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The Debt Problem and Growth

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Summary. — Easing the debt problem requires high-debt countries to generate significant trade and savings surpluses. If this has to be achieved quickly these surpluses can only be built up through contractive measures with lower imports and investment. Alternatively, if more time is available to deal with the problem, these surpluses can be built up, without sacrificing growth, through increases in exports and savings. This strategy will require new financing on the part of creditors until adjustment measures take effect. Debtor countries, for their part, will have to significantly improve their domestic performance. Domestic savings and exports will have to grow at fast rates. The productivity of capital and efficiency of resource use will also have to improve significantly. The paper provides a simple quantitative framework that identifies the critical values of these variables required for a successful outcome of a growth-oriented debt policy.

1. INTRODUCTION

The high-debt countries have been servicing their debt largely by austerity measures. They have squeezed imports and investments to generate the trade surpluses (and equivalent savings surpluses) necessary to finance the debt service, but at a high cost in terms of foregone consumption and output. Without access to significant new lending to provide time for expanding exports and savings, they had little choice but to contract.

Table 1 shows what has happened in recent years in 17 high-debt countries. Current account balances have, on average, become approximately zero in the absence of significant net capital flows. Trade balances have sharply improved, but largely by a major reduction in imports rather than an increase in exports. Lower imports have affected short-run output and consumption. Consequently, *GDP* has stagnated and consumption per head has fallen. Investment has also shrunk, severely restraining future growth.

Countries are unlikely to continue along this path for the sake of servicing their foreign debt and reducing its long-run burden to a reasonable level. Belt tightening alone is not an acceptable solution, economically, socially or politically. Easing the debt problem through growth is a more promising alternative. This has become increasingly recognized, for example, in the Baker initiative. But the mechanics of such adjustment through growth and the critical conditions for its success — in particular the respective roles of external and domestic efforts and the way they interact as time passes — have not been made fully transparent in recent discussions. To do so is the purpose of this paper.

2. THE MECHANICS OF ADJUSTMENT

The outcome of a growth-oriented debt policy hinges critically on the rate of growth of domestic savings (that is, gross domestic product minus total consumption). For debt ultimately to decline, in relation to *GDP* and absolutely, savings should increase faster than the sum of investment and interest payments on the foreign debt. To generate the required rate of increase in savings, it is necessary to constrain consumption below the growth in *GDP*. In many countries, especially those with modest population growth, savings can rise sufficiently fast with constant, or even slowly rising consumption per head. Growth and rapidly rising savings will, after some years, ease the debt burden. But in the early years of recovery, the country will need to borrow more, in addition to rolling over its existing debt. Below we shall consider in more detail the total net borrowing required under

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Table 1. *Seventeen high debtors: Macroeconomic indicators*

	1978–81	1984
1. *As a percent of* GDP		
Trade balance	−1.5	4.2
Current account balance	−3.7	−0.1
2. *Average annual growth rate between* 1980 *and* 1984		
GDP	−0.3	
Exports	1.8	
Imports	−9.2	
Investment	−9.7	
Consumption per capita	−1.8	

Source: World Bank.
Countries included are Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cote d'Ivoire, Ecuador, Ivory Coast, Jamaica, Mexico, Morocco, Nigeria, Peru, Philippines, Uruguay, Venezuela, Yugoslavia.

various scenarios, and the time it takes to reach crucial turning points in the recovery process. As would be expected, key factors to emerge will be the desired rate of consumption growth, the population growth rate, the efficiency of investment, the initial savings rate, and the (real) rate of interest on foreign debt.

The analysis starts with the selection of a "reasonable" growth rate of *GDP*, g. Together with an estimate of the incremental capital–output ratio, *ICOR*, which should reflect a judgment on the average efficiency of investment, this determines also the required investment rate $I/G = g \cdot ICOR$. The efficiency of investment is likely to change over time. For ease of exposition, we assume initially that the *ICOR* remains constant. In that case, the growth rate of investment equals, of course, the growth rate of *GDP*.

What happens to savings depends on the change in consumption. The more consumption is allowed to rise, the less will be the increase in savings. As a starting point, assume it is socially and politically acceptable to maintain consumption per head constant, so that aggregate consumption grows at the same rate as population. Given the growth rate of *GDP* and the initial savings rate, $s = S/G$, the change in savings over time can then be determined.[1] As long as aggregate consumption growth is kept below the growth of *GDP*, savings will grow faster than *GDP*, and thus than investment (when the *ICOR* is assumed constant). The savings rate will then increase.

However (domestic) savings are necessary to finance not only the required investments but also the interest payments on the foreign debt rD, where D is the outstanding (real) debt and r the average (real) interest rate. Assuming as a first step r constant, then the change in interest payments over time depends on the change in the outstanding debt, that is, net borrowing, over and above rolling over of amortization of the existing debt. Net borrowing will be necessary as long as savings are insufficient to cover the sum of investment and foreign interest payments: $S < I + rD$. In other words, net borrowing becomes $B = rD + I - S$, which is also equivalent to the current account deficit (defined here as positive).[2,3]

As long as the country is a net borrower, its total debt will continue to grow. A useful reference point is that when net borrowing equals interest payments, the rate of growth of debt equals the rate of interest. The growth rate of debt will be higher (lower) than the interest rate if net borrowing is larger (smaller) than interest payments on the foreign debt.

In many cases, domestic savings do not even cover investments, let alone interest payments on the foreign debt. Net borrowing will have to finance both interest payments on the existing debt and part of investment; and debt will then grow at a rate exceeding the rate of interest. With savings growing substantially faster than investment, as they will when consumption growth is constrained significantly below that of *GDP*, at some point domestic savings will equal investment (or equivalently, the trade balance will become zero, $X - M = 0$). Net borrowing will then be necessary only to finance the foreign interest payments, and debt (and interest pay-

ments) will at that point grow more slowly, at the rate of interest r. With a growing excess of savings over investments (or equivalently, a growing trade surplus), net borrowing necessary to finance interest payments will decline, and debt will grow at a rate less than the rate of interest. At some point the rate of growth in the foreign debt (and interest payments) will fall to g, the rate of growth of GDP, and debt will begin to decrease in relation to GDP. Still later, domestic savings will grow to cover both investments and foreign interest payments (that is, the current account becomes zero, $I + rD - S = M + rD - X = 0$) and debt will begin to decline absolutely. In brief, the growth of debt, and of the interest burden, will steadily decline and ultimately become negative as long as our basic assumption holds which constrains the increase in consumption below that of GDP and investment. However, the process takes time and substantial net borrowing is likely to be required before debt begins to decline.

There is a further complication. The adjustment process requires that a domestic savings shortfall, with respect to investment, is transformed into an adequate savings surplus. Or, equivalently, as noted above, that a trade deficit is transformed into an adequate trade surplus ($I - S = M - X$). Without the trade surplus there will be no savings surplus, and vice versa. Growth in GDP is likely to require additional imports. If imports are not forthcoming, growth of GDP will be less (that is, the $ICOR$ will rise). As a first approximation, assume that the value of imports needs to increase *pari passu* with GDP and therefore, with a constant $ICOR$, as fast as investment. The value of exports will have to grow much more rapidly. If the expansion of exports involves a worsening in the terms of trade, then the volume of exports needs to increase even more (and the savings effort will need to be that much greater). If the elasticity of imports, with respect to GDP, is greater than one, as is often the case, exports will need to increase even faster. If they do not, the trade surplus, and therefore the savings surplus, will not rise as rapidly as derived above. Export performance and savings behavior have to be consistent for the recovery from the debt problem to progress smoothly.

3. A GRAPHICAL ILLUSTRATION

This debt recovery process is illustrated by Figure 1, where all variables are in real terms and expressed as a fraction of GDP. In the upper panel, the behavior of the debt/GDP ratio is shown. The lower panel shows the major flow magnitudes. The domestic savings rate starts below the "required" investment rate, but is assumed to increase rapidly through a constraint on consumption. As long as the resource requirements R, that is, the sum of investments and interest payments on the foreign debt, are above savings, net borrowing is required to sustain the growth rate of GDP. Net borrowing declines as time passes because the rate of growth of savings is set higher than the rate of growth of resource requirements. Notice, however, that the debt/GDP ratio (and thus interest payments as a fraction of GDP) starts declining while net borrowing is still positive, but small enough to result in a percentage increase in debt smaller than the growth in GDP.

Figure 1 distinguishes all the stages described earlier:

Stage 1: Up to T_a, when savings are still below investment, borrowing is such that the rate of growth of debt, and of interest payments, is larger than the (average) interest rate.

Stage 2: At T_a, savings equal investment, and exports equal imports. Net borrowing is equal to interest payments. Debt and interest payments grow at a rate equal to the average interest rate.

Stage 3a: From T_a to T_b, savings are large enough to finance a fraction of interest payments. Debt and interest payments grow at a rate below the interest rate but above the rate of growth of GDP.

Stage 3b: At T_b, net borrowing is such that debt and interest payments grow at the same rate as GDP, and the interest payments/GDP and debt/GDP ratios reach their maximum level.

Stage 3c: Between T_b and T_c, net borrowing diminishes further, so that debt and interest payments grow at a slower rate than GDP, and decline as a fraction of GDP.

Stage 3d: From T_c on, net borrowing becomes negative, that is, savings finance not only interest payments but also part of the amortization. Debt and interest payments decline in absolute terms. At year T^*, the debt/GDP ratio has declined to a "normal" level where the country is considered creditworthy.

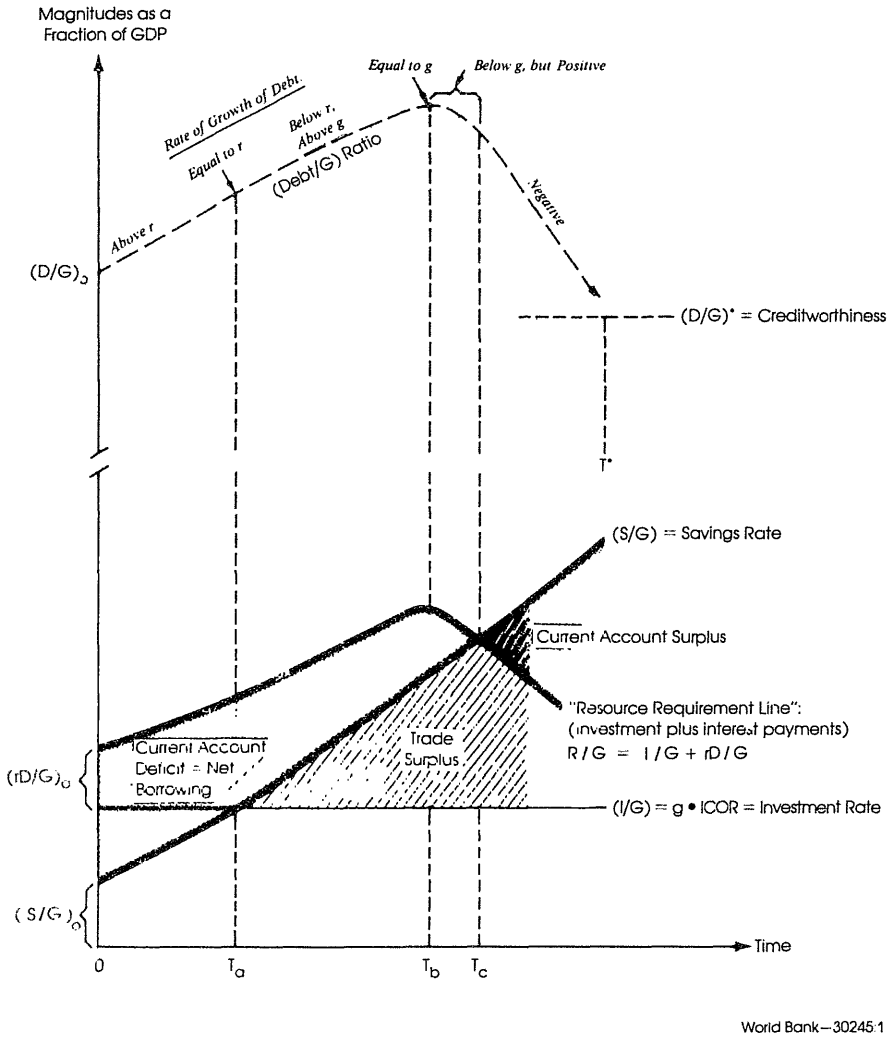

Figure 1.

This pattern of recovery from a debt crisis will hold generally true, provided savings grow sufficiently faster than investments (or exports than imports). But the time it takes a country to reach the turning points identified above, and the amount of net borrowing required before debt begins to decline relatively or absolutely, will vary greatly depending on the particular circumstances of the country. The initial debt overhang; the average rate of interest on the foreign debt; the efficiency of resource use, as reflected in the *ICOR*; the minimum acceptable growth in consumption; the elasticity of imports with respect to output; the extent to which net borrowing can be obtained, are key factors in this regard. Most of them will vary over time and are influenced by government policy. Below we show the results of simulations with different sets of parameters.

4. NUMERICAL ANALYSIS

As *base case*, we assume the following set of parameters:

(a) Target growth rate in *GDP* in constant dollars, $g = 0.04$.

(b) Initial domestic savings rate = 0.15.

(c) Target growth rate of aggregate consumption, in constant dollars = 0.02. If

this rate is above the population growth rate, this implies an annual increase in consumption per capita. If it is below the population growth rate, it implies a decline in consumption per capita.

(d) Incremental capital output ratio (*ICOR*) = 4. Given g = 0.04, this implies a required investment rate of 0.16.

(e) Average real interest rates paid on the foreign debt. Two alternative assumptions: (i) average real interest rates remain constant at 8% a year; (ii) they decline to 7% after the initial year, to 6% by the following year, and remain at that level thereafter.

Tables 2 and 3 show results for the *base case*, assuming constant and declining real interest rates, respectively. In each case, results are shown for two types of countries. In Type A, initial real interest payments as a fraction of *GDP* are 0.05. It characterizes countries like Mexico, Argentina, Venezuela, Philippines, and Brazil, with initial debt/*GDP* ratios in the 0.60–0.70 range. In Type B, the "debt overhang" is much larger, and initial real interest payments as a fraction of *GDP* are 0.08. It characterizes countries like Chile, Jamaica, and Ivory Coast, with initial debt/*GDP* ratios of about 1.00.[4]

The columns of Tables 2 and 3 show the following derived variables, all expressed as a fraction of *GDP*:

Column 1: Required investment rate, given g = 0.04 and *ICOR* = 4.

Column 2: Domestic savings rate, resulting from g = 0.04 and aggregate consumption growth rate = 0.02.

Column 3: Savings surplus (or trade balance), which is negative when savings are below required investment and positive when savings are higher than required investment.

Columns 4 and 6: Real interest payments; they increase by an amount equal to net borrowing the year before multiplied by the interest rate, plus (the increase) or minus (the decline) in interest payments on existing debt due to changes in interest rates, if any, all in real terms.

Columns 5 and 7: Real net borrowing, i.e., the increase in the real stock of debt, equal to the interest payments plus (minus) the domestic savings deficit (surplus), all in real terms.[5]

(a) *Base case under constant real interest rates*

Table 2 shows the external balance from the initial year to the year where (real) interest payments again decline to an "acceptable" level, arbitrarily set at 4.0% of *GDP*, where the country is again considered "creditworthy." When the country starts with interest payments equal to 5% of *GDP* (Type A), it takes 8 years to reach this new level. When initial interest payments are 8% of *GDP* (Type B), it takes 13 years. Notice — as was illustrated in Figure 1 — that the savings balance steadily improves and net borrowing steadily declines as a percentage of *GDP*, but interest payments (and debt) as a fraction of *GDP* first increase, reaching a maximum in the third and fourth years, respectively. In other words, some creditworthiness indicators worsen in the short run, before starting to improve.

On the base case assumptions, the recovery path would require substantial net borrowing, totaling nearly 15% of *GDP* in Type A countries, and more than 30% in Type B countries. If borrowing on this scale is not feasible, the country will need to follow another recovery path, for example by further increasing the savings rate or lowering investment requirements or seeking lower interest payments.

(b) *Base case under declining real interest rates*

Interest rates payable on foreign debt may be lower, on average, for several reasons. International interest rates may decline and affect the variable interest component of outstanding debt; inflation may reduce its fixed interest component; countries may obtain more concessionary rates, on additional borrowing or in connection with debt rescheduling; or they may benefit from more grants or cancellation of debt. Our alternative base case assumes that for a combination of such reasons the average real interest on existing debt paid by the prototype countries declines from 8 to 6% over 2 years, and remains constant thereafter.

Table 3 shows the results. As would be expected, lower interest rates reduce both the aggregate amount and the period of net borrowing required. In fact, if the interest decline is large, in relation to the percentage increase in debt in the preceding year, the (real) interest burden as a fraction of *GDP* will immediately decline, as in Table 3, because the "declining interest rate effect" more than compensates the "additional debt effect." Nevertheless, total net borrowing required remains substantial. But it now takes less time for the country to become "creditworthy" again. With declining interest rates, interest payments in Type A countries

Table 2. *Base case: External balance under a constant real interest rate of 8% (values as a percentage of* GDP)

Year	Required investment rate (1)	Resulting savings rate (2)	Savings surplus (3)=(2)−(1)	Type A Medium level of initial debt: Real interest payments (4)	Type A: Real net borrowing (5)=(4)−(3)	Type B High level of initial debt: Real interest payments (6)	Type B: Real net borrowing (7)=(6)−(3)
0	16	15.0	−1.0	5.0	6.0	8.0	9.0
1	16	16.6	0.6 (T_a)	5.3	4.7	8.4	7.8
2	16	18.2	2.2	5.4	3.2	8.7	6.5
3	16	19.8	3.8	5.5 (T_b)	1.7	8.8	5.0
4	16	21.4	5.4	5.4 (T_c)	0	8.9 (T_b)	3.5
5	16	22.9	6.9	5.2	−1.7	8.8	1.9
6	16	24.3	8.3	4.8	−3.5	8.6 (T_c)	0.3
7	16	25.8	9.8	4.4	−5.4	8.3	−1.5
8	16	27.2	11.2	3.8 (T^*)	−7.4	7.9	−3.3
9	16	28.6	12.6	3.1	−9.5	7.3	−5.3
10	16	30.0	14.0	2.2	−11.8	6.6	−7.4
11	16	31.3	15.3			5.8	−9.5
12	16	32.7	16.7			4.8	−11.9
13	16	34.0	18.0			3.8 (T^*)	−14.3
14	16	35.2	19.2			2.5	−16.7

Assumptions: $g = 0.04$, $ICOR = 4$, $\Delta C/C = 0.02$, $r = 0.08$.

Initial (D/G) ratio: Type A = 0.625; Type B = 1.0.

Table 3. *Base case: External balance under a declining real interest rate (values as a percentage of* GDP)

Year	Required investment rate (1)	Resulting savings rate (2)	Savings surplus (3)=(2)−(1)	Type A Medium level of initial debt: Real interest payments (4)	Type A: Real net borrowing (5)=(4)−(3)	Type B High level of initial debt: Real interest payments (6)	Type B: Real net borrowing (7)=(6)−(3)
0	16	15.0	−1.0	5.0	6.0	8.0	9.0
1	16	16.6	0.6	4.6	4.0	7.3	6.7
2	16	18.2	2.2	4.1	1.8	6.4	4.2
3	16	19.8	3.8	4.1 (T_c)	0.2	6.4	2.6
4	16	21.4	5.4	3.8 (T^*)	−1.6	6.3 (T_c)	0.9
5	16	22.9	6.9	3.6	−3.3	6.1	−0.8
6	16	24.3	8.3	3.3	−5.0	5.9	−2.4
7	16	25.8	9.8	2.9	−6.9	5.5	−4.3
8	16	27.2	11.2			5.0	−6.2
9	16	28.6	12.6			4.5	−8.1
10	16	30.0	14.0			3.8 (T^*)	−10.2
11	16	31.3	15.3			3.1	−12.2
12	16	32.7	16.7			2.3	−14.4

Assumptions: $g = 0.04$, $ICOR = 4$, $\Delta C/C = 0.02$, $r = 0.08, 0.07, 0.06, 0.06, \ldots$

Initial (D/G) ratio: Type A = 0.625; Type B = 1.0.

drop below 4% of *GDP* in 4 years, as compared to 8 years when interest rates are constant (Table 2).[6] For Type B countries, it takes 10 instead of 13 years. A more severe test of creditworthiness, reducing (real) interest payments on foreign debt to 3% of *GDP*, would take a few years longer (also shown in Table 3).

(c) *Consumption implications*

All these scenarios assume that aggregate consumption growth is constrained to 2% a year. For most countries, this means at best constant consumption per head, and for many countries, with population growth rates exceeding 2%, declining consumption per head. For the high-debt countries (Type B), this consumption constraint or decline would have to be maintained for over a decade, if this recovery path were followed. Even for the medium-debt countries, austerity would last nearly a decade, unless average interest rates on the foreign debt came down.

It is doubtful that countries would be able or willing to keep consumption down for such long periods. A more likely, and more sensible, approach would be to relax the consumption constraints somewhat after recovery had proceeded to the point, T_t, where net borrowing becomes negative, that is, debt declines absolutely, or possibly even earlier, at point T_b, where net borrowing begins to decline as a proportion of *GDP*. This would shorten, or with declining interest rates possibly eliminate, the period of extreme austerity, but at the cost of a longer period before the debt is reduced to an acceptable level T^*.

(d) *Export requirements*

Column 3 of Table 3 shows that countries have to generate a rapidly rising export surplus (that is, savings surplus) in order to sustain the recovery paths discussed above. The rate of increase in exports that is required will be greater, the larger is the initial trade deficit, the rise in imports when *GDP* grows, and the deterioration in the terms of trade associated with the expansion of exports, and the smaller is the initial value of exports in relation to *GDP*.

Table 4 illustrates the export performance required of a Type B country, under the declining interest rate assumption, to reach creditworthiness in 10 years. (The improvement in the savings, that is, trade balance follows the same path for the different scenarios in Tables 2 and 3, and is determined by the growth of *GDP*, investment requirements, and the growth in consumption; but to reach creditworthiness the improvement has to be sustained for different periods.) It shows that the average annual growth rate of exports[7] is substantially greater when the initial share of exports in *GDP* is small. This suggests that countries that are large or less open to trade face a more difficult task. This is further aggravated if countries depend heavily on imports of equipment and intermediate inputs for their growth in *GDP* and have little room for efficient import substitution, so that their import elasticity will not be significantly lower than one.

Table 4. *Required annual rate of growth of exports* (10-*year average percentage*)

Import elasticity	Initial share of exports in *GDP*	
	$X/G = 0.15$	$X/G = 0.25$
0.8	11.0	8.4
1.0	11.4	9.0
1.2	11.9	9.5

If exports do not grow fast enough to generate the necessary export (and savings) surpluses, then the particular adjustment process is not feasible. To be consistent with the poorer export performance, savings will rise less than anticipated, either through higher consumption or slower growth of *GDP*. In the first case, borrowing requirements and the time taken to recover creditworthiness may increase substantially. In the second, borrowing requirements will be less (unless the *ICOR* rises), but at the cost of lower consumption levels in the long run. The following section on sensitivity analysis further explores some of these relationships.

5. SENSITIVITY ANALYSIS

(a) *Sensitivity to changes in the target growth rate of* GDP *and* ICOR

Table 5 shows for medium-debt overhang (Type A) countries the sensitivity of borrowing requirements to alternative specifications of the target growth rate of *GDP* and the value of *ICOR*. The results can also be interpreted differently. They show the maximum growth rate that can be achieved under alternative availability of foreign finance, given that countries will be making a savings effort compatible with a consumption growth of 2% a year. The bottom line shows the number of years it will take countries to lower their (real) interest payments on foreign debt from the initial figure of 5% of *GDP* to 4% of *GDP*, the level taken above as a proxy for "creditworthiness;" it also shows this for a more

Table 5. *Required real net borrowing: Sensitivity to the target growth rate and* ICOR: *Type A countries (medium debt overhang) (values as percentage of* GDP)

Year	*ICOR* = 4 Growth rate of *GDP* (%) 3	4 (base case)	5	*ICOR* = 5 Growth Rate of *GDP* (%) 3	4	5
0	2.0	6.0	10.0	5.0	10.0	15.0
1	0.6	4.0	7.4	3.8	8.2	12.7
2	−1.0	1.8	4.6	2.4	6.3	10.2
3	−1.9	0.2	2.3	1.6	4.9	8.2
4	−3.0	−1.6	0	0.8	3.4	6.2
5	−4.0	−3.3	−2.3	−0.1	1.9	4.1
6		−5.0	−4.8	−1.0	0.4	4.1
7		−6.9	−7.3	−1.9	−1.2	−0.2
8			−9.8	−2.9	−2.9	−2.4
9				−4.0	−4.6	−4.8
10				−5.0	−6.4	−7.1
11					−8.3	−9.6
12						−12.0
No. of years it takes interest payments to become						
4% of *GDP* (T^*)	2	4	6	6	9	10
3% of *GDP*	5	7	8	10	11	12

Assumptions: $\Delta C/C = 0.02$
$r = 0.08, 0.07, 0.06, 0.06, \ldots$

severe test of creditworthiness, 3% of *GDP*. As will be seen, the "turning points" where debt begins to decline or creditworthiness is reached are only moderately sensitive to changes in the growth rate of *GDP* or in *ICOR*. But the net borrowing requirements are quite sensitive.

As expected, the "recovery of creditworthiness" with low capital inflows can only be achieved with low *GDP* growth. This is probably what characterizes the present situation. To achieve "creditworthiness" with a higher growth rate requires substantially higher capital inflows, although only for a few years. Table 5 shows the results to be highly sensitive to the values of *ICOR*, that is, the inverse of the productivity of capital. A 25% lower productivity of capital implies a substantially darker picture. Not only do capital inflows have to be substantially larger, more than double in many cases, they also must continue for longer periods of time. The number of years required for the country to reach the assumed proxy for "creditworthiness" also increases significantly.

Table 6 shows results for the high-debtor countries (Type B). Even with an *ICOR* = 4, it is difficult to expect that the capital inflows required in the short run to achieve a 5% annual *GDP* growth could be forthcoming. If the productivity of capital is lower, *ICOR* = 5, even a 4% *GDP* growth does not appear feasible. Countries in this situation can at best achieve a 3% *GDP* growth, unless average real interest rates payable by them experience further and strong reductions.

(b) *Sensitivity to alternative rates of consumption growth*

Table 7 compares the borrowing requirements for the base case — where consumption was assumed to increase at 2% a year — with an alternative assumption where consumption is allowed to grow at 3% a year. This might be a necessary condition for a country with a population growth rate above 2%. The most important effect of relaxing the consumption constraint is to lengthen the period where net borrowing is necessary. Net borrowing requirements do not increase significantly in the first 3 years. However, with the higher consumption growth, net borrowing is needed for an extra 3 years in Type A countries, and an extra 5 years in Type B countries. The number of years required for the

Table 6. *Required real net borrowing: Sensitivity to the target growth rate and* ICOR: *Type B countries (high debt overhang) (values as percentage of* GDP)

Year	*ICOR* = 4 Growth rate of *GDP* (%) 3	4 (base case)	5	*ICOR* = 5 Growth Rate of *GDP* (%) 3	4	5
0	5.0	9.0	13.0	8.0	13.0	18.0
1	3.3	6.7	10.1	6.5	11.0	15.4
2	1.5	4.2	6.9	4.8	8.7	12.5
3	0.6	2.6	4.7	4.1	7.3	10.6
4	−0.4	0.9	2.4	3.4	5.9	8.6
5	−1.3	−0.8	0.1	2.6	4.5	6.6
6	−2.4	−2.4	−2.3	1.8	3.0	4.4
7	−3.4	−4.3	−4.8	0.9	1.4	2.3
8	−4.6	−6.2	−7.3	0	−0.2	0.1
9	−5.7	−8.1	−9.9	−1.0	−1.9	−2.2
10	−7.0	−10.2	−12.6	−2.0	−3.6	−4.6
11				−3.0	−5.4	−7.0
12				−4.1	−7.3	−9.4
13				−5.2	−9.2	−12.0
14				−6.4	−11.2	−14.5
15				−7.6		
16						
17						
18						
19						
No. of years it takes for interest payments to become 4% of *GDP* (T^*)	10	10	10	15	14	14

Assumptions: $\Delta C/C = 0.02$
$r = 0.08, 0.07, 0.06, 0.06, \ldots$

interest payments to reach an assumed "creditworthiness" level of 3 or 4% of *GDP* increases substantially, particularly for countries with a high debt overhang.

(c) *Infeasible adjustment path*

The foregoing exercises suggest that regaining creditworthiness will be difficult to the extent that consumption growth cannot be restrained, the *ICOR* is high, exports cannot be rapidly expanded or imports compressed, and the average rate of interest on foreign debt is high. This may well apply, for example, to some countries in Africa, except that their borrowing terms are rather soft. Rapid population growth puts pressure on aggregate consumption growth. Export prospects are often dim, and import dependence to sustain growth of output is large. *ICOR*s are, and have been, rising. In such circumstances the design of an adjustment path may face a dilemma: consumption has to be restrained for long periods below acceptable levels, or the average interest burden needs to be effectively reduced further.

6. CHOICE OF GROWTH AND CONSUMPTION PATH

(a) *Growth after creditworthiness is restored*

Up to this point the analysis has focused on various scenarios for recovering creditworthiness, here defined as reducing the (real) foreign interest payments/*GDP* ratio to a "reasonable" level, assumed to be 4% or less of *GDP*. As shown, this requires in all cases a sharp increase in the domestic savings rate, typically to between 20 and 30% of *GDP*, and thus a severe constraint on consumption increases below the rate of growth of *GDP*. What happens when creditworthiness is restored?

Once interest payments on the foreign debt, in

Table 7. *Required real net borrowing: Sensitivity to growth rate of consumption (values as percentage of* GDP)

Year	Type A countries (medium debt overhang) Growth of consumption 2% (base case)	3%	Type B countries (high debt overhang) Growth of consumption 2% (base case)	3%
0	6.0	6.0	9.0	9.0
1	4.0	4.8	6.7	7.5
2	1.8	3.4	4.2	5.9
3	0.2	2.7	2.6	5.1
4	−1.6	1.9	0.9	4.4
5	−3.3	1.1	−0.8	3.6
6	−5.0	0.2	−2.4	2.8
7	−6.9	−0.7	−4.3	1.9
8		−1.7	−6.2	1.0
9		−2.7	−8.1	0.1
10		−3.7	−10.2	−0.9
11			−12.2	−1.9
12				−3.0
13				−4.1
14				−5.2
15				−6.4
16				−7.7
17				−9.0
No. of years it takes for interest payments to become				
4% of *GDP* (*T*)	4	7	10	15
3% of *GDP*	7	10	11	17

Assumptions: $g = 0.04$
$ICOR = 4$
$r = 0.08, 0.07, 0.06, 0.06, \ldots$

relation to *GDP*, have been reduced to their creditworthiness level, they can be allowed to rise in line with the growth in *GDP*. The interest payment/*GDP* ratio will then remain constant, and with a constant interest rate, so will the ratios of debt to *GDP* and net borrowing to *GDP*. Interest payments, total debt, and net borrowing will then all grow at the same rate as *GDP*. Instead of repaying debt, the country can become a net borrower again.

What about savings and consumption? With the shift from debt repayment to net borrowing, the domestic savings required to sustain *GDP* growth will sharply decline, and consumption can be allowed to rise substantially. After this once-for-all change, they will both grow at the rate of growth of *GDP*. To illustrate, consider a Type B country that reaches creditworthiness after 10 years of austerity, when interest payments are reduced to 3.8% of *GDP* (see Table 3). At that point it resumes net borrowing, such that rD/G is maintained at 0.038. With r constant at 6%, this implies the debt/*GDP* ratio is kept constant at 0.633. If the country chooses to continue *GDP* growth at 4% (with $ICOR = 4$ as before) the required investment rate will remain at 16% of *GDP*. With the debt/*GDP* ratio constant, the net borrowing/*GDP* ratio will also be constant:

$$B/GDP = g(D/GDP) = 0.04 \times 0.633 = 0.025.$$

The required savings rate drops from 30% in year 10 when creditworthiness is reached, to 17.3%, since $B/G = I/G + rD/G - S/G$, that is $2.5 = 16 + 3.8 - 17.3$. The consumption rate correspondingly jumps up from 70 to 82.7%. After this large adjustment, both savings and consumption grow at the same rate as *GDP*.

However, the country could choose another strategy and accelerate its growth of *GDP*, say to 5% a year, when creditworthiness is reached. This is illustrated in Figure 2. Faster growth of *GDP* does not affect the creditworthiness condition, $rD/G = 0.038$, or, as long as $r = 6\%$, the

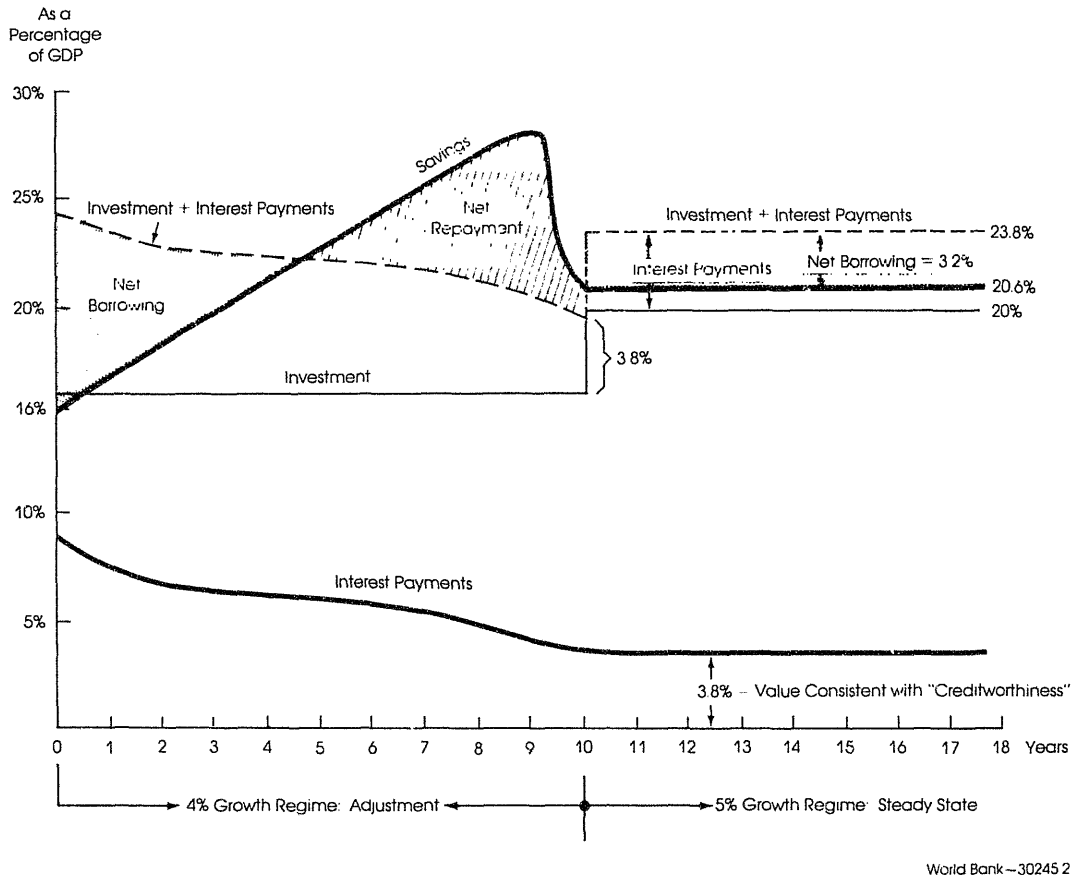

Figure 2. *Type B countries. Evolution to a new equilibrium. Moving from a* GDP *growth of 4% to 5% after creditworthiness is reached. Consumption growth increases from 2% (during the adjustment period) to 5% in the new steady state (values as % of* GDP*).*

debt/*GDP* ratio, which remains 0.633. But the required investment rate rises to 20% of *GDP*. And net borrowing increases to $B/GDP = 0.032$. As a result, the required savings rate does not fall as much as with continuation of the 4% growth rate in *GDP* (to 20.6% rather than 17.3%). And the upsurge in the consumption rate is correspondingly less (to 79.4% rather than 82.7%), but consumption will now grow at 5% a year rather than 4%. So there is the usual tradeoff between more consumption now or later.

(b) *Comparing alternative growth paths*

This line of analysis can also be used to assess the tradeoff between strategies of fast or slow growth from the start of the recovery process. For example, Table 5 (with $ICOR = 4$) shows that a Type A country which follows a 3% growth strategy will reach creditworthiness (defined here as real interest payments equal to 3% of *GDP*) 3 years earlier than with a 5% growth strategy. Thus it will be able to lower the savings rate and increase consumption earlier than under the high growth strategy. However, with the high growth strategy the country will reach a higher level of *GDP* and consumption in the long run. How can these consumption flows be compared?

Table 8 shows the index of aggregate consumption under three alternative strategies. Strategy 1 starts with a 3% *GDP* growth and then switches to 5% growth 5 years later, when creditworthiness is reached. At this point, consumption benefits from a once-for-all upward adjustment, as discussed above, and shifts from 2% to 5% growth. Strategy 2 starts with a 5% growth of *GDP* and maintains that rate throughout. Creditworthiness is reached later than under Strategy 1. At that time, net borrowing, investment and interest payments become the same constant fraction of *GDP* under the two strategies, and so

Table 8. *Consumption streams with alternative growth paths; Type A countries (index: Year 0 = 100)*

Before creditworthiness	Path 1 (%)	Path 2 (%)	Path 3 (%)	*Consumption differences*	
GDP growth:	3	5	5	Path 2	Path 2
Consumption growth:	2	2	3	minus	minus
				Path 1	Path 3
After creditworthiness					
GDP growth:	5	5	5		
Consumption growth:	5	5	5		
Year					
0	100.0	100.0	100.0	0	0
1	102.0	102.0	103.0	0	−1.0
2	104.0	104.0	106.1	0	−2.1
3	106.1	106.1	109.3	0	−3.2
4	108.2	108.2	112.6	0	−4.4
5	110.6 (T^*)	110.3	115.9	−0.3	−5.6
6	116.1	112.6	119.4	−3.5	−6.8
7	121.9	114.8	122.9	−7.1	−8.1
8	128.0	138.2 (T^*)	126.7	+10.2	+11.5
9	134.3	145.2	130.5	+10.9	+14.7
10	141.0	152.5	134.3	+11.5	+18.2
11	148.1	160.0	160.0 (T^*)	+11.9	0
12	155.5	168.0	168.0	+12.5	0
13	163.3	176.5	176.5	+13.2	0
14	171.5	185.3	185.3	+13.8	0
15	180.0	194.4	194.4	+14.4	0
16	189.0	204.2	204.2	+15.2	0
17	198.5	214.4	214.4	+15.9	0
18	208.5	225.2	225.2	+16.7	0
19	218.8	236.5	236.5	+17.7	0

Source: Table 4, with *ICOR* = 4.
Notes: Creditworthiness is assumed to be reached when real interest payments become 3% of *GDP*.

do savings and hence consumption. But with Strategy 2, the absolute level of consumption will be higher, and the one-for-all adjustment greater, since *GDP* has been growing at a higher rate in the early years and consumption has been constrained longer. As a result, Strategy 1 consumption is higher only during the few years when creditworthiness has been restored with this strategy but not yet with Strategy 2. But Strategy 2 consumption is higher for all subsequent years.

Under any reasonable discount rate, these results favor the higher growth strategy (Strategy 2), given the assumptions underlying Table 8.[8] However, a higher growth strategy from the start of recovery requires also substantially higher net borrowing in the early years (see Table 5), which may not be forthcoming. Furthermore, a sharp increase in investment may lower its returns, that is, raise the *ICOR*, thus reducing the benefits of a high growth strategy. And additional borrowing may entail increasing costs because (a) it may raise interest rates on both the additional and existing debt and (b) when the debt has to be serviced, it is likely to increase the domestic cost of generating the necessary foreign exchange, through pressure on the real exchange rate and lower terms of trade. While a higher growth strategy is generally attractive, there are definite limits to its feasibility and desirability, as current debt problems have abundantly demonstrated.

Table 8 also shows the consumption path with an alternative high growth strategy (Strategy 3). *GDP* grows again at 5% throughout, but consumption growth starts at 3%, rather than 2% as with Strategy 2. This requires more net borrowing and it takes several years longer for creditworthiness to be reached (see Table 7). At that point, consumption is adjusted upward and then grows *pari passu* with the 5% growth rate of *GDP*. As a result, consumption with this strategy is higher than with Strategy 2 in the early years. But the high-savings Strategy 2 restores creditworthiness sooner, which allows an earlier boost in both the absolute level and the rate of growth in consumption. After a few more years, when Strategy 3 also achieves creditworthiness, consumption levels and growth become the same

with both strategies (as do *GDP*, debt, interest payments, etc.). So the only lasting difference is that Strategy 2 sacrifices consumption in the early years for a temporary gain later.

Which strategy is preferable depends on the discount rate. A higher discount rate would favor higher initial consumption (as in Strategy 3); a lower discount rate would favor higher postponed consumption (Strategy 2). The appropriate level of the discount rate is difficult to determine. But note that, if borrowing is rational, it cannot be lower than the real rate of interest on additional foreign borrowing (or more precisely, the marginal cost of borrowing). Note also that the "political discount rate" is likely to be high, to help ensure acceptability of adjustment policies and survival of the government. This may well swing the balance in favor of a "higher-growth rising-consumption" path as in Strategy 3. But this requires even higher net borrowing, and for a longer period, than a policy of high growth with low consumption (Strategy 2). It is not feasible without sustained financial support from foreign lenders.

7. NOMINAL INTEREST BURDEN AND NET BORROWING

The preceding analysis has discussed the changes in the real interest burden in relation to real *GDP* during the adjustment process. Hence all variables, *GDP*, investments, savings, the interest rate and the stock of debt outstanding, are expressed in real terms. Consequently, net borrowing was defined as the change in the *real stock of debt*.

However, interest payments and net borrowing, as observed in the world, are not expressed in real terms, but in nominal terms. Corresponding current account balances as traditionally shown in national accounts are also in nominal terms. In order to translate our earlier estimates of real net borrowing to nominal amounts, it is necessary to add the borrowing required to hold the real stock of existing debt constant. The size of this adjustment will depend on the rate of inflation.[9]

The nominal interest rate i exceeds the real rate of interest r by the rate of inflation p, i.e., $i = r + p$. The analysis in real terms incorporated only the r component of the equation. For an analysis in nominal terms, it is necessary to include the p component in the estimates of interest payments that have to be financed, and hence of the current account deficit and net borrowing required. In nominal terms, therefore, both interest payments and net borrowing requirements exceed the corresponding real amounts shown (as a fraction of *GDP*) in earlier tables by $p(D/G)$ (see Appendix).

Table 9 compares real and nominal interest payments and net borrowing requirements. It assumes a dollar inflation rate of 3% per annum,[10] and uses the base case of declining real interest rates (from 8 to 7% in the following year and 6% in all subsequent years). The corresponding nominal interest rates i, therefore, become 11, 10 and 9%. The resulting nominal interest payments and net borrowing requirements are seen to be much higher than the corresponding real magnitudes. For example, in the first year, both nominal interest payments and net borrowing needs exceed their corresponding real values by 1.9 and 3.0 percentage points for Type A and B countries, respectively.[11] Nominal borrowing becomes 7.9% of *GDP* in Type A countries and 12.0% in Type B countries. Cumulative borrowing needs are also substantially higher in nominal terms. In Type A countries, an increase in the real stock of debt (in a 4-year period) equivalent to 12% of *GDP*, requires an increase in the nominal stock of debt equal to 19.9% of *GDP*. In Type B countries, an increase in the real stock of debt (in a 5-year period) equal to 23.4% of *GDP* requires an increase in the nominal stock of debt of 39.1%.[12]

If one applies the previous yardstick that creditworthiness is "restored" once interest payments fall below 4% of *GDP* to nominal rather than to real interest payments, one uses, of course, a tougher yardstick and the adjustment period will be longer. For the case shown in Table 9, an extra 4 years will be required for a Type A country, and an extra 2 years for a Type B country.

8. POLICY IMPLICATIONS

The earlier analysis has identified the main variables — and the way they interact as time passes — which determine the success of an adjustment program aimed at recovering creditworthiness with growth. As expected, the success of such a program depends on four sets of variables: the availability of net foreign financing, particularly in the short run; the possibility of rapidly increasing the domestic savings rate; the possibility of rapidly generating an export surplus; and the possibility of increasing the overall efficiency of resource use, that is, a decline in *ICOR*.

Table 9. *Comparison between real and nominal interest payments and net borrowing (base case under declining real interest rates; values as percentage of* GDP)*

	Type A countries				Type B countries			
	Interest payments		Net borrowing		Interest payments		Net borrowing	
Year	Real	Nominal	Real	Nominal	Real	Nominal	Real	Nominal
0	5.0	6.9	6.0	7.9	8.0	11.0	9.0	12.0
1	4.6	6.6	4.0	6.0	7.3	10.5	6.7	9.9
2	4.1	6.1	1.8	3.8	6.4	9.6	4.2	7.4
3	4.1	6.1	0.2	2.2	6.4	9.6	2.6	5.8
4	3.8 (T^*)	5.7	−1.6	0.3	6.3	9.4	0.9	4.0
5	3.6	5.4	−3.3	−1.5	6.1	9.2	−0.8	2.3
6	3.3	4.9	−5.0	−3.4	5.9	8.7	−2.4	0.4
7	2.9	4.3	−6.9	−5.5	5.5	8.2	−4.3	−1.6
8	2.3	3.5	−8.9	−7.7	5.0	7.5	−6.2	−3.7
9					4.5	6.7	−8.1	−5.9
10					3.8 (T^*)	5.8	−10.2	−8.2
11					3.1	4.7	−12.2	−10.6
12					2.3	3.5	−14.4	−13.2

Assumptions:
$g = 0.04$
$ICOR = 4$
$\Delta C/C = 0.02$
$r = 0.08, 0.07, 0.06, 0.06, \ldots$
$p = 0.03$
$i = 0.11, 0.10, 0.9, 0.9, \ldots$

*Nominal values are expressed as a percentage of nominal *GDP*; real values are expressed as a percentage of real *GDP*.

(a) *Net flows of foreign finance*

Any program of adjustment compatible with a sustained "minimum" *GDP* growth in the range of 4% a year will require significant net borrowing as a percentage of *GDP*, particularly in the short run. During the first 3 years of such a program, these annual flows may be around 3–5% of *GDP*, in real terms, for countries with a medium debt overhang (real interest payments around 5% of *GDP*), and approximately 5–9% for countries where such overhang is around 8% of *GDP* (corresponding nominal flows are even larger). Further net borrowing is likely to be necessary in subsequent years, but on a declining scale. Required annual borrowing is less if interest rates fall, and greater if resource use is less efficient. Equally important, a policy of more rapid economic growth (and some relaxation of consumption constraints) which is likely to be preferable and compatible with recovery of creditworthiness in many cases, is only feasible if supported by even higher levels of net borrowing sustained over a number of years.

(b) *Domestic savings*

Strong increases in domestic savings rates are required; they will have to reach values ranging from 20 to 30% of *GDP*. These increases will not allow increases in per capita consumption for periods that range from 5 to 12 years, unless sufficient net-foreign financing is forthcoming to support a high growth/rising consumption path of adjustment.

Three policy issues arise: First, what system of incentives and policy reforms can sharply increase private savings. Second, what is the most efficient mix of policies to raise public savings: increase taxation, improve pricing of public services, and reduce government expenditure. Third, what domestic borrowing policies are appropriate to help the public sector service its large part of the foreign debt. In most circumstances, a key objective of these policies will be to avoid preempting private savings and investment, particularly where the public sector has become overextended. In most cases, a large part of additional public savings will have to come about at the expense of government expenditures.

A reduction of public expenditures will have to be accompanied by important reallocations among expenditure items. Subsidies will have to be highly selective and targeted. Their objective should be to protect the poorest groups of the

population (children?) from the possible cuts in their per capita consumption levels. Government investment will have to concentrate on support for the expansion of exports and efficient import substitution.

(c) *Exports surplus*

As shown earlier, the export surplus will have to grow at the same pace as the savings surplus. That surplus increases by increasing exports and substituting imports. But it should not be expanded at any cost. To promote expansion of the most efficient export and import competing sectors, the increased scarcity of foreign exchange in the economy should be translated into (a) a higher market exchange rate, (b) a more neutral trade regime that would help not only exports, but also the most efficient import competing sectors, that is, those that need little protection other than this higher exchange rate. For such policies of the debtor countries to be successful, it is important that they be complemented and supported by economic expansion and liberal trade policies in the creditor countries.

(d) *The overall efficiency of resource use*

As discussed earlier, greater efficiency of resource use will increase the productivity of additional investment and produce more output from existing resources, that is, lower the *ICOR*. This will clearly speed up the recovery of creditworthiness for any given rate of consumption growth, or allow the achievement of creditworthiness with lower consumption sacrifices. This requires that both the private and the public sectors are guided by signals and incentives that better reflect the opportunity costs of resources and the benefits to society.

(e) *Conclusions*

The domestic policy reforms and adjustments required for recovery of creditworthiness through growth are well known. Most of them would be desirable for sound development anyway, even without the debt problem. But the urgency of the reforms is now much greater. For them to be successful, it is important that they be sustained, and that they be perceived as permanent by nationals and creditors alike. More automatic policy instruments that are less subject to discretionary changes will help boost confidence that the reforms are here to stay, which is a key factor in generating the necessary responses both from local producers and consumers, and from foreign lenders.

As we have seen, the debtor countries can recover their creditworthiness with different growth rates of *GDP*. Lower growth will require little net borrowing and can restore creditworthiness rather quickly, but at a high cost of permanently lower output and consumption. This is clearly not in the interest of the borrowers; it may not even be in the interest of the creditors, if political problems associated with low growth increase the risk of debt repudiation. A higher growth of *GDP* is probably preferable as an adjustment path, but requires substantial net borrowing on a larger scale than currently in prospect, and delays the recovery of creditworthiness. This will only be feasible if creditors are willing to match a long-term commitment of debtor countries to policy reforms with adequate net lending.

More definite conclusions on appropriate recovery paths, and their net borrowing implications, can only be reached by calibrating the general approach outlined here with specific country conditions. Some of the simplifying assumptions made above will need to be carefully considered and modified in that case. In particular, as noted earlier, the *ICOR* (the proxy for the productivity of investment) and the cost of borrowing are unlikely to be roughly constant, as assumed above, within the range of additional investment and borrowing being examined. The productivity of investment may fall (the *ICOR* will rise) if the pace of investment is accelerated and meets absorptive capacity constraints of various kinds. The country's cost of borrowing may go up with additional borrowing, if it drives up the interest rate the country otherwise has to pay, and/or the cost of generating foreign exchange when interest and repayment are due is larger than the benefits of additional dollars at the time of borrowing. And finally, in judging the benefits and costs from a high investment/high borrowing strategy, one should properly compare the marginal social productivity of investment, rather than the *ICOR*, with the marginal social cost of borrowing. This more selective measure of the productivity of investment further limits the range over which it is desirable to boost investment and growth. But these refinements and qualifications do not change the broad qualitative conclusions of this paper.

NOTES

1. The relevant formulas are summarized in the Appendix.

2. The definitions of net borrowing, current account balance and interest payments used here differ from

those conventionally used in the national accounts. Net borrowing (and thus, the current account balance) is defined here as the change in the *real* (not nominal) stock of debt. The amount that has to be borrowed just to keep the real stock of debt constant is considered as part of the rollover of debt. This amount is equivalent to the part of nominal interest which matches the inflation rate. Of course, the equivalent increase in the *nominal* stock of debt must include this inflation component of interest payments. The effect of inflation on nominal borrowing requirements is illustrated in Table 9 below and discussed in Section 7. A more formal analysis is presented in the Appendix.

3. This exposition ignores equity investment and capital flight, as well as other factor payments and current transfers; it also ignores the possible need to build up foreign exchange reserves. Suitable adjustments can easily be made to allow for these factors.

4. Typical Type A countries have nominal interest payments as a fraction of *GNP* in the 0.055 to 0.08 range. For typical Type B countries, these interest payments are in the 0.09–0.13 range.

5. Nominal interest payments and nominal net borrowing are larger to compensate for inflation. Corresponding estimates in nominal terms are discussed in Section 7.

6. Note that declining interest rates restore the creditworthiness of Type A countries without any net repayment of foreign debt (Table 3).

7. The improvement in the trade balance in Tables 2 and 3 implies a somewhat faster growth rate of exports in the early years, tapering off later.

8. The higher absolute debt with Strategy 2 (high growth) does not substantially change this conclusion.

9. If this adjustment is not made, the real stock of debt is declining because of inflation, and the country is, in effect, amortizing its debt to that extent.

10. The relevant dollar inflation rate should include only internationally traded goods.

11. With $p = 0.03$ and $D/G = 0.63$ (Type A), $p(D/G) = 1.9\%$
With $p = 0.03$ and $D/G = 1.00$ (Type B), $p(D/G) = 3.0\%$.

12. Since *GDP* is growing over the period, one should strictly not take the simple sum of the annual net borrowing needs, where each year is expressed as a percentage of current year *GDP*. However, the distortion is small, and the substantive point remains.

APPENDIX

1. *The phases of the debt burden*

The earlier discussion can be summarized specifying the following set of relationships:

(a) A target *GDP* growth in constant dollars, g, is set at a "predetermined" value.

(b) Assuming a constant incremental capital-output ratio, *ICOR*, the investment requirement (I) is automatically determined. The required investment rate becomes a constant and equal to:

$$I/G = g \cdot ICOR \tag{A1}$$

where $G = GDP$.

The economy starts with a given burden of interest payments on foreign debt, rD, where r is the real dollar interest rate on existing debt and D the stock of debt in constant dollars. Assuming r remains constant, the change in interest payments over time will depend on the change in D, which is equal to the amount of net real borrowing, B — over and above rolling over of amortization. Thus the change in interest payments can be written as:

$$\Delta(rD) = r\Delta D = rB. \tag{A2}$$

On the other hand, net borrowing will be determined by the gap between domestic savings, S, and the requirements to finance investment plus interest payments abroad, that is, the current account deficit (here defined positive).

$$B = rD + I - S. \tag{A3}$$

Substituting (A3) into (A2):

$$\Delta(rD) = r\Delta D = r[rD + I - S]. \tag{A4}$$

The growth rate of interest payments and debt are equal (as long as r is constant) and can be written as:

$$\frac{\Delta(rD)}{rD} = \frac{r\,\Delta D}{rD} = \frac{\Delta D}{D}$$

$$= r + \frac{(I/G) - (S/G)}{(D/G)} \tag{A5}$$

Expression (A5) is convenient because it allows the rate of growth of interest payments (and debt) to be written in terms of the interest rate plus (minus) a "correction" factor.[A1] Thus, the interest rate can be used as a reference point, as was done earlier. A decline in the debt/*GDP* or interest payments/*GDP* ratio requires for the growth of debt to be lower than g.

Thus, if the interest rate is larger than g, the savings rate will have to increase to a minimum critical value *above* the investment rate to achieve this result. Consequently, a *necessary* condition to achieve a lower debt/*GDP* ratio is to increase the savings rate, that is, savings must grow faster than *GDP* growth, g.

Because the investment rate (I/G) is constant, expression (5) can be used to define the different phases of the adjustment process as the savings *rate* increases, as shown in Figure 1.[A2] Defining $s = (S/G)$:

Phase	*Debt*/GDP *Ratio* 1
Phase 1: $s_1 < I/G$, so $\Delta D/D > r > g$	Increases
Phase 2: $s_2 = I/G$, so $\Delta D/D = r > g$	Increases
Phase 3: $s_3 > I/G$, such that $g < \Delta D/D < r$	Increases
Phase 4: $s_4 > I/G$, such that $g = \Delta D/D < r$	Reaches its maximum
Phase 5: $s_5 > I/G$, such that $g > \Delta D/D < r$	Declines
Phase 6: $s_6 > I/G$, such that $\Delta D/D$ negative.	Absolute debt declines

A necessary condition to lower the debt burden is an increase in the savings rate. That increase can be written in terms of g and $\Delta C/C$, the rate of growth of aggregate consumption.

$$\Delta s = (1 - s)(g - \Delta C/C). \tag{A6}$$

Thus consumption must grow at a lower rate than *GDP*. If $\Delta C/C$ is set below population growth, consumption per capita will be declining and vice versa.

The trade surplus as a fraction of *GDP* can be written as:

$$\frac{X}{G} - \frac{M}{G} = s - \frac{I}{G} \tag{A7}$$

where s is again the *domestic savings rate*.[A3] Because the investment rate is constant, the change in the export ratio X/G can be written as:

$$\Delta(X/G) = \Delta s + (M/G)[E - 1]g \tag{A8}$$

where E is the elasticity of import requirements with respect to output. If this elasticity is larger than one, the export ratio will have to increase (in absolute terms) faster than the required increase in the savings rate. If it is equal to one, the export ratio increases at the same pace as the savings rate. Notice that, for a given value of $\Delta(X/G)$, the required growth rate of exports will have to be larger the smaller the initial share of exports in *GDP*.

2. *Real and nominal magnitudes*

Nominal debt, interest payments and net borrowing exceed real debt, interest payments and net borrowing (the subscript N denotes nominal values):

$$\text{Real debt } D = D_N/P, \tag{A9}$$

where P is a dollar price index. Real net borrowing is defined as the change in real debt:

$$\Delta D = \Delta D_N/P - pD_N/P, \tag{A10}$$

where $p = \Delta P/P$ is the rate of inflation.

Nominal net borrowing is:

$$\Delta D_N = iD_N + I_N - S_N, \tag{A11}$$

where i is the nominal interest rate.

$$\text{Hence } \Delta D = \frac{I_N - S_N}{P} + i\frac{D_N}{P} - p\frac{D_N}{P} \tag{A12}$$

$$\text{or } \Delta D = I - S + rD \tag{A13}$$

where $r = i - p$.

As a fraction of real *GDP*, G:

$$\frac{\Delta D}{G} = \frac{I - S}{G} + r\frac{D}{G} = \text{increase in real debt as a fraction of real } GDP. \tag{A14}$$

But nominal net borrowing as a fraction of nominal (current dollars) *GDP*, G_N, is:

$$\frac{\Delta D_N}{G_N} = \frac{I_N - S_N}{G_N} + i\frac{D_N}{G_N} = \frac{I - S}{G} + i\frac{D}{G} \tag{A15}$$

$$\text{or } \frac{\Delta D_N}{G_N} = \frac{\Delta D}{G} + p\frac{D}{G} = \text{increase in nominal debt as a fraction of current } GDP. \tag{A16}$$

Thus, nominal net borrowing as a fraction of current *GDP* is equal to the change in real net borrowing (the change in the real stock of debt) over real *GDP plus* the rate of inflation multiplied by the debt to *GDP* ratio. Nominal interest payments in relation to nominal *GDP* is:

$$i\frac{D_N}{G_N} = i\frac{D}{G} = r\frac{D}{G} + p\frac{D}{G}. \tag{A17}$$

Nominal interest payments as a fraction of nominal *GDP* equals real interest payments as a fraction of real *GDP plus* the rate of inflation multiplied by the debt to *GDP* ratio.

APPENDIX NOTES

A1. When interest rates change and existing debt obligations are at variable interest rates, the change in interest payments, $\Delta(rD)$, becomes:

$$\Delta[rD] = \Delta rD + r\Delta D \qquad \text{(A1')}$$

where

$\Delta D = B = [rD + I - S]$; thus substituting into (A1'):

$$\Delta[rD] = \Delta rD + r[rD + I - S]. \qquad \text{(A2')}$$

The rate of change of interest payments becomes now:

$$\frac{\Delta[rD]}{[rD]} = \frac{\Delta r}{r} + r + \frac{I - S}{D} \qquad \text{(A3')}$$

This can be compared with expression (A5) earlier; expression (A5) is a special case of (A3') and where $\Delta r/r = 0$. In other words, the rate of change of interest payments can be written as the rate of change in debt plus the rate of change in the interest rate.

$$\frac{\Delta\ [rD]}{rD} = \frac{\Delta D}{D} + \frac{\Delta r}{r}. \qquad \text{(A4')}$$

A2. When r is constant, these phases are equally applicable to derive the change in the interest payments/GDP ratio. If r changes, they still hold for the debt/GDP ratio; to be applicable to the interest payments/GDP ratio, $\Delta D/D$ must be replaced by

$$\frac{\Delta D}{D} + \frac{\Delta r}{r}.$$

A3. If alternatively the concept of *national* savings (S^*) is used, where $S^* = S - rD$, the equilibrium condition (A7) can be written as $S^* + rD - I = X - M$, which is equivalent to the well-known current account identity $S^* - I = X - M - rD$.