior of the economy can be characterized by the following system:

$$(14) \quad \frac{I_t}{K_t} = \left(\frac{q_{t+1}}{\beta} - 1\right)/2\psi$$

$$(15) \quad q_t = (1-b)F_K(K_t,L_t) + \psi\left(I_t/K_t\right)^2 + \beta(1-\delta)\, q_{t+1}$$

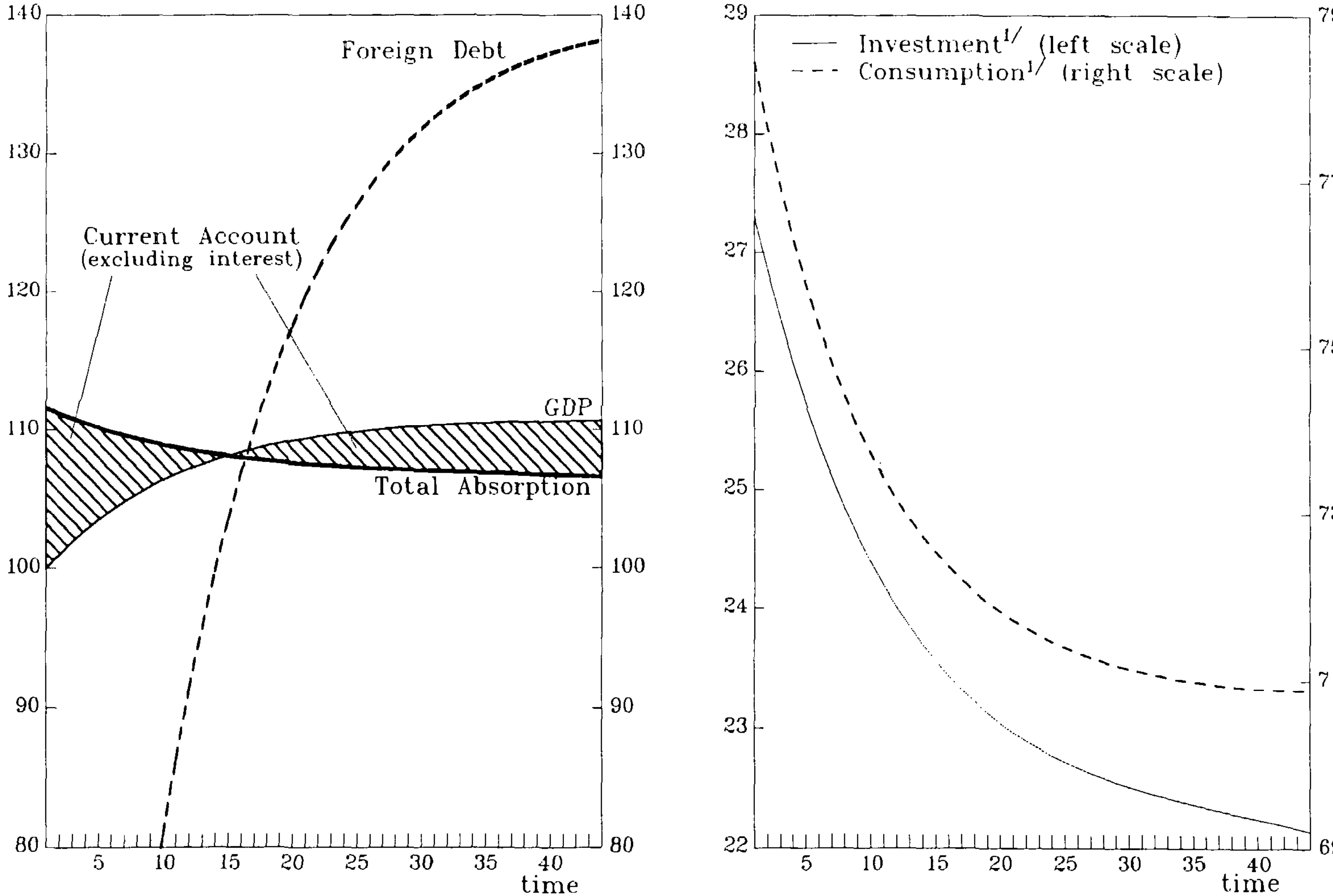
$$(16) \quad K_{t+1} = (1-\delta)K_t + I_t$$

$$(17) \quad L_t c_t = (1-b)F(K_t,L_t) - I_t(1 + \psi I_t/K_t)$$

The value of the parameter β is critical to the simulation results because of its influence on the value of the domestic interest rate, which has direct bearing on investment. In the steady state, the domestic interest rate is in fact equal to β^{-1}, so that when β^{-1} = 1+r--as in the above example--credit rationing does not affect the steady-state investment and production position. Out of the steady state, it turns out that the domestic interest rate is only slightly higher than β^{-1}, reflecting higher investment spending due to the incomplete capital accumulation process and higher consumption demand. But the discrepancy of the domestic interest rates from β^{-1} over the whole simulation period is relatively small, so that the question of what is the appropriate value of β is the same question as what is the expected change in domestic interest rate when a *country hits a credit constraint.*

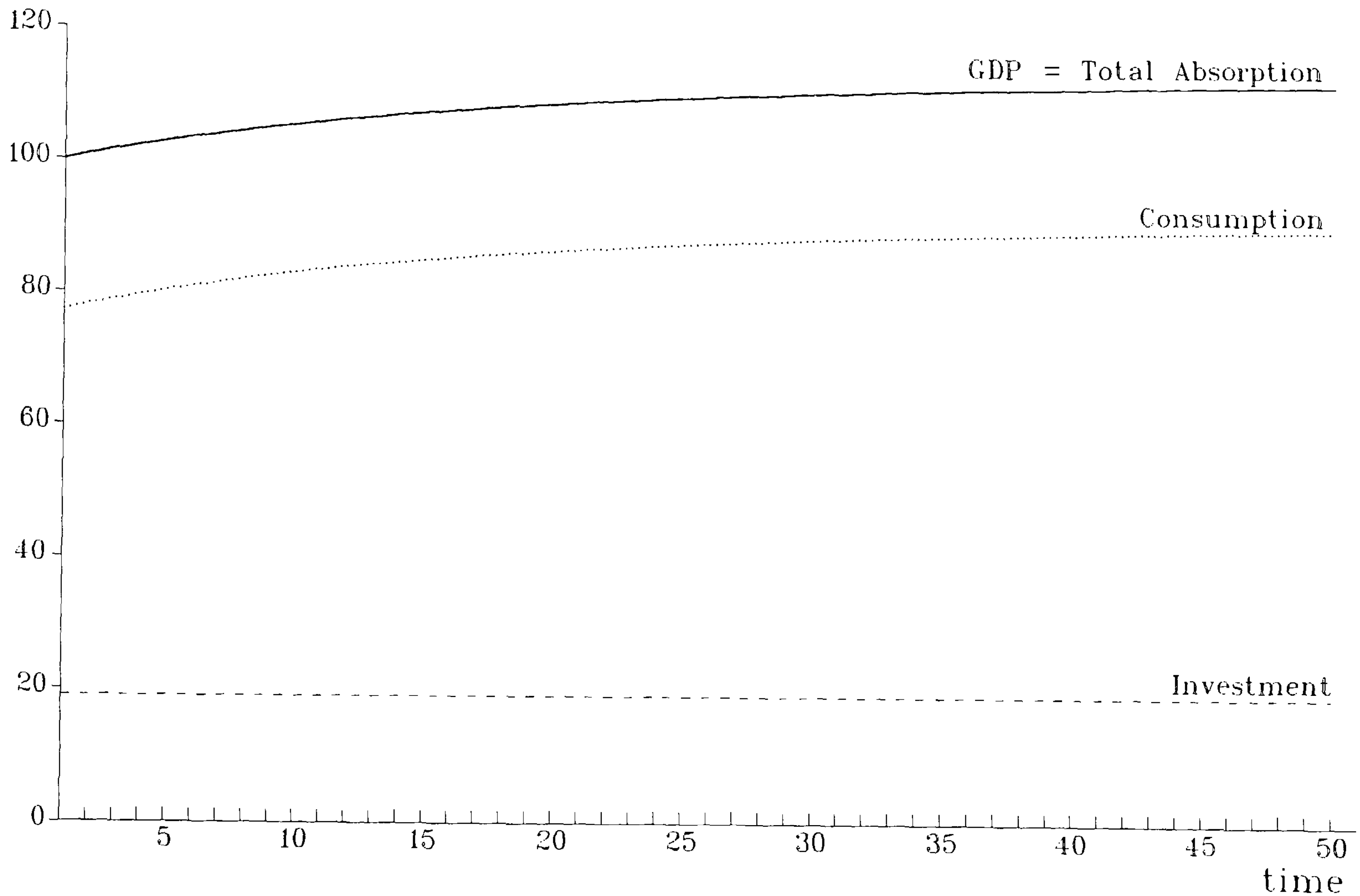
For $\beta = 1/1.07$, the simulation results are displayed in Chart 2. As can be seen, the combined effects of the debt overhang on the proceeds from production and of credit rationing on international borrowing reduce the incentives to invest and the share of investment in GDP is lower, ranging from 19 percent to 17 percent along the dynamic path of the economy. The effects of the debt overhang and financial autarky persist over time, and the economy settles at a steady state with lower output, capital/labor ratio, and investment. Because of the situation of complete financial autarky, the current account balance is always equal to zero.

CHART 1
Benchmark Economy



1/ In percent of GDP

CHART 2
Economy with Debt Overhang and Credit Rationing



Is a reduction in the debt overhang likely to increase total repayments by the debtor country? That situation, sometimes termed a debt relief Laffer curve can also be examined with this model. This is done by varying the value of b, the foreign debt "tax" and computing the associated present discounted value of debt payments. This is illustrated in Chart 3. The results indicate that the "wrong side of the Laffer curve" starts at pretty high values of b, somewhere between .5 and .6. On the surface, this is very discouraging for this hypothesis: no debtor country's debt payments are anywhere near 50 percent of its GDP. However, one could reinterpret this model as representing only the tradable sector of the economy, which may be possible by assuming separability of the utility function in consumption of tradables and nontradables and sector-specificity of both capital and labor. Then, a debt service burden of 50 percent of the tradable sector, while still very high, is not out of the ballpark. However, with standard production and investment functions as the ones used in this simulation, the effect of debt relief on investment appears to be much smaller than the effect of interest rate changes in the relevant range. Further experiments with the elasticity of investment to interest rate changes are reported below.

In the steady state position, the elasticity of debt payments with respect to b can be analytically computed, which permits an easier evaluation of the effect of debt relief. Given that in any stationary position $I/K = \delta+n$, the steady-state marginal product of capital must then be given by:

$$(18) \quad F_K = \frac{1}{1-b}\left[(1+2\psi(\delta+n))\ (\beta^{-1} - (1-\delta)) - \psi(\delta+n)^2\right]$$

from where the elasticity of debt service with respect to b can be computed as:

$$(19) \quad \frac{d(bY)}{db} = Y + b\frac{dY}{dK}\frac{dK}{db} = Y\left[1 - \frac{\gamma}{1-\gamma}\frac{b}{1-b}\right]$$

which implies that the economy would generate larger repayments with a lower "tax" rate if $b > 1-\gamma$, where $1-\gamma$ is the share of labor in production. 1/ This result is roughly consistent with the simulation results reported above.

Another possibility that may strengthen the effect of a reduction in the debt overhang is to consider that foreign debt imposes in fact a different kind of tax. Consider for example the case in which all debt is owed by the government, which needs to impose taxes on the private sector to finance its budgetary outlays. In an extreme case, all taxation could fall on investment spending. This would increase the disincentive to investment generated by the debt overhang problem. Another case would be the possibility of a one-time capital levy at some probably uncertain future time T. To the extent that current investment has high

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1/ This is the same result as in the two-period model with debt overhang but no credit rationing.

intertemporal substitution, and that the (expected) capital levy rate is significant, this type of taxation could have a major temporary impact on investment spending.

3. No Credit Rationing

Consider the case in which there is debt overhang but no credit rationing. This is the case in which the country can freely access new international borrowing, which is serviced in full, but it is still carrying the burden of past debts that reduce the amount of output available for consumers in the debtor country. This implies that the relevant interest rate for investment and saving decisions is the international rate. Therefore, the dynamics of this economy will respond to:

$$(20)\quad \frac{I_t}{K_t} = \left(\frac{q_{t+1}}{1+r} - 1\right)/2\psi$$

$$(21)\quad q_t = (1-b)F_K(K_t,L_t) + \psi\left(I_t/K_t\right)^2 + \frac{1-\delta}{1+r}\, q_{t+1}$$

$$(22)\quad K_{t+1} = (1-\delta)K_t + I_t$$

$$(23)\quad D_{t+1} = (1+r)D_t + L_t c_t - (1-b)F(K_t,L_t) + I_t(1+\psi\ I_t/K_t)$$

where D represents new senior debt, and $q_t = V_K/u'(c_t)$.

An interesting result is that old creditors would also benefit from the availability of new loans that are senior to their own claims. 1/ The new loans permit a reduction in the domestic interest rate and an improved economic performance, which generates higher payments on the junior debts as well. The extent of the improvement in economic performance depends on the extent to which the debtor economy is being affected by the credit rationing situation. This is confirmed by the simulations that are reported in Chart 4, which plots the repayment paths under different assumptions about the domestic interest rate. In the case in which the domestic interest rate initially exceeds 10 percent (compared to a world interest rate of 5 percent), the value of repayments to junior claims increase by as much as 30 percent after a few years when the debtor country is allowed to contract new senior debt.

A summary of the macroeconomic and external sector paths effects of foreign debt is presented in Table 2. There, the simulations of four different economies are reported. The four economies are: first, the benchmark case of no debt overhang and no credit rationing, as described by equations (11) to (13); second, an economy with debt overhang and credit rationing, as described by the equation system (14) to (17); third, an economy with debt overhang but no credit rationing, as described by the

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1/ This possibility is discussed by Fischer (1987) and Calvo (1989).

CHART 3
Debt Relief Laffer Curve

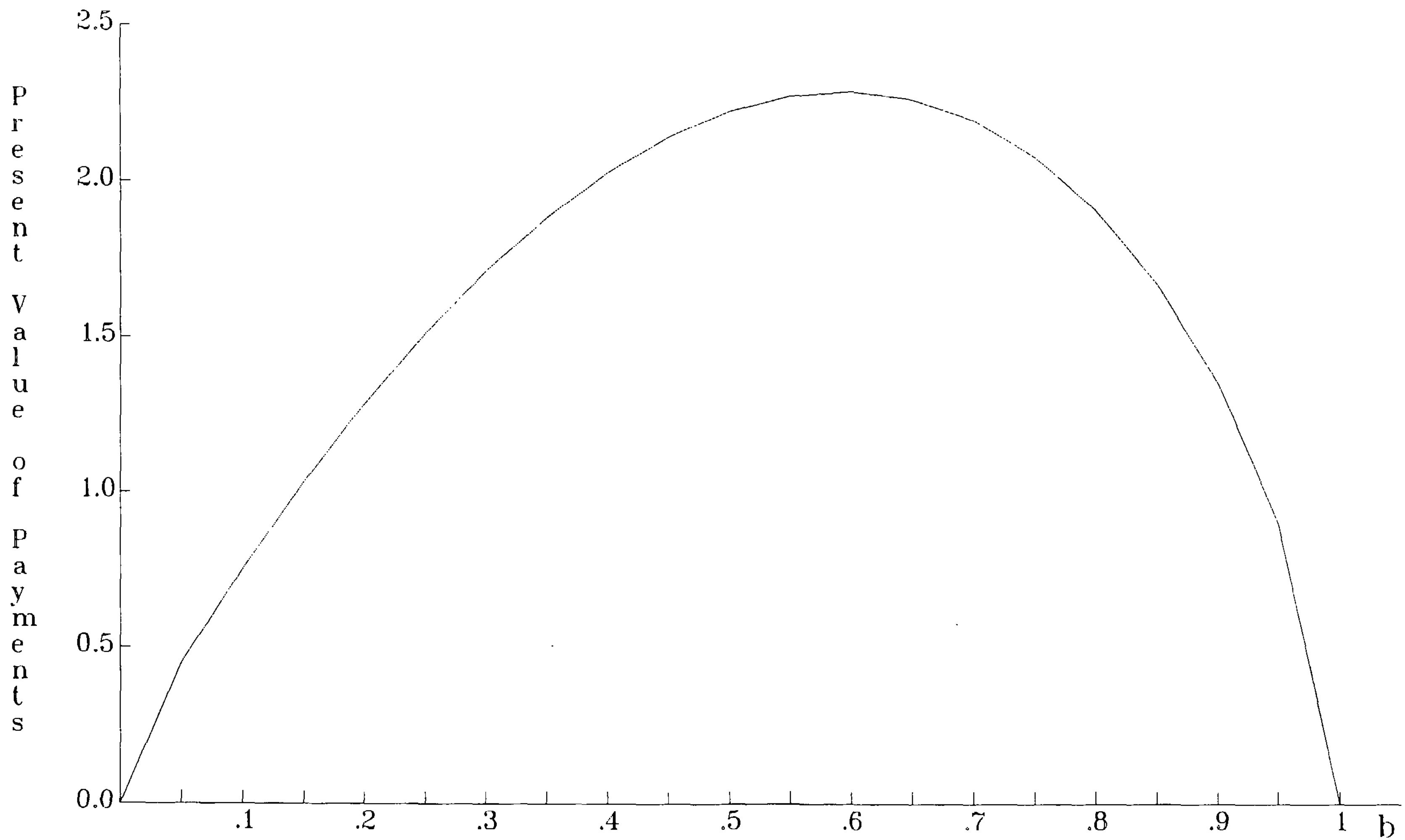


CHART 4
Simulation of Debt Payments

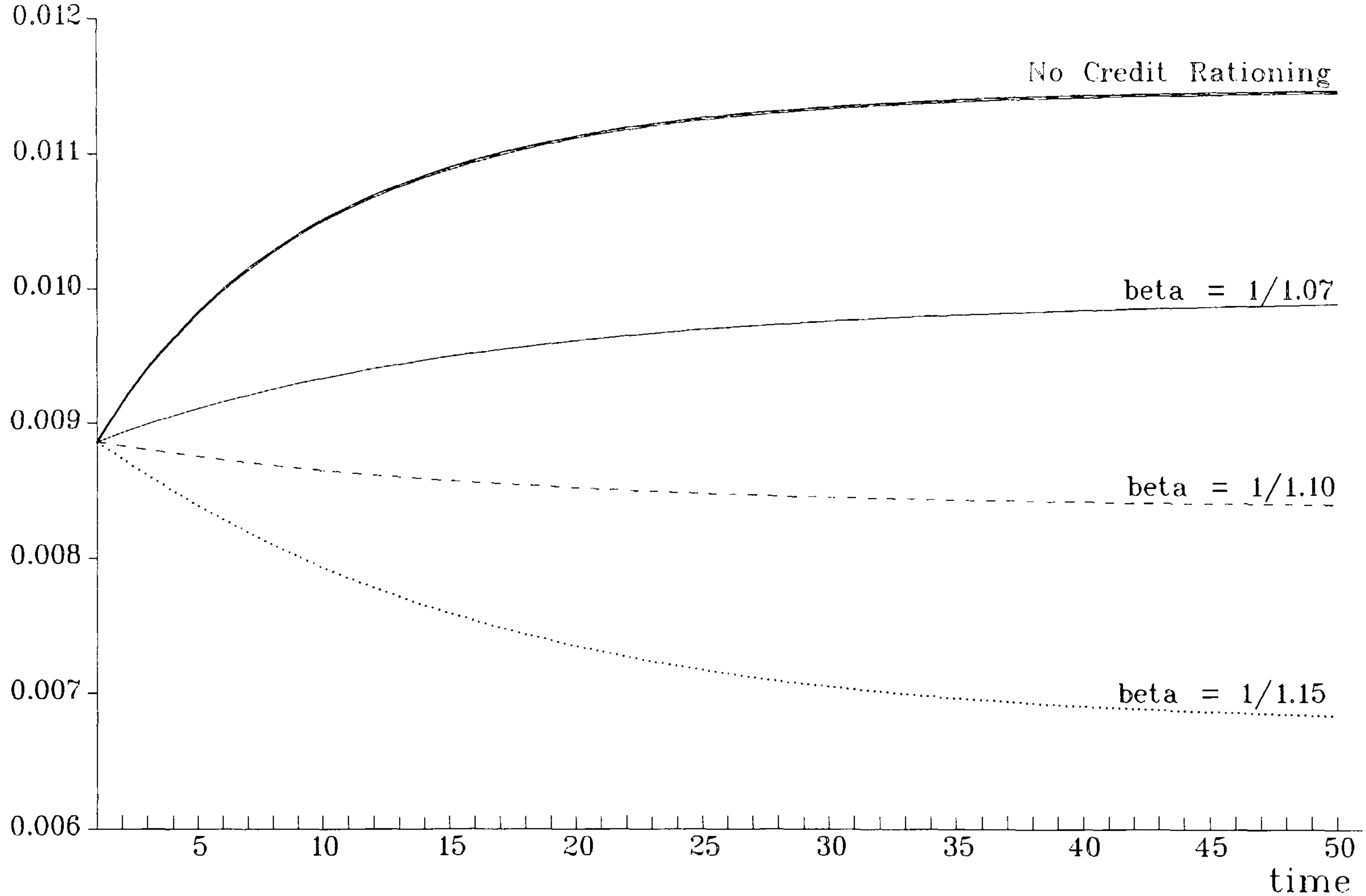


Table 2. Simulation Results

(In percent of GDP)

Period	Consumption	Investment	Adjustment Costs	Non-Interest Current Account
		Benchmark Economy		
Initial	78.4	27.3	5.9	-11.6
Steady State	70.9	22.1	3.4	3.6
		Economy with Debt Overhang and Credit Rationing		
Initial	68.5	22.5	4.0	5.0
Steady State	70.7	21.1	3.2	5.0
		Economy with Debt Overhang but No Credit Rationing		
Initial	74.0	25.3	5.1	-4.4
Steady State	68.2	21.1	3.2	7.5
		Economy with No Debt Overhang but with Credit Rationing		
Initial	71.1	24.3	4.6	0
Steady State	74.4	22.2	3.3	0

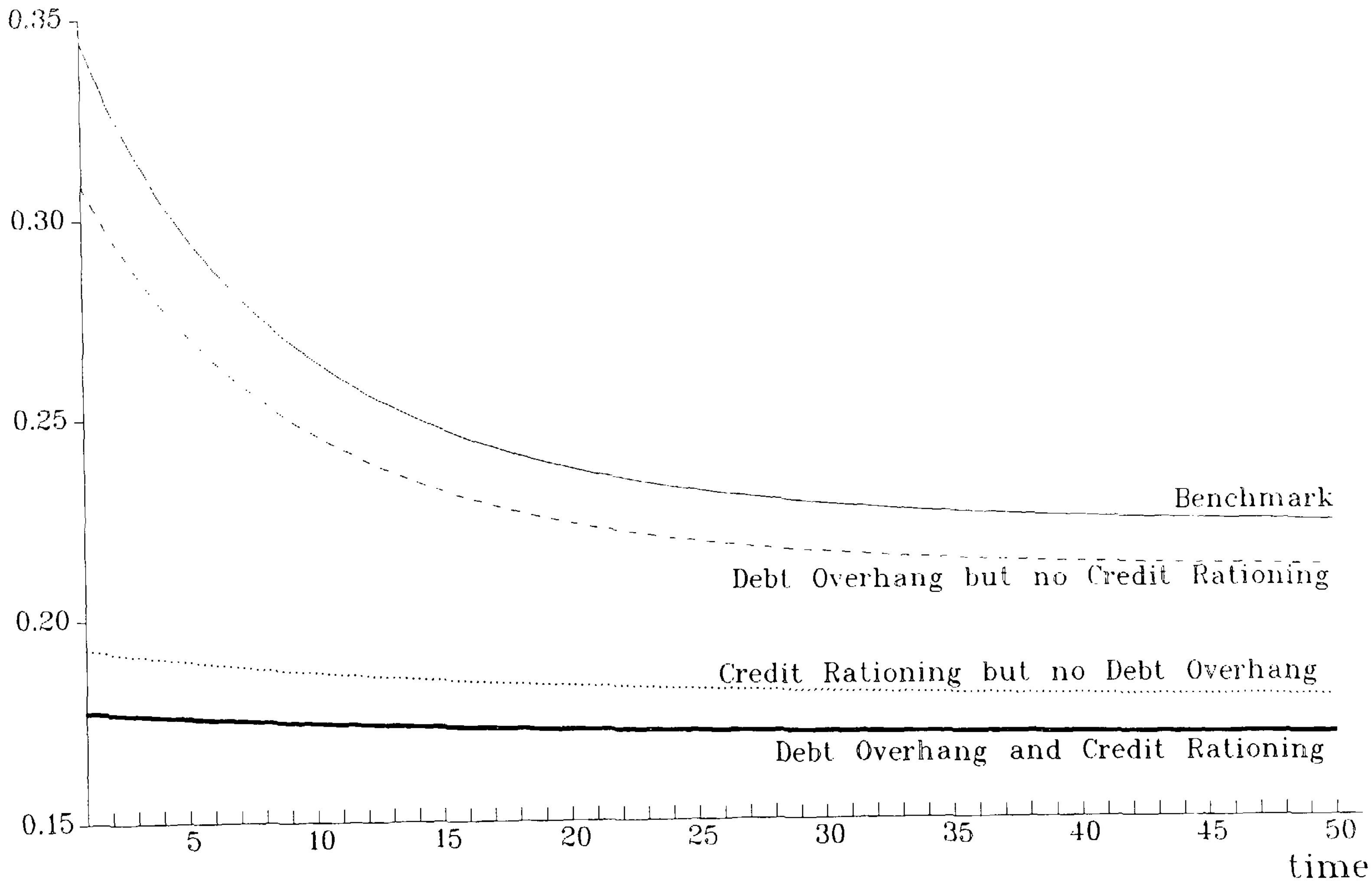
equation system (20) to (23), and finally, an economy without debt overhang but with credit rationing. The latter case simply corresponds to a closed economy. It is described by an equation system similar to (14) to (17), but with a value of 0 for the parameter b.

The results show a declining path for investment in all four economies, due to the fact that the starting point of the simulations correspond to growing economies with capital stocks that fall short of their steady-state value. In the two economies with no credit constraints consumption is constant in per capita terms, but declines as a fraction of GDP (because per capita GDP grows). In the two credit-constrained economies, per capita consumption rises over time and also as a fraction of GDP, because the interest rate exceeds the rate of time preference. The two economies with no credit constraints run initial trade deficits, basically due their relatively high initial investment rates and consumption smoothing, and they run surpluses later on in order to pay back accumulated debt. The two economies with debt overhang run a non-interest current account surplus equivalent to 5 percent due to the exogenously imposed debt payments, which may be additional to the non-interest current account deficit/surplus derived from "new" borrowing. In the economy with credit rationing and no debt overhang the current account is always zero.

The decline in investment is moderately larger under credit rationing and no debt overhang than under debt overhang and no credit rationing even though the parameter values used imply that the domestic interest rate would rise very little when the debtor country is constrained from international borrowing. A more dramatic picture arises from Chart 5, where the simulations were done using a value of 1.07 for β^{-1}. This value of β implies that the domestic interest rate rises 2 to 3 percentage points from the initial 5 percent level (its international level) when the economy is constrained from borrowing abroad. For this value of β, the investment to GDP ratio in the benchmark economy starts at over 34 percent and declines towards its steady state value of about 22 percent. The economy with debt overhang but no credit constraints follows a similar path, but with an investment to GDP ratio that moves from almost 31 percent to about 21 percent. Thus, the effect of the debt overhang over this baseline is initially of about three percentage points of GDP and declines over time. But notice that because GDP is lower in the second economy after the initial period, the absolute difference in productive investment is larger than suggested by the chart. The effect of credit constraints on investment is much more significant. The economy with credit rationing and no debt overhang settles at a steady state investment ratio of just under 18 percent, and the economy that in addition suffers from debt overhang settles at about one percentage point lower. At the beginning of the simulation period the contrast is much larger yet, because the initial position of the economies (which is the same in all four cases) is much closer to the steady state of the credit-rationed economies.

The above simulations suggest that credit rationing is a more powerful factor limiting real investment and growth in a highly-indebted country. However, the actual costs imposed by the debt overhang effect may have been underestimated for a number of reasons. First, there might be an important difference between the average and marginal effects of the debt overhang. For example, debt payments may be determined as a percentage of the excess

Chart 5
Simulation of Investment Paths



of GDP or exports over certain level, which may imply that a value of (marginal) b of 0.5 may not be completely out of line. And the marginal effect of the debt overhang is the relevant consideration for investment. Second, the investment process may not be characterized by the smooth neoclassical functions used in the simulations, but may instead be influenced by irreversibilities and lump-sum costs, which could make the debt overhang effect more powerful. And finally, the debt overhang may impose some indirect costs on the debtor economy, for example derived from the bargaining process as in Rotemberg (1988), which are not captured by this model.

IV. Conclusions

Some interesting policy conclusions can be drawn. At least for much of the parameter space, the simulation results suggest that a debtor country would benefit more from access to more lending than from only a reduction in existing obligations, in terms of the impact on the investment to GDP ratio. Consider, for example, the case of a benefactor third party willing to make available some funds to an indebted country, and weighing the relative merits of using the resources to buy back existing debt from private banks and then forgive it versus providing additional loans that carry a seniority clause. If the impact on investment in the debtor country is the selection criterion, additional lending should be preferred. Interestingly, the third party would also keep a good-standing claim, and creditor banks would also derive some benefit from the operation (although probably less than what they would obtain from the buyback.) A possible qualification is the argument put forward by Rotemberg (1988) in the sense that the bargaining process may itself be costly to both parties both in terms of direct costs and of efficiency losses generated as the parties take actions designed to affect the bargaining outcome in their favor, but that are not economically advisable. In this case, a buyback may then benefit the debtor country by reducing or avoiding bargaining costs and distortions.

In view of the above discussion, and of the fact that domestic interest rates in debtor economies appear to have generally increased since 1982, one could wonder why creditor banks do not authorize the issuance of senior loans to heavily indebted countries since that would enhance their repayment prospects. Leaving aside legal difficulties and problems of coordination among multiple creditor banks as explanations, it could be argued that, to some extent, official lending is playing the role of the senior claims. It might also be the case that senior lending from private sources would be ineffective because it would not be possible to guarantee that the procedure could not later be repeated and a new batch of first-seniority claims would be forthcoming. The question seems worthy of further exploration.

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