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DEBT OVERHANG, LIQUIDITY CONSTRAINTS
AND ADJUSTMENT INCENTIVES

by

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"The hallmark of bad macroeconomics is an overriding concern with undifferentiated aggregates like investment, consumption and savings".

The Economist, September 23, 1989.

Debt Overhang, Liquidity Constraints, and Adjustment Incentives

1. Introduction

Investment in most heavily indebted countries has been weak since 1982. Several papers (Krugman, 1988; Corden, 1988; Sachs, 1989) have subsequently established the debt overhang proposition: the existence of a heavy debt burden reduces the incentive to invest.[1] This proposition has given an important rationale for the 1989 shift in international debt management, emphasizing debt relief rather than new money for problem debtors. This paper will raise doubts against the debt overhang proposition: Its analytical implications are found to be ambiguous, its empirical content is found to be weak. We conclude, that investment in the average debtor country is likely to benefit more from new lending than from debt reduction.

That liquidity constraints, not the debt overhang, are probably decisive for the low levels of investment in the problem debtors, may be suggested by Table 1. Since 1982, investment in Latin America has fallen on average by 6.8 per cent of GDP compared with the 1970s, almost exactly equal to the increase in the non-interest external surplus (which roughly measures the reduction in liquidity). In the meantime, foreign debt has grown only slowly. While investment ratios in Latin America dropped immediately in 1983 to accommodate the switch in net financial transfers (net new debt minus interest), they have stabilized thereafter on a modest upward trend (IDB, 1989, table II-4). Table 1 shows also, contrary to what is often maintained, that investment ratios in Latin America are not low by historical standards. Investment ratios and the non-interest current account look now as they looked in the 1960s. Given this prima facie evidence, it would be surprising if investment had been more affected by the debt overhang channel than by the liquidity channel.

TABLE 1. Latin America: Investment and the Non-Interest External Surplus

percent of GDP

	1960-69	1970-82	1983-88
Investment	18.6	23.2	16.4
Non-Interest External Surplus	5.3	-0.4	6.1
Change 1983-88 against period			
Investment	-1.8	-6.8	-
External Surplus	0.8	6.5	-

Source: IDB, Economic and Social Progress in Latin America, 1989 Report.

Nevertheless, some preliminary analysis by the IMF (1989) has concluded that the debt overhang plays a large part in explaining the slump in investment in problem debtor countries. The IMF bases its support of the debt overhang proposition on two pieces of evidence. First, the savings ratio in the so-called Baker-15 countries[2)] has fallen, rather than increased, when external finance dried up. The necessary squeeze in domestic demand relative to output was therefore more than fully reflected in lower investment. Second, a comparison of the country group of problem debtors with a group of other heavily-indebted countries which did not experience debt-servicing problems shows that investment and savings ratios dropped in the former group but not in the latter. This evidence supposedly confirms the debt overhang hypothesis which attributes disincentive effects to the fact that debt service

becomes linked to economic performance in problem debtors, thus weakening the incentive to invest.

A closer inspection of the IMF analysis reveals several shortcomings, however.

--First, the base period 1975-81, against which the IMF compares events after 1981, is highly exceptional because it includes the years when the build-up of foreign debt was overshooting at an unsustainable pace. Especially during 1978-81, foreign savings financed exceptional levels of investment in problem debtor countries. A standard investment model easily explains why investment ratios peaked in that period and dropped thereafter (Dornbusch, 1985). The increasing anticipation of future depreciation of the real exchange rate acts as a temporary investment stimulus in developing countries, since imports form an important part of inputs in the production of investment. While anticipated depreciation means an immediate jump in the real price of assets, real capital costs start only to rise once real depreciation sets in. Then disinvestment takes place.

--Second, the IMF analysis selects a control group of middle-income non-problem debtors which is highly arbitrary. Non-problem debtors are defined as indebted countries that have not confronted serious debt-servicing difficulties. The IMF sample picks only high-investment countries (Indonesia, Korea, Malaysia,

Thailand and Turkey). We have added Algeria, Greece, Israel, and Portugal which also belong to the group of non-problem debtors to extend the control group[3] for a covariance test.

The covariance test is presented in Table 2 for savings ratios, in Table 3 for investment ratios. The test reveals that the change in savings ratios (comparing the periods 1982-87 and 1971-81) was not significant at a 95 per cent confidence level, regardless if the IMF sample or the extended sample was chosen as a control group. There has indeed been an important drop in savings ratios and investment ratios in problem debtor countries during the 1980s. But the variance of national savings ratios within the country groups was too big and the variance between country groups too small to confirm the debt overhang proposition along these lines. The only difference which is significant at a 95 per cent confidence level is found for the changes in investment ratios between problem debtors and the IMF sample of non-problem debtors. The fact that investment behavior changed more markedly than the savings behavior between problem and non-problem debtors, points again to the evidence that investment was governed by net financial flows more than by debt stock related disincentives.

[TABLE 2]

[TABLE 3]

Hence, more rigorous empirical evidence is needed about the debt-related channels that have impacted on investment in developing debtor countries. This is the principal aim of this paper. The remainder of it is structured as follows: Section 2 will put the debt overhang proposition into perspective, by contrasting it with the standard theories of consumption and investment behavior under a credit constraint, and integrates both views in empirical specifications of investment and consumption functions. The results of the econometric test are presented in section 3. Section 4 concludes that debt reduction will not produce higher savings and investment compared to alternative debt strategies (such as forced lending) unless it maximizes the cash flow relief for indebted countries.

2. Foreign Debt, Consumption, and Investment

2.1: The Debt Overhang proposition

The "debt overhang" proposition belongs to the group of moral hazard interpretations of the current debt crisis. Their advocates (Sachs, 1989; Krugman, 1988; Corden, 1988) argue that a "debt overhang" provides a disincentive for adjustment. Both concepts have been put into a specific context. "Adjustment" (which can be thought of as economic reform) refers to the debtor's decision to invest or to consume in a two-period model. The economy "inherits" a given stock of debt in the first period which must be serviced in the second period. The decision in period one is to consume or

to invest, the latter yielding a return in period two, which serves to pay back the debt and to consume. This decision is presumed to be biased towards consumption in the presence of a "debt overhang". This is defined as the difference between the face value of debt outstanding and its market value -- the expected present value of future resource transfers (debt service minus new debt) from the borrower to the lender. The "debt overhang" may act like a tax on the debtor's consumption in period two. This is because for over-indebted countries, debt service does not depend on scheduled interest and amortization anymore, but is linked to their economic performance via arrears and involuntary lending. If a debtor is only servicing part of his debt, reduced consumption in period one is not offset by higher consumption in the future, because the creditor would reap all or most of the benefits of that adjustment effort. Consequently, it does not pay to invest, and the country will consume its resources in period one, and will default upon its debt. Hence the conclusion, that debt relief would increase the incentive of a debtor country to make an adjustment effort (to invest), because it would leave a larger share of the benefits from investment to the debtor. Debt relief would be in the interest of both debtor and creditor, since now at least part of the debt is repaid.

Following Corden's (1988) interpretation, debt overhang can be illustrated as in figure 1[4)].

[Insert Figure 1]

In figure 1, the horizontal axis measures -predetermined- output net of debt obligations in period 1, A. Consumption in period 1 is measured from the origin to the right, and period 1 investment is measured leftwards, starting from A. Investment yields output in period 2 along AB. Without inherited debt, AB is the consumption possibility curve, and the country would choose S1, the point of tangency of this curve with the utility function U1; it will invest AJ1, and consume OJ1. A small inherited debt D1 shifts consumption possibilities downwards to C_0C_0, and the optimum now yields higher investment AJ2, and lower consumption. At low levels of debt, therefore a positive association between debt and investments should exist. However, if the inherited debt is very large, say D2, point A would be optimal, implying the consumption of all resources in period one, and default in period 2. The debt overhang position A therefore predicts the association of high debt and low investments, which the IMF finds in the data. If indeed point A in figure 1 applies to the problem debtor countries, debt relief would be rational for the creditors. Forgiving the amount R would induce the country to choose S3, thus investing AJ3, and paying back (D2-R).

2.2 Debt and Liquidity Constraints

The positive effect of a small debt on investment, as described by Corden apply in the case of a cut-off from the capital markets from international capital markets, but equally, if the debtor is credit constraint, as will be shown below. With free access to capital markets, no pro-investment incentive effect of a small debt exists, as is shown by Callier (1989)[5]), and will be repeated here. Then the case of a credit constrained debtor is analyzed, and factors which explain investment and consumption behavior will be identified. These will be used in the empirical section 3, for testing the various hypothesis presented. Throughout, it is assumed that the consumption and investment decisions are under control of a social planner, thus substitution effects are neglected.[6)]

If a country has unrestricted access to the international capital market, i.e., is only limited by its intertemporal budget constraint, investment and consumption decisions are separated. The country will invest until the marginal productivity of capital is equal to the world interest rate (see appendix I, case I for a formal exposition), and it will borrow up to the point where marginal utility is equated in each period. The capital market is used to allocate wealth over time and the country will consume according to its wealth constraint (see, for example, Sachs 1984,

p.6 ff). The equilibrium of a debtor without a liquidity constraint is depicted as point S_0 in figure 2.

[INSERT FIGURE 2]

In figure 2, consumption possibilities are not restricted to C_0C_0, as in Corden's case, but can be extended along the capital market line HH, with slope $-1/(1 + r)$, where r is the world interest rate. In the unconstrained case, r represents the opportunity costs of borrowing. The borrower will invest until the capital market line is tangent to the C_0C_0 schedule, i.e. AJ_0. It will subsequently borrow J_0D in order to achieve the preferred consumption point S_0, where the utility function is tangent to HH. An increase in inherited debt[7] from D_0 to D_1 would shift the C_0C_0 curve downwards to C_1C_1, but would leave investment unaffected at AJ_0, since both marginal productivity of capital and the opportunity costs of capital are unaffected. The loss in wealth from W_0 to W_1 caused by the increase in debt burden is spread over consumption in period 1 and 2, as can be seen in the new consumption point S_1. Borrowing is reduced, and period 1 consumption as a percentage of -- predetermined -- output A falls. However, if the utility function is homothetic,

consumption as a percentage of wealth remains constant.

Corden's (1988) pro-incentive effect of an increase in debt therefore does not apply if access to capital markets exists. Investments are only determined by marginal productivity and world market interest rates.

Unrestricted access to capital markets seems hardly a relevant case for most LDC borrowers, and especially for the problem debtors over the 1980s. The inability to borrow as much as desired, or indeed the net lenders position enforced upon these countries, affects the optimal investment-consumption choice, since these entities are now inter-related.

[Insert figure 3]

Suppose a country can only borrow the amount B_c (see figure 3), and suppose this constraint is binding. Investing AJ_0 would imply consuming in point S_2, since only B_c can be borrowed. This is no longer optimal: a higher utility level could be reached by reducing investments, and increasing consumption. Due to the credit constraint, the shadow price of capital now exceeds the world discount rate (Sachs, 1984, p.20), yielding a steeper opportunity costs of capital line, H_cH_c (see Appendix 1, case II). The opportunity costs of capital are a function of borrowing possibilities and marginal utility of consumption. The optimal investment is now AJ_1, where H_cH_c, is tangent with the C_0C_0 curve[8]. Optimal consumption is determined by the amount which can be

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borrowed on the international capital market, B_c, which gives S_3, where $C_1=A-AJ_1+B_c$ and $C_2=f(AJ_1)-D-(1+r)B$ [9]. Note that in the consumption point the utility curve U_3 is tangent to a line parallel to the H_cH_c line, and thus the marginal rate of substitution is still equal to the marginal rate of transformation.

The lower Bc is, the more the opportunity costs of capital will differ from the world interest rate, and the less will be invested, and the less is consumed in period one, both absolute, and in terms of output in period one. However, due to reduced investments, the credit constraint reduces the country's wealth as well, and the change in consumption as a percentage of the latter is ambiguous. The credit constraint has several other implications as well (formally derived in Appendix I, case II). The lower discounted period 2 marginal utility is relative to period 1 marginal utility --in other words, the lower the propensity to save-- the lower investments will be. Savings, being a source of capital, become argument in the investment function.

An increase in inherited debt now again has a positive effect on investment: since more old debt has to be repaid in period two, the country is less willing to borrow in period one. This means, however, that the the credit constraint becomes less binding, the shadow price of capital falls, and investment and consumption in period one are increased. Corden's (1988) case of isolation from

the capital market, in which a small debt stimulates investments, is nothing but a special case of a credit constraint borrower.

For a net borrower which is credit constraint, an increase in the interest rate has equally a positive effect on investment. The increase in the costs of borrowing reduces the propensity to do so, and therefore relaxes the borrowing constraint, which reduces the shadow price of capital, hence investments are increased. However, most problem debtors have become net lenders over the 1980's, by repaying old obligations, without receiving new loans. In that case, a rise in interest rates makes it more profitable to repay, but this tightens the credit constraint (less capital is available for domestic purposes), and thus investments are reduced.

An interesting special case arises, when the credit limit is a function of the inherited debt (see appendix I, case III). Now, the positive direct effect of an increase in inherited debt, as described above, are counteracted by the reduced borrowing possibilities due to this increase, and the total effect might result in reduced investments. Simple bivariate correlations could therefore yield the rather misleading result that debt reduces investments, whereas the crucial point would be the credit constraint.

2.3 Empirical Specification

The conceptual discussion of the previous section has identified a number of variables influencing consumption and investment in debtor countries, the effects of which may vary with the credit regime the country is subject to. This section will give the empirical specification, and will identify the various hypotheses to be tested.

2.3.1 The Investment Function

The effect of debt on investment is estimated in the context of an investment equation, containing the variables discussed in the previous two sections:

$$(2.1)\quad I = \alpha_0 + \alpha_1 r + \alpha_2 S + \alpha_3 (dF/dK) + \alpha_4 NTR + \alpha_5 D + \mu$$

where I = investment

r = real interest rate

S = savings

dF/dK = marginal productivity of capital

NTR = net transfer to the debtor country

D = debt burden

μ = error term

The expected signs of the coefficients differ with the various hypotheses discussed and are summarized in Table 4.

[INSERT TABLE 4]

Table 4 presents the extreme form of the debt overhang, in which all benefits of investments in excess of "minimum consumption" are captured by creditors, and if one relaxes this assumption, α_2 α_3 and α_4 will be positive under the debt overhang hypothesis as well. However, the two hypothesis predict opposite impact on consumption.

In order to estimate equation (2.1) a number of proxies for the variables had to be taken of which the most important one is that of debt burden. The debt burden, D, can be measured in a number of ways. In the empirical research concerning the determinants of repayment problems, usually a measure of debt/exports, debt/GDP or debt service is used. Neither of these variables is a perfect measure of real burden, and all of them are endogenous variables to a certain extent: rational creditors would only allow a country to build up a high debt or debt service level (compared to GDP or exports) if they ascribe a high creditworthiness to this country, or in other words, if the debt burden for the country is manageable. Besides, the correct measure for debt burden depends upon the nature of the problem: if the debt crisis is basically

seen as an internal transfer problem, debt to GDP is more accurate than debt to exports or debt service to exports, whereas the latter is more accurate if the problem is the external transfer. Debt service depends, to a large extent, on the maturity distribution of the debt, and is rather a measure of liquidity than of debt burden. As such, it is already included in the transfer variable of equation (2.1). Differences in timing of repayments and levels of interest for different countries would make the discounted present value of future debt service a better indicator, but if liquidity is constrained, not only present values count, but also the timing of debt service. Finally, without any change in debt, debt service, or any other conventional measure, the real burden may increase, e.g. due to terms of trade movements, a rise in interest rates, if the debt is floating rate debt, etc..

Given these qualifications, one can expect to find the conventional measures to have only a weak relation with debt burden. However, this relation may become stronger, if we add a priori information: given that a country has debt servicing problems, an increase in the debt to GDP-ratio will more likely indicate an increase in the debt burden than a reduction of it. A more direct measure of debt problems is equally tested as a proxy for debt burden: interest arrears. Again, this is not an undisputed measure of debt burden, but it does track the debt overhang proposition.

As a proxy for world market real interest rates, the US

government bond yield deflated by the percentage change in the U.S. GDP deflator was taken. Productivity of investments was proxied by growth in GDP. For the savings variable, Domestic Savings as a percentage of GDP were taken. Net transfers were calculated as net long term capital disbursements minus long term interest payments. Short term capital movements were excluded, due to lack of data over the 1970s.

2.3.2 The Consumption Function

As discussed in the previous section, the unconstrained borrower will divide its wealth over consumption now and in the future. Debt and credit constraints have influence on the marginal propensity to consume, as well as on wealth itself. In order to distinguish empirically between these effects, we will test the hypotheses on consumption in the context of the Permanent Income hypothesis. The IDB (1989, p.116) reviews empirical evidence for the Permanent Income Hypothesis in developing countries, and concludes that it "provides a useful explanation" for consumption behavior. Following this hypothesis, permanent consumption C_p is a function of permanent income Y_p:

$$(2.2)\quad C_p = k\ Y_p$$

where k is the marginal propensity to consume out of permanent income. Assuming that adaptive expectations are a reasonable

approximation of expectations formation in developing countries, equation (2.1) can be readily operationalized. Permanent income is then proxied by a weighted average of present and past current income.[10] Taking into account a trend factor in income, and using a Koyck transformation, then yields (see for a full derivation, König, 1978):

$$(2.3) \qquad C_t = k\beta Y_t + (1 + \alpha - \beta)C_{t-1} + \mu_t$$

with C_i = consumption in period i

Y_t = income in period t

α = trend in income

β = coefficient of expectations adjustment

μ_t = error term

k can now be identified from the coefficients of C_{t-1} and Y_t, if either α is neglected, or if this is estimated directly.

In case of a debt overhang, one would expect k to be higher, than in the case of normal credit relations. If a country is constrained on the capital market, one would expect k to be lower than in the case of free access to the capital market, due to imperfect smoothing of consumption (see section 2.2).

The problem with the hypotheses on k is, of course, to find the normal k. If we accept the IMF criterium of rescheduling as a sign of disrupted capital market relations, the 1970s can be considered

as a reasonable counterfactual. We will therefore take the change in marginal propensity to consume outof permanent income between 1971-81 and 1982-87 as an indicator of presence or absence of debt overhang.

The consumption function was estimated with total per capita consumption and per capita gross national product, using 1980 prices. This assumes that government consumption is equally valued as private consumption, but avoids the problem of defining disposable income for each country

3. Empirical Results

Equations (2.1) and (2.3) were estimated for the period 1971-87 and the two subperiods, 1971-81 and 1982-87 using pooled time series cross section data for problem debtor countries, in order to gain the necessary degrees of freedom. For the consumption function, the Instrumental Variable method was used, since shocks on income are likely to affect consumption as well. Dummy variables allowed for different intercepts in both investment and consumption estimations. The results can thus only be interpreted for an "average" problem debtor. This precludes detecting presence or absence of debt incentives for an individual country. The estimation results are presented in Tables 5 and 6.

3.1 The Investment Function

[INSERT TABLE 5]

The estimated investment equations in table 5 perform rather well in terms of R^2 and F statistics, but this is due to the lagged investment terms, which were included to suppress autocorrelation of the residual. Inclusion of a time trend suppressed heteroscedasticity. This time trend may well capture the effect of omitted variables equally trended, but candidates for this (terms of trade, real exchange rates) did not perform well in the equations, or had inexplicable signs.

The evidence on debt-related variables would reject the debt overhang hypothesis for the average problem debtor, in the sense that no negative correlation of debt and investments could be detected. On the contrary, in the 1982-87 period, both Debt/GDP and Debt/Exports are significantly positive at the 5 per cent level. This is in line with the theoretical findings for a liquidity constraint country. Arrears do not seem to influence investment behavior in the 1982-87 period, which would occur under the debt overhang hypothesis. The coefficient for Net Transfers is significantly positive in both periods, and in each specification. Estimations were also performed with Net Transfers

split up on Long Term Debt Service and Long Term Capital Disbursements, using further the specification of equations (1) and (3). In 1971-81, the values were respectively (t-values in parenthesis) -0.39(2.25) and 0.24(2.12). For the 1982-87 period, the same values were -0.52(3.28) and 0.49(3.66). For both periods, the null hypothesis that the absolute value of the coefficients was equal could not be rejected (see appendix II). This implies that debt service showed no other effects than liquidity effects; possible negative effects, due to taxation for financing the debt service, could not be detected in this way.

The second liquidity variable, Savings, is only significantly positive in the 1980s (equations 3 and 5). A joint test of the significance of both the Net Transfers and the Savings variable accepts the null hypothesis of no significant difference from zero in equation (1), but rejects the same hypothesis for equation (3) (see appendix II). This would indicate that over the latter period, the problem debtors have become more constrained in their access to the international capital market. Tests for structural change equally indicate different behavior for both sub-periods (see appendix II), regardless of whether the specification with Debt/GDP or Debt/Exports is taken.

The negative correlation of interest and investment in the 1982-87 period is compatible with the credit constraint hypothesis, given that the problem debtors were net lenders over this period.

Given the joint insignificance the Net Transfer and Savings variable over the 1971-1981 period, one might conclude that the negative correlation of interest and investments indicates unconstrained capital market access for this period. However, this is not very plausible, and the interest rate term might capture part of the neglected substitution effects (see also note 6). The world market interest rate might be the relevant opportunity costs of capital for individual agents capable of moving their capital abroad. The bulk of capital flight took place in the period 1978-82 (see Gajdeczka, 1990, chart 1), and this might have affected domestic investments negatively. Including capital flight in the theoretical analysis seems an interesting extension of this research.

Although more formal tests for the pooling procedure followed in the estimations were rejected -- or could not be performed, due to lack of degrees of freedom -- the equations estimated for the whole sample performed quite well for individual countries, as can be seen in table 6. (For a similar procedure of testing the pooling procedure, see Pastor, 1989).

[INSERT TABLE 6]

3.2 The Consumption Function

[INSERT TABLE 7]

The marginal propensity to consume out of permanent income, k, shows a fall in the 1980s as compared to the 1970s. This holds equally for the marginal propensity to consume corrected for a trend factor, k_g.[11] We conclude therefore that it is more likely that the marginal propensity to consume was lower in the 1980s compared to the 1970s, for the problem debtors, than the reverse, thus contradicting the debt overhang proposition, and the evidence quoted in IMF (1989). The fall in k is predicted by the credit constraint hypothesis as presented in section 2.2. The results from the estimations of table 7 should, however, be interpreted with precaution. Apart from the specification of the Permanent Income hypothesis, the estimated coefficients are not very stable over time, and the observed heteroskedasticity indicates omitted variables. An F-test for the sub-periods refutes the hypothesis of no structural change between the 1970's and 1980's. Moreover, the causes of the movement in k are not analyzed, and might be other than debt and liquidity variables. Integrating these in the Permanent Income set-up would be necessary to derive more firmer conclusions.[12] This is left for further research.

Although a formal F-test would again reject the method of

pooling chosen, the correlation of the predicted values from the estimated equations and the actual values observed for the individual countries is in general high. Exceptions to this are Colombia, Brazil and Peru in the period 1971-81.

[INSERT TABLE 8]

4. Conclusions

Whether the drop in problem debtors' investment is due to a debt overhang rather than to the switch in net transfers, has important implications for policy. If a debt overhang was to blame for weak investment, the provision of liquidity alone would leave the problem of debt-stock-related disincentives unresolved. Debt reduction would give investment a bigger boost than interest reduction or new foreign money. On the other hand, countries that are constrained only by liquidity need infusion of new funds to take advantage of profitable investment opportunities. Cutting the debt stock without new lending would not spur investment there.

This paper has developed hypothesis on optimal reactions of a credit constrained debtor on an increase in debt, variations in the credit constraint, and changes in interest rates, and contrasted these with the predictions stemming from the debt overhang hypothesis. The empirical evidence presented seems to

reject the debt overhang hypothesis, and is in line with the credit constraint hypotheses.

The rejection of the debt overhang hypothesis for the average problem debtor confirms previous alternative empirical attempts to show the existence of a debt overhang. These have measured the elasticity of the secondary market price of the debt with respect to its nominal value (see, notably, Cohen 1989). They have systematically found a low estimate. While these results cannot reject the existence of a debt overhang, they imply that debt relief cannot be Pareto improving (Froot, 1988) except for very few countries such as Bolivia, Peru, Nicaragua and Sudan.

This is bad news for the new international debt strategy which relies on `voluntary, market-based' debt reduction. For the available evidence, presented here and elsewhere, implies that the banks cannot gain (increase the market value of their claims) by granting debt reduction once they have overcome their own free-rider problem. Their claims could be better protected by the provision of new loans.

NOTES

1. The concept of investment stands here for the broader concept of "economic reform", like trade liberalization, privatization, or tax reform. Both investment and "economic reform" are expected to increase future output and the capacity to service debt.

2. Another term often used for the countries is `problem debtors'. They include Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Côte d'Ivoire, Mexico, Morocco, Nigeria, Peru, Philippines, Uruguay, Venezuela, and Yugoslavia.

3. The sample of non-problem countries could be further extended according to the selection criteria practiced by the IMF if some small island economies were added for which, however, investment and savings data were not readily available.

4. Without loss of generality, Corden's "minimum consumption" can be set to zero (see Sachs, 1989).

5. Callier (1989) extends Corden's analysis by assuming free access to this market, but he neglects the effect of credit rationing on consumption and investment. Free access in

combination with debt overhang seems a rather odd case.

6. Corden (1988) devotes some analysis to these substitution effects. In the case of debt overhang, debt relief would, due to substitution effects, lead to more investments since individuals expect lower taxes in the future. He neglects, however, these substitution effects when discussing the pro-incentive effect of debt. The substitution effects of an increase in debt as a fraction of taxes would then lead to less investment, and will thus counter the pro-incentive effect.

The analysis is complicated by the possibility of substitution of investments abroad. Capital flight might be a rational response to future tax obligation. If no effective control exists, an increase in debt might only affect the decision to invest abroad or at home, without affecting the consumption (or savings) decision. A social planner could counter these effects by taxing consumption, equally affecting income from domestic and foreign sources. Intertemporal substitution effects could be countered by equalizing tax rates over time, e.g., by supplying investment credits once an increase in debt occurs. For a discussion of the effect of debt on capital flight, see for example, Ize and Ortiz, 1987.

7. An increase in inherited debt can, for example, be caused by an increase in world interest rates, if the obligations have variable interest rates. In order not to complicate the analysis, however, we consider the increase as purely exogenous.

8. This liquidity effect would be mitigated if creditworthiness is a function of investments, and if the country could credibly commit itself to a high level of investments. We abstract from this possibility here.

9. This consumption point is reached if the receipts from charging a higher interest rate internally are distributed in a lump sum matter. In this, the analysis is comparable to that of a quota on an imported good.

10. This concept of permanent income is valid if current and past income provide a reasonable indicator for future income streams. This concept is not undisputed (see for example, Hall, 1978 and 1989).

11. The trend factor was found by regressing the logarithm of per capita GNP on time: $\ln(GNP/CAP) = a + bt + e$. The trends, α, for the debtor groups and the two periods, are then found by:

α = antilog(b) -1 (See World Bank, 1988).

The values found for α are;

1971-81	1982-87
0.022	-0.006

It should be noted that the coefficient for time was not always significant. Furthermore, the value of -0.006 for the problem debtors is unlikely to be the expected trend. A higher value for α would imply a lower value for the problem debtors' trend-corrected marginal propensity to consume over the 1980s.

16. Adding debt and net transfer variables to the consumption equation in an ad-hoc manner yields positive signs for both in the 1971-81 period, with only net transfers significantly different from 0. In the 1980s, both variables have a significantly negative sign.

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Appendix I

The social planner's problem is:

$$\text{Max! } U(C_1;C_2)$$

subject to:

$C_1 = A+B-I$

$C_2 = f(I)-D-(1+r)B$

$B \leq B_{max}$

where

C_i = Consumption in period i

A = Period 1 output

I = Investments in period 1

$f(I)$ = Output in period 2

D = Inherited debt, to be repaid in period 2

B = Period 1 Borrowing

B_{max} = Credit constraint

r = World interest rate

Assuming a simple, time separable utility function, the Lagrangian becomes:

$$(1) \quad Z = U(C_1) + \delta U(C_2) + \mu_1[A+B-I-C_1] + \mu_2[f(I)-D-(1+r)B-C_2] + \mu_3[B_{max}-B]$$

where μ_i are Lagrangian multipliers

First order conditions, with subscripts indicating partial derivatives yield:

$$(2) \quad U_1-\mu_1 = 0$$
$$(3) \quad \delta U_2-\mu_2 = 0$$
$$(4) \quad -\mu_1+\mu_2 f_I = 0$$
$$(5) \quad \mu_1-\mu_2(1+r)-\mu_3 = 0$$
$$(6) \quad B_{max}-B \geq 0 \text{ and } \mu_3 \geq 0 \text{ and } \mu_3[B_{max}-B] = 0$$

and the two definitions for consumption.

<u>Case I</u>: Unconstrained borrowing

If $B<Bmax$, condition (6) implies that $\mu_3=0$, and combining (4)and (5) then gives the usual condition

$$(7) \quad f_I = (1+r)$$

i.e. investment takes place until marginal returns equal the world discount rate, and consequently

$$(8) \quad dI = dr/f_{II} < 0$$

dI/dD equals zero: a change in inherited debt leaves investments

unaffected.

Case II: Constrained Borrowing

If $B_{max}-B=0$, $\mu_3>0$, and combining (4) and (5) yields the first order conditions for investment:

(9) $f_I = (1+r) + \mu_3/(\delta U_2)$

In the optimum, marginal productivity of investments is therefore larger then the world discount rate.
Taking the total differential of (9) yields:

(10) $f_{II}dI = dr + (d\mu_3/\delta U_2) - (\mu_3 dC_2/\delta U_{22})$

Inserting equations (2),(3),(5) and their total differentials into (10) and rearranging gives:

(11) $f_{II}dI = (U_{11}/\delta U_2)dC_1 + \{(U_2(1+r)/U_{22}) - (U_{22}(1+r)/U_2) - (U_1/\delta U_{22})dC_2$

Realizing that $dC_1=(dB-dI)$ and $dC_2=(f_I dI-D-(1+r)dB-Bdr)$, the partial derivatives can be determined as:

$$\frac{dI}{dD} = \frac{-\Gamma}{f_{II}+(U_{11}/\delta U_2)-\Gamma} \qquad >0 \text{ if } \Gamma>0$$

$$\frac{dI}{dB} = \frac{(U_{11}/\delta U_2)-\Gamma}{f_{II}+(U_{11}/\delta U_2)-\Gamma} \qquad >0 \text{ if } \Gamma>0$$

$$\frac{dI}{dr} = \frac{-B\Gamma}{f_{II}+(U_{11}/\delta U_2)-\Gamma} \qquad >0\ (<0) \text{ if } B>0\ (<0), \text{ and } \Gamma>0$$

where $\Gamma = \{(U_2(1+r)/U_{22}) - (U_{22}(1+r)/U_2) - (U_1/\delta U_{22})\}$

For Γ to be larger then zero, it is sufficient to assume that the preferences are homothetic (i.e. the functional form of the Utility function is the same in period 1 and 2) and that the country, if unconstrained would be a net borrower, implying that $\delta<1/(1+r)$, since then the last term of the definition of Γ is larger then the first term in absolute terms, and the whole becomes positive.

Case III: debt and credit constraint interrelated

If the credit constraint depends upon the inherited debt, and if the credit constraint is binding, dB becomes a function of dD.

Suppose, for simplicity, that under this assumption the credit constraint becomes:

(12) $B \leq B_{max} - D$

and therefore $dB/dD=-1$. Inserting this in equation (11), the partial derivative of investments towards debt now becomes:

$$\frac{dI}{dD} = \frac{-(U_{11}/\delta U_1)}{f_{II}+(U_{11}/\delta U_2)-\Gamma} < 0$$

This could be the reason why in bivariate correlations, a negative relation between debt and investments is found.

Appendix II: F-Tests quoted in text

1. Tests for structural changes in the investments equations.

Ho: no structural change

Equations	F value	accept/reject at 95% level
(1) and (3)	$F_{23,188} = 2.04$	reject
(2) and (4)	$F_{23,201} = 1.63$	reject

2. Tests for joint significance of the Savings and Net Transfer variables. Ho: not significantly different from zero

Equations	F value	accept/reject at 95% level
(1)	$F_{2,124} = 2.85$	accept
(3)	$F_{2,64} = 14.52$	reject

3. Test for difference in absolute values of the coefficients of Debt Service and Long Term Capital disbursements. The unrestricted equation includes these variables separate; the restricted equations are (1) and (3) in table 5. Ho: no difference in absolute value.

Sum of Squared Residuals

Unrestricted Equation	Restricted Equation	F value	Accept/Reject at 95% level
595.7	(1)	$F_{1,123} = 1.18$	accept
157.9	(3)	$F_{1,63} = 0.06$	accept

4. Test for structural change in the Consumption Function.

Ho: no structural change

Equations	F value	accept/reject at 95% level
(1) and (2)	$F_{17,221}=3.79$	reject

Table 2

Savings Ratios: A Covariance Test

	1971-81	1982-87	1982-87 vs 1971-81
I. Savings Ratios			
* Problem Debtors	19.4	14.5	- 4.9
* Non-Problem Debtors			
--IMF Sample	22.7	23.5	0.8
--Ext'd Sample	24.1	21.9	- 2.3
II. Variance Within Country Groups			
* Problem Debtors	48.2	97.6	52.0
* Non-Problem Debtors			
-- IMF Sample	7.0	11.9	9.2
-- Ext'd Sample	40.9	48.1	24.6
III. Variance Among Country Groups			
* IMF Sample	2.1	15.2	6.0
* Ext'd Sample	5.3	12.9	1.6
IV. F-Statistics			
* IMF Sample	1.0	3.6	2.4 (< 4.4)
* Ext'd Sample	2.4	3.3	0.7 (< 4.3)

Source: World Bank, World Tables 1988-1989, Tape Documentation

Note: Savings Ratios are defined as Gross National Savings as a percentage of Gross National Product, at current prices. For the definition of country groups, see text. Figures in brackets for F-Statistics show the critical values at the 95 p.c. confidence level.

Table 3

Investment Ratios: A Covariance Test

	1971-81	1982-87	1982-87 vs 1971-81
I. Investment Ratios			
* Problem Debtors	23.3	17.8	- 5.5
* Non-Problem Debtors			
--IMF Sample	25.1	26.4	1.3
--Ext'd Sample	27.9	25.8	- 2.0
II. Variance Within Country Groups			
* Problem Debtors	25.5	51.1	33.8
* Non-Problem Debtors			
--IMF Sample	6.2	10.0	3.9
--Ext'd Sample	28.7	21.8	17.7
III. Variance Among Country Groups			
* IMF Sample	0.6	14.0	8.8
* Ext'd Sample	4.8	15.1	2.9
IV. F-Statistics			
* IMF Sample	0.5	6.2	6.0 (> 4.4)
* Ext'd Sample	3.6	7.6	2.1 (< 4.3)

Source: World Bank, World Tables 1988-1989, Tape Documentation

Note: Investment Ratios are defined as Gross Domestic Investment as a percentage of Gross Domestic Product, at current prices. For the definition of country groups, see text. Figures in brackets for F-Statistics show the critical values at the 95 percent confidence level.

Table 4

Expected signs of coefficients in the investment function under various hypotheses

	Unrestricted Borrower	Liquidity Constraint		Debt Overhang[1)]
		Borrower	Lender	
α_1	-	+	-	0
α_2	0	+	+	0
α_3	0	+	+	0
α_4	0	+	+	0
α_5	0	-	+	-

- = negative
+ = positive
0 = no influence

(1) assuming that the `debt overhang' remains after the change in the respective variables.

Table 5

Investment in Debtor Countries 1971-87

	1971-81		1982-87			1971-87	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Constant	8.95	7.34	16.13	18.85	9.58	2.54	3.76
	(3.58)	(3.70)	(3.44)	(3.58)	(1.21)	(1.75)	(3.42)
Investments(-1)	0.70	0.75	0.56	0.55	0.59	0.80	0.81
	(8.66)	(9.48)	(5.28)	(5.03)	(4.85)	(12.89)	(13.32)
Investments(-2)	-0.28	-0.30	-0.35	-0.30	-0.43	-0.28	-0.28
	(3.34)	(3.67)	(3.24)	(2.56)	(3.56)	(4.72)	(4.68)
Real Interest	-0.51	-0.48	-0.57	-0.56	-0.17	-0.43	-0.42
	(2.64)	(2.69)	(2.31)	(2.66)	(0.55)	(4.17)	(4.33)
Growth	0.11	0.10	0.16	0.23	0.09	0.12	0.12
	(1.56)	(1.33)	(2.29)	(2.96)	(1.00)	(2.44)	(2.54)
Savings	0.12	0.11	0.28	0.14	0.24	0.20	0.16
	(1.80)	(1.64)	(3.65)	(1.68)	(2.66)	(4.96)	(4.64)
Net Transfers	0.25	0.23	0.50	0.53	0.62	0.29	0.23
	(2.16)	(2.07)	(4.29)	(4.39)	(4.46)	(3.65)	(3.09)
Debt/GDP		-0.03		0.05			-0.00
		(1.05)		(2.01)			(0.49)
Debt/Exports	-0.01		0.01			0.00	
	(1.92)		(2.92)			(0.87)	
Arrears					0.02		
					(0.97)		
Time	0.39	0.32	-0.60	-0.59	-0.06	0.21	0.21
	(3.88)	(3.75)	(2.80)	(2.40)	(0.20)	(3.08)	(3.65)
R^2	0.84	0.83	0.91	0.91	0.90	0.87	0.87
F	35.4	37.4	41.0	38.3	30.2	73.7	76.4
Observations	147	147	87	87	72	234	247
Sum of Squared Residuals	601.4	674.2	158.0	168.5	120.7	949.2	1000.3
ϕ	0.00	-0.04	-0.12	0.07	-0.12	0.03	0.01
	(0.03)	(0.44)	(1.03)	(0.59)	(0.99)	(0.30)	(0.18)
B (Chi^2_{23})	12.5	9.8	7.9	2.4	7.4	7.9	7.9

Source:	World Bank, World Tables, 1988-89, Tape Documentation; IMF, International Financial Statistics Yearbook 1988 (for Yield on US government bonds and US inflation); Institute of International Finance (Arrear data); own calculations.
Note:	Estimation Method: OSL; fixed effect model. The country group is defined in section 1.
Investments(-1):	Fixed investment as a percentage of GDP, lagged one period
Investments(-2):	Fixed investment as a percentage of GDP, lagged two periods.
Real interest rate:	Yield on US government bonds corrected for depreciation: REALRA = RUS - ($INFL_t$) with RUS = Yield on US government bonds, INFL = percentage change in US GDP-deflator.
Savings:	Gross Domestic Savings as a percentage of GDP.
Growth:	Percentage growth in GDP measured as 100 x d log (constant GDP).
Net Transfers:	Long term capital disbursements minus long term capital repayments minus long term interest payments as a percentage of GDP.
Debt/GDP:	Public and private long term external debt minus international reserves as a percentage of GDP.
Debt/Exports:	Public and Private long term external debt minus international reserves as a percentage of Exports and Non-Factor Services.
Time:	Time variable, with 1968 = 1 ..... 1987 = 20.
Arrears:	Interest arrears outstanding as a percentage of total debt service due.
ϕ :	Estimated first order correlation of the residuals.
B:	Breusch Pagan Test statistic for heteroscedasticity.

All variables, except the investment terms, are averages of period t and (t-1).
(Absolute value of t-statistics in parenthesis)

Table 6

Correlation Coefficients between actual and predicted values of Investments from reported regressions

	Equation		
	(1)	(3)	(6)
Argentina	0.82	0.92	0.93
Bolivia	0.65	0.93	0.91
Brazil	0.01	0.92	0.88
Chile	0.69	0.84	0.81
Colombia	0.21	0.31	0.21
Côte d'Ivoire	0.81	0.97	0.95
Ecuador	0.65	0.83	0.73
Mexico	0.82	0.82	0.87
Morocco	0.88	0.64	0.85
Nigeria	0.18	0.95	0.72
Peru	0.88	0.73	0.83
Philippines	0.96	0.96	0.95
Uruguay	0.98	0.89	0.96
Venezuela	0.80	0.94	0.88
Yugoslavia	0.87	0.97	0.93

Note: Equations refer to the estimations reported in table 5.

Table 7

Consumption in Problem Debtor Countries 1971-87
(dependent variable: consumption)

	1971-81	1982-87	1971-87
	(1)	(2)	(3)
Lagged Consumption	0.556	0.143	0.576
	(8.34)	(2.93)	(11.05)
Income	0.328	0.553	0.257
	(3.00)	(9.87)	(3.57)
k	0.74	0.64	0.60
kg	0.70	0.57	..
R^2	1.00	1.00	1.00
F-statistic	2738	1046	4815
Sum of Squared Residuals	$1.8*10^9$	$7.9*10^8$	$2.4*10^9$
ϕ	0.06	-0.13	0.10
# Observations	165	90	255
$B(Chi^2_{16})$	15.5	17.5	14.8

Source:World Bank, World Tables, 1988-89, Tape Documentation; World Bank, World Development Report, 1989; own calculations.

Note: Estimation Method:Instrumental variables, fixed effect model. Instruments: Lagged Consumption, lagged income and country intercept dummies. The constant term, in all but one case insignificant, is not reported. The variables used in the regressions were expressed in local currency per capita, using 1980 prices.
Consumption is private plus government consumption. Lagged Consumption is private plus government consumption lagged one period; Income is Gross National Product.
k is the marginal propensity to consume from permanent income (see text); k_g is the marginal propensity to consume from permanent, corrected for a trend factor. ϕ denotes estimates first order auto correlation. B is the Breusch Pagan test statistic for heteroscedasticity. Population was calculated using 1968 data, and extrapolated using population growth rates from the World Development Report, 1989. (Absolute value of t-statistics are in parentheses).

Table 8

Correlation Coefficients between actual and predicted values of Consumption from reported regressions

	Equation		
	(1)	(2)	(3)
Argentina	0.69	0.72	0.67
Bolivia	0.92	0.95	0.85
Brazil	0.98	0.97	0.98
Chile	0.89	0.39	0.86
Colombia	0.99	0.97	0.99
Côte d'Ivoire	0.83	0.96	0.83
Ecuador	0.99	0.85	0.88
Mexico	0.99	0.93	0.97
Morocco	0.98	0.87	0.96
Nigeria	0.37	0.97	0.64
Peru	0.79	0.99	0.88
Philippines	0.98	0.94	0.95
Uruguay	0.97	0.97	0.88
Venezuela	0.93	0.69	0.91
Yugoslavia	0.92	0.92	0.91

Note: Equations refer to the estimations reported in table 6.

Fig. 1

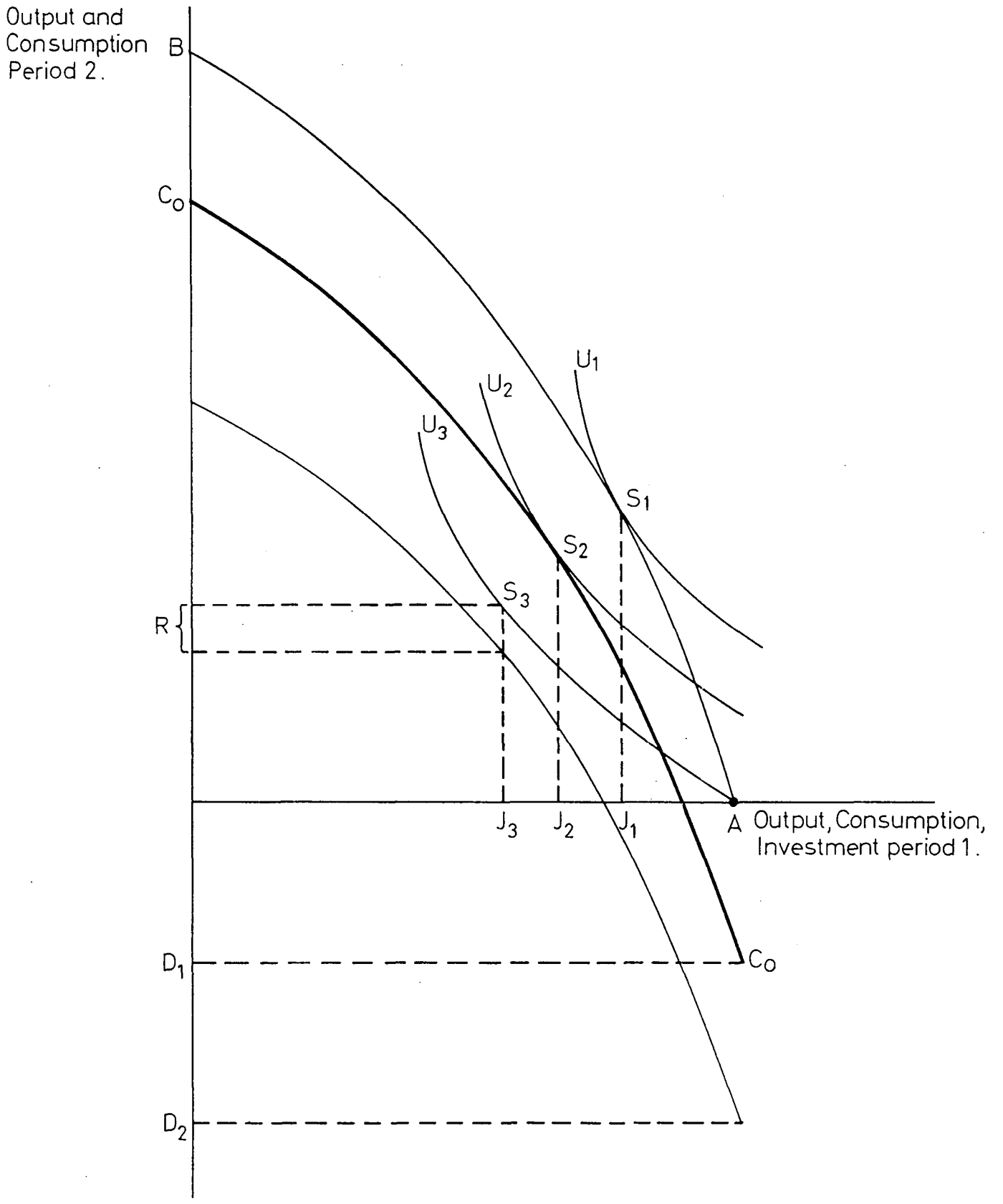

Output and
Consumption
Period 2.
B
C_o
U_1
U_2
U_3
S_1
S_2
S_3
R
J_3
J_2
J_1
A
Output, Consumption,
Investment period 1.
C_o
D_1
D_2

Fig. 2

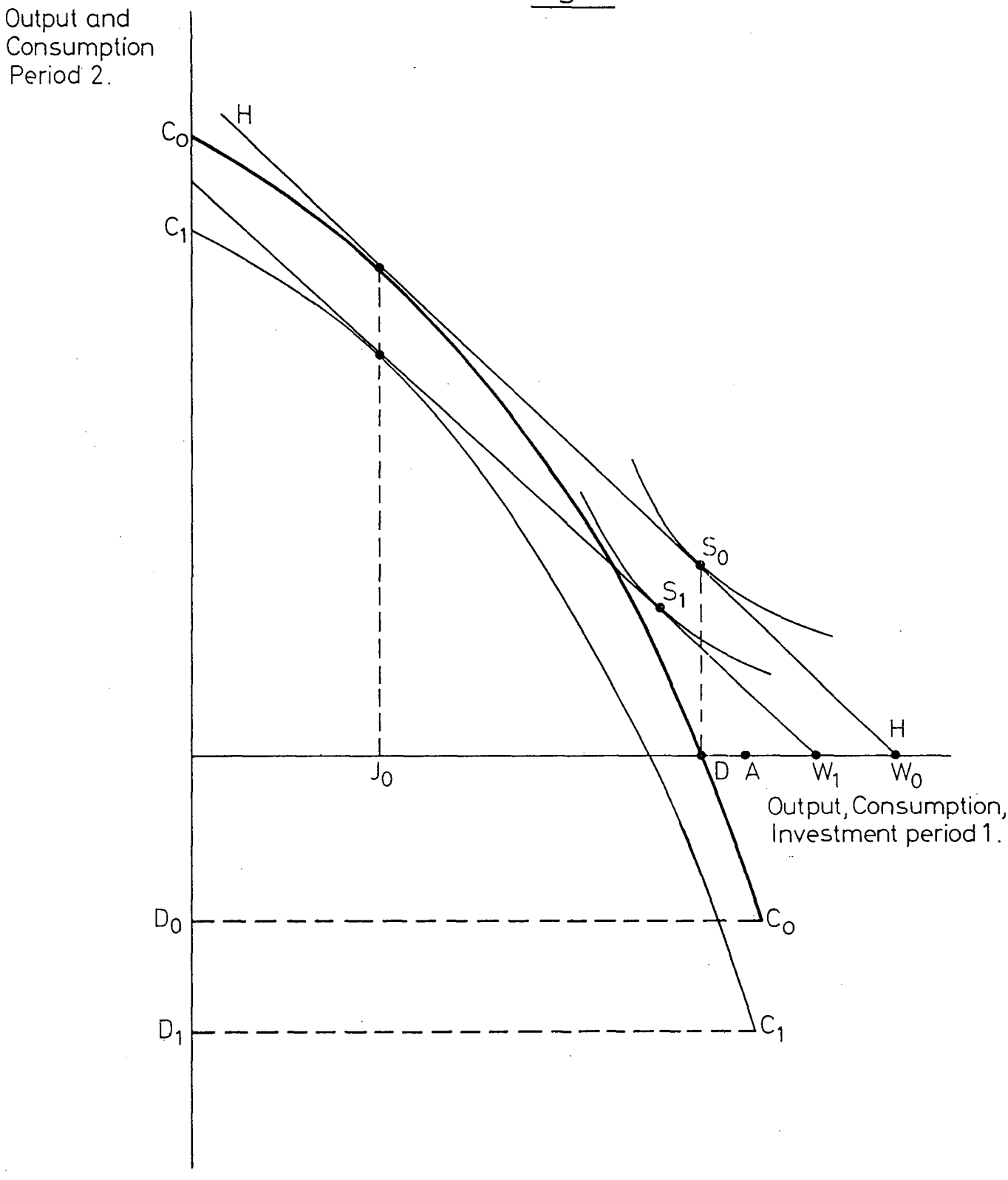
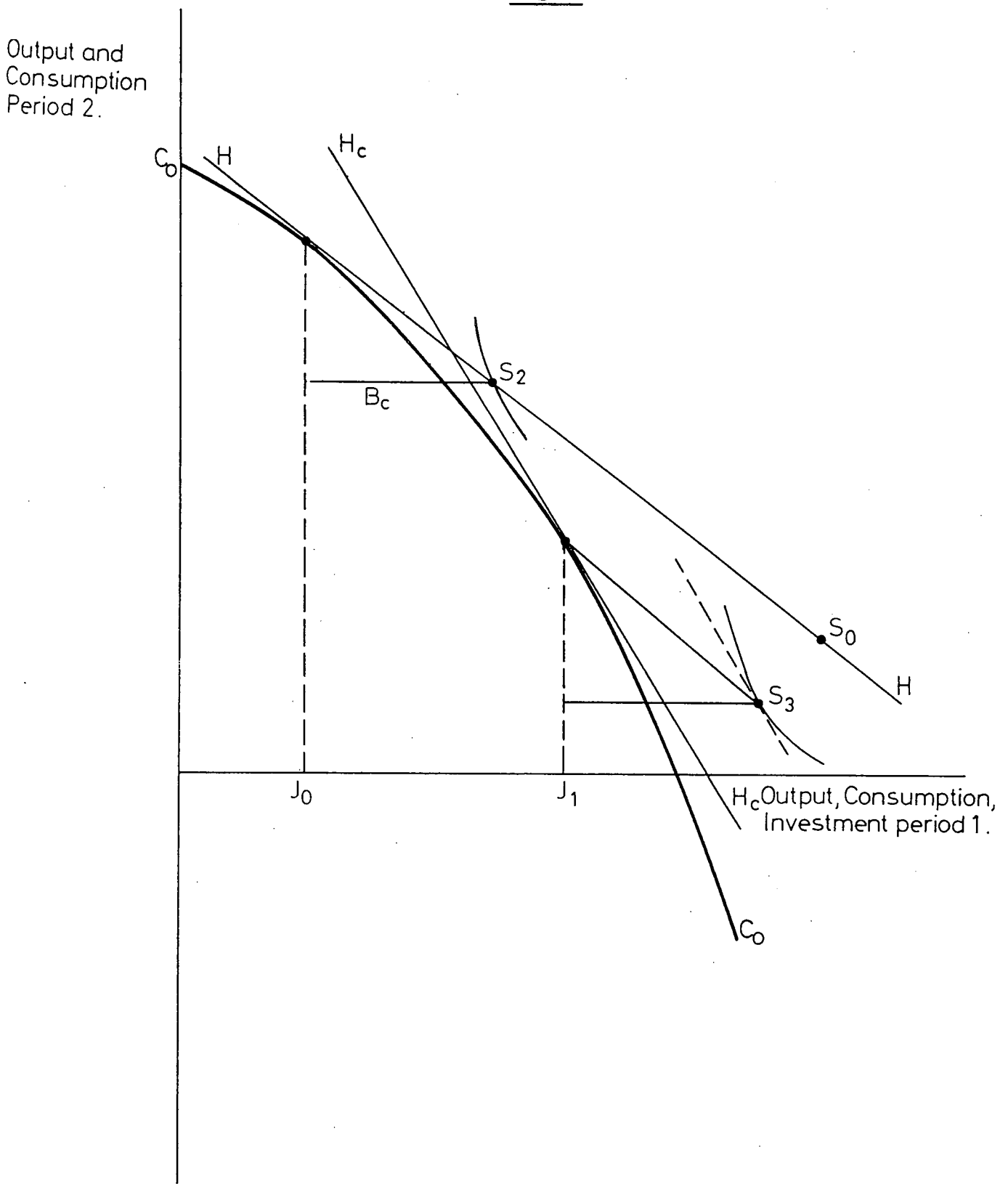

Output and
Consumption
Period 2.
H
C_0
C_1
S_0
S_1
H
J_0
D
A
W_1
W_0
Output, Consumption,
Investment period 1.
D_0
C_0
D_1
C_1

Fig. 3


Output and
Consumption
Period 2.
C_0
H
H_c
S_2
B_c
S_0
H
S_3
J_0
J_1
H_c Output, Consumption,
Investment period 1.
C_0