Economic Growth, Foreign Loans, and Debt Servicing Capacity of Developing Countries

Economic Growth, Foreign Loans and Debt Servicing Capacity of Developing Countries

by Gershon Feder*

The paper links a simple aggregate model of growth-cum-external debt with an empirical formula for debt-servicing capacity. Through simulations of growth and debt patterns, using data related to two groups of LDCs, the underlying conditions and the pattern of debt service problems which emerge are studied. Simulation of policies designed to alleviate debt-service problems allows an assessment of the efficiency and suitability of different policies. The time dimension of debt problems and its relevance to policy are considered as well. The study raises doubts regarding the applicability of accepted beliefs and rules of thumb related to external debt management.

I INTRODUCTION

Foreign capital has played an important role in the economic development of many countries which are presently considered mature or developed economies. Most of the developing countries are still at a stage where their development depends, in part, on the flow of foreign funds in the form of grants, loans and direct foreign investment. It is, therefore, not surprising that a substantial research effort, of both empirical and theoretical nature, has been directed at the study of the relation between economic development and foreign funds. While the earlier works tended to view foreign capital as 'aid' (e.g. McKinnon [1964], Chenery and Strout [1966]), it was recognized that most of the funds obtained by less developed countries (LDC's) are in the form of loans. This implies that the growth process is almost inevitably accompanied by indebtedness. Indeed, the external debt of LDC's has grown from less than $50 billion in 1967 to about $250 billion by end 1978.1 The debt service burden related to this indebtedness is becoming heavier as the share of commercial lenders in the debt is increasing.

Several analytical studies have addressed themselves to the topic of debt in the context of development (e.g. Alter [1961], Avramovic et al. [1964], King [1968], Ohlin [1966], and more recently Solomon [1977]). The ability to service the foreign debt accumulated during the process of growth is considered in these models through a requirement that debt will not grow at a rate faster than that of GDP, since if this condition is not met, GNP will

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eventually become negative. This approach, however, misses an important aspect of the debt service problem, namely, that debt service payments are made in terms of foreign currency. The ability to service foreign loans depends to a large extent on the economy's ability to generate foreign exchange earnings through exports (or import substitution), at a level which, when added to new loans, suffices to cover both the import bill and debt service obligations.

The present paper attempts to improve on these earlier works by linking the growth-cum-indebtedness model underlying the earlier work with a more realistic, empirically based concept of debt servicing capacity. Simulations referring to two broad groups of LDC's are performed, to show the relation between debt servicing capacity and growth. Situations which are likely to result in debt service problems can thus be identified. Furthermore, the impacts of some remedial policies and their timing is assessed and compared to intuitive beliefs and accepted rules of thumb.

II. THE MODEL

The present model retains the simplistic features of previous works of both the two gap literature and the growth-cum-indebtedness model. It thus involves a minimal number of behavioral equations to be numerically specified. This property is particularly advantageous in the present study, which deals with a group of countries rather than with a specific country.

A detailed presentation is provided for expository purposes, and because some of the earlier works may not be readily available to readers. Symbols:

(A) Variables

\[
\begin{align*}
Q & : \text{Gross domestic product (GDP)}; \\
Y & : \text{Gross national product (GNP)}; \\
C & : \text{National consumption}; \\
I & : \text{Gross domestic investment}; \\
I_d & : \text{Domestic production of capital goods}; \\
M_k & : \text{Imports of capital goods}; \\
X & : \text{Exports of goods and non-factor services}; \\
M_c & : \text{Imports of consumption goods and services}; \\
M & : \text{Total imports}; \\
B & : \text{Total outstanding debt}; \\
L & : \text{Gross loans}; \\
A & : \text{Loan amortization payments}.
\end{align*}
\]

(B) Parameters

\[
\begin{align*}
\alpha & : \text{Incremental (local capital) output ratio}; \\
\beta & : \text{Incremental (foreign capital) output ratio}; \\
k & : \text{Overall capital output ratio}; \\
C_o & : \text{Total consumption at year zero}; \\
c & : \text{Marginal propensity to consume}; \\
i & : \text{Rate of interest on foreign loans}; \\
X_o & : \text{Exports at year zero}; \\
Y_o & : \text{GNP at year zero};
\end{align*}
\]
B. Outstanding debt at year zero;
 ε : Rate of growth of exports;
 g* : Desired rate of growth of GNP.

(C) Basic Model Equations and Identities:

Resources — uses identity:

\[ Q + M - X = C + I \] ; (1)

Balance of payments equilibrium condition:

\[ M - X = L - iB - A \] ; (2)

Production technology description:\

\[ \Delta Q = \min \left( \frac{I_d}{\alpha}; \frac{M_k}{\beta} \right) \] ; (3)

Consumption function:\

\[ C = C_o + c \cdot [Y(t) - Y_o] \] ; (4)

Definitional equations:

\[ I = I_d + M_k \] ; (5)
\[ M = M_k + M_e \] ; (6)
\[ Q = Y + iB \] ; (7)
\[ \Delta B = L - A \] ; (8)

Since the production technology is of fixed proportions, efficiency considerations imply:\

\[ \frac{M_k}{\beta} = \frac{I_d}{\alpha} \] ; (9)

We thus have a system of 9 equations and 11 unknowns \((Q, M, X, C, I, L - A, B, I_d, M_k, Y, M_e)\). There are, then, two degrees of freedom in the system. The approach adopted in the present paper, however, is that of a planning model. Accordingly, a desired level of GNP growth is specified, which also determines the level of GNP at any given point in time, given an initial value. In addition, exports are specified by a given initial value and a growth rate. For convenience, the following notation is introduced at this point: \(1 - c \equiv s, cY_o - C_o \equiv S\) and \(\alpha + \beta \equiv k\), where \(s\) is the marginal savings rate, \(S\) is the hypothetical level of savings at \(Y = 0\), and \(k\) is the total capital/output ratio. Also a continuous time rather than discrete
time formulation is adopted, such that for any variable Z, it is assumed $DZ = \Delta Z$. Using this notation imposing $DY = g^* Y$, and obtaining $DQ = DY + iDB$ (from (7)), model equations can be manipulated to yield

$$DB = \frac{-S}{1 - ik} \cdot \frac{(s - kg^*) \cdot Y_0 \cdot e^{g^*t}}{1 - ik}; \quad (10)$$

Solving the differential equation (10) provides the time pattern of debt accumulation over time:

$$B(t) = B_o - \frac{S \cdot t}{1 - ik} \cdot \frac{(s - kg^*) \cdot Y_0 \cdot (e^{g^*t} - 1)}{(1 - ik) g^*}; \quad (11)$$

The time when debt reaches its highest level (say, $t^*$) can be calculated by setting $DB$ equal to zero in equation (10) and solving for $t^*$.

$$t^* = \frac{1}{g^*} \left[ \ln(-S/Y_0) - \ln(s - kg^*) \right] - \frac{1}{g^*} \frac{1}{\ln \left[ \frac{s}{s - kg^*} \right]} \quad (12)$$

where $S_o$ denotes national savings at the initial period.

It is interesting to note that the time required to reach maximal indebtedness does not depend on the rate of interest or on the initial debt level.

Equation (12) implies that if $S_o/Y_0$ is less than $kg^*$, then $t^* < 0$, i.e., debt is declining throughout the time period considered. Also, if average and marginal savings are identical (i.e., $s = S_o/Y_0$), then debt will decline indefinitely if $s < kg^*$, since this situation implies that the average supply of national savings exceeds investment requirements at the initial point and at any point in time thereafter. Equation (12) will generate a positive and finite solution for the time of maximum indebtedness only in the case $(S_o/Y_0) < kg^* < c$.

By differentiation of equation (12), it is concluded that higher values of $g^*$ and $k$ imply higher values of $t^*$, since this implies higher investment requirements at any point in time, and thus it will take longer for national savings to build up to a level sufficient to match investment needs. Higher values of the marginal savings rate and average initial savings ($s$ and $S_o/Y_0$, respectively) correspond to a shorter period until debt reaches a maximal level.

By differentiating equation (11), one can show (as expected) that higher values of $k$ imply higher levels of debt throughout the growth path, while higher levels of $s$ and $(S_o/Y_0)$ are related to lower levels of debt. As for $g^*$, it is possible to demonstrate that a higher target rate of growth corresponds to higher levels of debt practically throughout the relevant time period. This is so because a higher target growth rate requires more investment (both local and foreign), which implies more borrowing.

Specifying exports as

$$X(t) = X_0 e^{ct}; \quad (13)$$

all that is left in order to obtain numerical results from the model is to specify values for the parameters, and initial values for $Y, X, and B$. 
III. SIMULATIONS OF GROWTH AND DEBT SERVICING CAPACITY

Using the model to generate predictions, a planner can identify inconsistencies at the planning stage. If the time pattern of $M_s(t)$ or $DB(t)$ as implied by the model is not compatible with the economy's minimal needs of consumption imports (such as foodstuffs), or with loans availabilities, the plan needs to be modified. If adjustments are not made in due time, it may be difficult to make changes in a short time under crisis conditions. When adjustments are not successful, debt service obligations cannot be met and some form of rescheduling or debt relief will be necessary. For the moment, we are assuming that the planning process is consistent and such problems do not arise.

However, a debt service problem\(^9\) of a different kind may arise when projections and assumptions made by planners are not realized for various reasons, such as world recession which hinders growth, bad crops, deterioration of the terms of trade and general poor performance of the economy. Such developments require adjustments in national policies, but if sufficient adjustments are not implemented debt service payments may have to be deferred or renegotiated.

Since developments leading to such an outcome cannot be forecast with certainty, the projections of the growth model should be linked to an index of the likelihood that a debt service problem leading to 'default'\(^{10}\) will arise. Such an index has been estimated by Feder and Just [1977], who identified six variables which significantly affect the probability of default, and provided estimated coefficients relating these variables to that probability using the logit specification.

$$P = \frac{\exp(\delta'Z)}{1 + \exp(\delta'Z)};$$

where $P$ denotes probability of default in the short run, $\delta$ is the vector of estimated coefficients, and $Z$ is the vector of relevant variables. Since the variables have a time dimension, the probability can be traced over time as variable values change.

The six variables are listed below, the sign indicating the direction of their impact on the probability of default.\(^{11}\)

1. The ratio of debt-service payments to export earnings, referred to in the literature as the debt service ratio. The debt service ratio is one of the most common rules of thumb related to assessment of debt servicing capacity. (+)

2. Per capita national income. (−)

3. The ratio of net foreign capital inflow to debt service payments which reflects the degree to which foreign funds are forthcoming to cover not only debt service but also other demands for foreign exchange. (−)

4. The rate of GDP per capita growth. (−)

5. Export growth. (−)

6. The ratio of imports to reserves. (+)

Of these six variables, only the imports/reserves ratio cannot explicitly be incorporated in the present model. It will be assumed, however, that a constant reserves/imports ratio of 1/2 is maintained through short term
borrowing and extension of IMF arrangements. Further, in order to be able to calculate debt amortization payments, it was assumed that amortization payment are a fixed proportion of outstanding debt, i.e.

\[ A(t) = aB(t) \] (14)

Having defined the index of DSC, one faces the task of choosing reference data for model parameters and initial conditions. Rather than focus on a few specific countries, the study is concerned with two broad groups of LDCs, referred to in World Bank publications as 'high income' and 'medium income' countries. It should be pointed out that these two groups are not homogeneous and that it is impossible to identify any two countries within either group that are alike in their parameters or initial conditions. However, the combination of median or average parameter values for each group serves as a convenient reference case, and the characterization of structures which are prone to debt service problems provides some general insights as to the critical values of certain parameters. Table 1 presents the basic set of data used, where variables are defined as either 'structural' or 'policy' variables.

Simulations covering 25 time periods were first run for the average, or 'reference' cases, namely, columns 1 and 2 of Table 1. Further simulations were then made with various combinations of structural variables that were potentially capable of producing high probability of default. If a certain combination of structural parameters yield a probability higher than .25 at any point of time within the 25 years covered, the situation was considered as a potential debt service problem. In such a case, changes in the policy variables were simulated so as to study the impact of such measures. Obviously, one cannot report the infinitely many combinations which yield debt service problems. Thus only a few combinations are reported here.

**TABLE 1**

**DATA SET FOR THE SIMULATIONS**

<table>
<thead>
<tr>
<th>Structural variables</th>
<th>High Income LDCs</th>
<th>Middle Income LDCs</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Median 1974 per capita GNP in US$</td>
<td>900</td>
<td>370</td>
</tr>
<tr>
<td>(2) Lower quartile 1974 per capita GNP in US$</td>
<td>650</td>
<td>300</td>
</tr>
<tr>
<td>(3) Average 1973 exports GNP ratio (X, Y)</td>
<td>.161</td>
<td>.21</td>
</tr>
<tr>
<td>(4) Average 1973 consumption GNP ratio (C, Y)</td>
<td>.81</td>
<td>.83</td>
</tr>
<tr>
<td>(5) Median 1974 debt GNP ratio (B, Y)</td>
<td>106</td>
<td>175</td>
</tr>
<tr>
<td>(6) Upper quartile 1973 debt GNP ratio (B, Y)</td>
<td>.200</td>
<td>.25</td>
</tr>
<tr>
<td>(7) Capital output ratio, 1973 (k)</td>
<td>3.32</td>
<td>3.44</td>
</tr>
<tr>
<td>(8) Average rate of interest, 1974 (i)</td>
<td>.0750</td>
<td>.0610</td>
</tr>
<tr>
<td>(9) Average rate of amortization, 1974 (a)</td>
<td>.0650</td>
<td>.0525</td>
</tr>
<tr>
<td>(10) Population growth, average 1965-73</td>
<td>.024</td>
<td>.024</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Policy variables</th>
<th>High Income LDCs</th>
<th>Middle Income LDCs</th>
</tr>
</thead>
<tbody>
<tr>
<td>(11) Target GNP growth rate (g*)</td>
<td>.066</td>
<td>.060</td>
</tr>
<tr>
<td>(12) Real average export growth rate, 1965-73 (e)</td>
<td>.076</td>
<td>.072</td>
</tr>
<tr>
<td>(13) Marginal rate of consumption (c)</td>
<td>.77</td>
<td>.79</td>
</tr>
</tbody>
</table>

*The data were obtained from World Bank publications. For exact references and methods of calculation see the appendix.
For each simulation the following variables are reported (the symbols in parentheses indicate notation):

(a) Date of attainment of maximal debt level ($t^*$);
(b) Maximal debt service ratio and the time it occurs

\[ \left( \frac{(i + a) B}{X} ; t_1 \right) ; \]

(c) Maximal probability of default and the time it occurs ($Max. P ; t_2$);
(d) The probability of default at year 1 ($P_1$).

Tables 2 and 3 present simulation results for high and middle income LDCs, respectively, covering several cases where debt service problems are not envisaged. The reference case relates to the 'typical' values reported in lines 1, 3, 4, 5, 7-13 of Table 1. In simulations where one or more of the structural variables differ from reference values, the values of the changed coefficients are reported together with the case description in the first column of each table, while the coefficients not indicated explicitly were maintained at the same level as those of the reference case.

Several observations related to Table 2 and 3 deserve comment:

(a) Although middle income countries are assumed to have a lower target rate of growth (which \textit{ceteris paribus}, would imply a lower $t^*$ with present coefficients), they will require a longer time period, compared to high income LDCs, before their debt starts declining. This is due to the

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Case Description</th>
<th>$t^*$</th>
<th>$(i + a) B / X$</th>
<th>$t_1$</th>
<th>Max. $P$</th>
<th>$t_2$</th>
<th>$P_1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Reference case</td>
<td>20</td>
<td>.180</td>
<td>8</td>
<td>0</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>Upper quartile debt ($B_{Yo} / Y_o = .2$)</td>
<td>20</td>
<td>.228</td>
<td>6</td>
<td>0</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>Lower quartile per capita GNP ($Y$ population = 650)</td>
<td>20</td>
<td>.180</td>
<td>8</td>
<td>0</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>Small export sector ($X / Y_o = .10$)</td>
<td>20</td>
<td>.289</td>
<td>8</td>
<td>0</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>Upper quartile debt lower quartile p.c. GNP ($B_{Yo} / Y_o = .2 ; Y/pop. = 650$)</td>
<td>20</td>
<td>.228</td>
<td>6</td>
<td>.003</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>Low average savings Lowe quartile p.c. GNP, Upper quartile debt ($S_{Yo} / Y_o = .16$; $B_{Yo} / Y_o = .2 ; Y/pop. = 650$)</td>
<td>28</td>
<td>.378</td>
<td>9</td>
<td>.134</td>
<td>7</td>
<td>0</td>
</tr>
</tbody>
</table>
TABLE 3
SIMULATION RESULTS FOR MIDDLE INCOME LDCs WITH STRUCTURES THAT ARE NOT LIKELY TO GENERATE DEBT SERVICE PROBLEMS

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Case Description</th>
<th>Max. ( (i + a)B )</th>
<th>( t^* )</th>
<th>Max. ( P )</th>
<th>( t_2 )</th>
<th>( P_1 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Reference case</td>
<td>35</td>
<td>.158</td>
<td>9</td>
<td>.008</td>
<td>8</td>
</tr>
<tr>
<td>8</td>
<td>Upper quartile debt ( (\frac{B_c}{Y_o}) .25 )</td>
<td>35</td>
<td>.180</td>
<td>7</td>
<td>.025</td>
<td>6</td>
</tr>
<tr>
<td>9</td>
<td>Lower quartile p.c. GNP (GNP/pop. 300)</td>
<td>35</td>
<td>.158</td>
<td>9</td>
<td>.024</td>
<td>8</td>
</tr>
<tr>
<td>10</td>
<td>Small export sector ( \frac{X_e}{Y_o} .16 )</td>
<td>35</td>
<td>.207</td>
<td>9</td>
<td>.090</td>
<td>8</td>
</tr>
<tr>
<td>11</td>
<td>Low average savings ( \frac{S}{Y_o} .14 )</td>
<td>45</td>
<td>.258</td>
<td>11</td>
<td>.165</td>
<td>10</td>
</tr>
</tbody>
</table>

lower average and marginal savings rate and higher capital/output ratio of middle income LDCs.

(b) The debt service ratio \( \frac{(i + a)B}{X} \) tends to rise reaching a maximal level within the first half of the period between year zero and the year of maximal debt level \( (t^*) \). Thereafter, the ratio declines continuously. The probability of default (which serves here as an index of debt servicing capacity) follows a similar pattern, in the cases where it reaches positive levels.

c) As demonstrated in cases \#4 and \#6 (Table 2), high income LDCs can sometimes afford high debt service ratios without running into debt service problems (i.e., while still maintaining a low probability of default). This result is verified by the experience of countries such as Brazil and Mexico. The ability of middle income countries to sustain high debt service ratios is obviously more limited, as demonstrated in case \#11 (Table 3).

Having reviewed some of the economic structures which do not pose serious debt service problems, we turn now to study several cases where problems are more likely to arise. Considering high income LDCs, two potentially risky structures are identified:

(1) Economies with relatively high levels of initial debt, a small export sector and a low per capita GNP, relative to the group's average or median.

(2) Economies with a relatively low rate of average savings and a small export sector.

These two cases, and various policy measures attempting to reduce the risk inherent in the original growth plan, are presented in Tables 4 and 5. The reference case in each one of these tables incorporates all parameters of case \#1 (Table 2), except for structural parameters indicated in parentheses. Each one of the policy variations similarly specifies the level of the policy variable which has been changed.
Two structures with a relatively high probability of debt servicing problem are considered for the group of middle income LDCs:

(a) Economies with a high debt, small export sector and relatively low income.

(b) Economies with low average savings rate and a high debt.

The simulations for these two classes of problem economies are reported in Table 6 and 7. It should be pointed out that the latter situation, namely, low savings and high debt, does not seem to present a particular problem for high income LDCs, as demonstrated in case #6 (Table 2). The policy variables in the simulations are: (a) The target rate of growth of GNP; (b) the marginal rate of savings; and (c) the rate of growth of exports.17

V ANALYSIS OF POLICY SIMULATIONS

The simulations of the impact of policy alternatives to be discussed below, deal with one policy measure at a time. This procedure enables the assessment of the effectiveness of each policy in isolation from other policies. In reality, of course, most or all possible avenues of action will be taken, allowing a smaller change in each policy variable and affording a smoother process of adjustment.

On the basis of the simulations in Tables 4-7, several observations can be made:

(a) Reduction of the GNP target growth rate reduces the level of indebtedness and the probability of debt problems, but the latter effect may be obtained only within a limited range. If the rate growth is reduced beyond some critical point, debt servicing capacity may be impaired rather than improved, as cases #16 (Table 4) and #31 (Table 6) demonstrate. This result follows from the trade off between reduced indebtedness on one hand,

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Case Description</th>
<th>Max. t* (i + a)B</th>
<th>Max.P</th>
<th>t1</th>
<th>t2</th>
<th>P1</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Reference case ($\frac{B}{Y} = .2$; $X = .1$)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>GNP target growth rate reduced to .0625</td>
<td>9 .292 2 .094 2 .0874</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>GNP target growth rate reduced to .060</td>
<td>4 .280 0 .126 1 .126</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>GNP target growth rate reduced to .0575</td>
<td>0 .280 0 .192 1 .192</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>GNP target growth rate reduced to .055</td>
<td>0 .280 0 .301 1 .301</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Marginal savings rate increased to .25</td>
<td>10 .342 4 .202 4 .061</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Marginal savings rate increased to .27</td>
<td>7 .329 3 .1777 3 .065</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Marginal savings rate increased to .30</td>
<td>5 .316 2 .167 3 .072</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Export growth rate increased to .085</td>
<td>20 .348 5 .135 4 .040</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Export growth rate increased to .095</td>
<td>20 .332 4 .066 4 .027</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
TABLE 5
SIMULATION OF POLICIES FOR HIGH INCOME LDCS WITH LOW AVERAGE SAVINGS AND A SMALL EXPORT SECTOR

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Case Description</th>
<th>t* (i+a)B</th>
<th>Max. X</th>
<th>Max.P</th>
<th>t1</th>
<th>t2</th>
<th>P1</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>Reference case ($S_n/Y_n = .16; X_o/Y_o = .1$)</td>
<td>28</td>
<td>.545</td>
<td>.405</td>
<td>8</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>GNP target rate of growth reduced to .06</td>
<td>14</td>
<td>.330</td>
<td>.0</td>
<td>7</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Marginal savings rate increased to .25</td>
<td>16</td>
<td>.481</td>
<td>.146</td>
<td>7</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Marginal savings rate increased to .27</td>
<td>9</td>
<td>.435</td>
<td>.057</td>
<td>6</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Export growth rate increased to .085</td>
<td>28</td>
<td>.500</td>
<td>.122</td>
<td>7</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>Export growth rate increased to .095</td>
<td>28</td>
<td>.458</td>
<td>.030</td>
<td>7</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

TABLE 6
SIMULATION OF POLICIES FOR MIDDLE INCOME LDCS WITH HIGH DEBT, SMALL EXPORT SECTOR AND LOWER QUARTILE PER CAPITA GNP

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Case Description</th>
<th>t* (i+a)B</th>
<th>Max. X</th>
<th>Max.P</th>
<th>t1</th>
<th>t2</th>
<th>P1</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>Reference case ($B_o/Y_o = .25; X_o/Y_o = .16; Y/pop = 300$)</td>
<td>35</td>
<td>.2361</td>
<td>.345</td>
<td>7</td>
<td>.059</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>GNP target growth rate reduced to .055</td>
<td>11</td>
<td>.180</td>
<td>2</td>
<td>.182</td>
<td>3</td>
<td>.165</td>
</tr>
<tr>
<td>30</td>
<td>GNP target growth rate reduced to .0525</td>
<td>5</td>
<td>.177</td>
<td>0</td>
<td>.275</td>
<td>1</td>
<td>.275</td>
</tr>
<tr>
<td>31</td>
<td>GNP target growth rate reduced to .05</td>
<td>1</td>
<td>.177</td>
<td>0</td>
<td>.436</td>
<td>1</td>
<td>.436</td>
</tr>
<tr>
<td>32</td>
<td>Marginal savings rate increased to .25</td>
<td>11</td>
<td>.212</td>
<td>4</td>
<td>.284</td>
<td>5</td>
<td>.068</td>
</tr>
<tr>
<td>33</td>
<td>Marginal savings rate increased to .27</td>
<td>7</td>
<td>.206</td>
<td>3</td>
<td>.283</td>
<td>5</td>
<td>.074</td>
</tr>
<tr>
<td>34</td>
<td>Export growth rate increased to .082</td>
<td>35</td>
<td>.221</td>
<td>6</td>
<td>.185</td>
<td>6</td>
<td>.041</td>
</tr>
<tr>
<td>35</td>
<td>Export growth rate increased to .092</td>
<td>35</td>
<td>.209</td>
<td>5</td>
<td>.097</td>
<td>5</td>
<td>.029</td>
</tr>
<tr>
<td>36</td>
<td>Export growth rate increased to .102</td>
<td>35</td>
<td>.200</td>
<td>4</td>
<td>.052</td>
<td>5</td>
<td>.020</td>
</tr>
</tbody>
</table>

TABLE 7
SIMULATION OF POLICIES FOR MIDDLE INCOME LDCS WITH HIGH DEBT, AND LOW AVERAGE SAVINGS

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Case Description</th>
<th>t* (i+a)B</th>
<th>Max. X</th>
<th>Max.P</th>
<th>t1</th>
<th>t2</th>
<th>P1</th>
</tr>
</thead>
<tbody>
<tr>
<td>37</td>
<td>Reference case ($S_n/Y_n = .14; B_o/Y_o = .25$)</td>
<td>45</td>
<td>.277</td>
<td>.317</td>
<td>9</td>
<td>.002</td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>GNP target growth rate reduced to .055</td>
<td>21</td>
<td>.207</td>
<td>.091</td>
<td>8</td>
<td>.004</td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>GNP target growth rate reduced to .05</td>
<td>12</td>
<td>.156</td>
<td>.040</td>
<td>5</td>
<td>.012</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>Marginal savings rate increased to .25</td>
<td>15</td>
<td>.238</td>
<td>7</td>
<td>.179</td>
<td>7</td>
<td>.002</td>
</tr>
<tr>
<td>41</td>
<td>Marginal savings rate increased to .27</td>
<td>12</td>
<td>.226</td>
<td>6</td>
<td>.150</td>
<td>7</td>
<td>.002</td>
</tr>
<tr>
<td>42</td>
<td>Export growth rate increased to .085</td>
<td>45</td>
<td>.245</td>
<td>.100</td>
<td>8</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>43</td>
<td>Export growth rate increased to .095</td>
<td>45</td>
<td>.227</td>
<td>.041</td>
<td>7</td>
<td>.001</td>
<td></td>
</tr>
</tbody>
</table>
and lower growth and income levels on the other hand, the net effect of which is not obvious. The reversal in the impact of GNP growth rate policies does not, however, seem to occur in the relevant range for economies with a low savings ratio. This conclusion is based in cases #23 (Table 5) and on experiments which are not reported in the tables. Figure 1 describes the trade-off between DSC (represented by the highest probability of default) and the target rate of growth of GNP, based on Tables 4 and 6.

(b) Changes in the marginal savings rate (s) seem to be more effective when one of the deficiencies of the economy is a low initial savings rate. In that case, a four percentage point increase in marginal savings reduces the maximal probability of default by 34 and 14 percentage points for high income and middle income countries, respectively, (see Tables 5 and 7). The effectiveness of this policy measure, however, may decline and taper off while Max. P is still high, as demonstrated in cases #18, #19 (Table 4) and #40 and #41 (Table 7).

(c) The acceleration of export growth is shown to be an effective policy in all of the situations considered. A two or three percentage point increase in the annual rate of growth of exports throughout the period reduces the maximal probability of default to a reasonably low level of 6 per cent or less. Although the effectiveness of increase in export growth is diminishing at the margin, as demonstrated in Figure 2, overall effectiveness within the relevant range is quite satisfactory.18

(d) In several cases, the debt service ratio (\( \frac{(i + a)B}{X} \)) reaches its highest point only after the probability of default has already been declining for a period or two. This result points out that the use of the debt service ratio as a sole leading indicator (which is quite a common rule of thumb, see Bittermann, pp. 68-69), is not acceptable, as the ratio may in fact be lagging behind the probability of default.

(e) Debt servicing problems (in the sense that the probability of default assumes high values) arise long before indebtedness reaches its maximal planned level \((t^*)\). A situation of low debt servicing capacity may develop fairly rapidly even though the initial situation is of negligible risk. It follows that short-run assessment of debt servicing capacity should not serve as an indication for medium or long-run performance. The importance of this conclusion is enhanced by the fact that all parameters (such as export growth rate, ICOR, GNP growth, etc.) were assumed constant in the simulation. The (misleading) intuitive conclusion might have been that if all parameters are constant then the situation is likely to remain essentially unchanged.

(f) The previous point calls attention to a related question: at what time should adjustment policies be initiated? The simulations reported so far have all assumed that policies designed to improve debt servicing capacity are started at year zero. This implies that corrective measures are taken several years before the probability of default starts to assume alarming magnitudes. However, since adjustment policies will usually involve some cost (foregone GNP, foregone consumption, possible frictional unemployment), policy makers may be tempted to delay the application of such
policies. Obviously, any rational decision maker is aware of the difficulties involved in hasty adjustments at a time of crisis, but it may seem that a two-three years' lead will suffice. An experiment was thus conducted referring to case #22 (Table 5), dealing with high income LDCs with a low savings ratio and a small export sector. It was observed that in that case, while Max P is .405 at year 8, the probability of default is only .122 at year 5. It was assumed then that policies to improve debt servicing capacity are initiated by the end of year 5, and several policies of various magnitudes were simulated. The results indicated that putting off adjustment policies is a dangerous decision and may lead to a situation that is not manageable, such that the probability of default cannot be reduced to reasonable levels. Export promotion policies were somewhat less affected by the delay, but given the short-run exogenous constraints on exports, and the possible time lag between policy and result, it would be risky to depend on the immediate effectiveness of that policy only.

VI CONCLUDING REMARKS

Several economic structures which are likely to characterize economies with low debt servicing capacity have been considered in the present study. This does not, of course, cover the whole range of such economies, as many other combinations and alternations of parameters are capable of yielding a high degree of risk. In addition, the highly simplistic nature of the underlying model does not allow the incorporation of other variables and parameters which may be of importance, such as inflation, changes in incremental capital output ratios, investment gestation lags, etc. Thus, while some of the results which have been derived seem to have general applicability in terms of scope and direction, the numerical values need to be considered with caution.

The study points out a problem which economic planners should be aware of: while fairly detailed development plans are designed for the medium-term (mostly five-year plans), the period of indebtedness and the build-up of debt service problems are of a longer time span, which is not covered by the detailed programmes. In most cases, it will not be reasonable to require such programmes to be expanded to the long run, both because of the cost and efforts involved and because of the likelihood that conditions and objectives will be changed, rendering many components of a detailed development programme irrelevant. Common sense suggests that simpler development models be designed to cover the period beyond the medium run, so as to account for the long-run implications of growth and borrowing implied by the detailed plan. While being cruder and less accurate, such models may still be able to flag inconsistencies and potentially risky situations. As already mentioned, the adjustments and revisions which are needed to avoid development of such situations should start at an early stage and would imply changes in the detailed programmes. A model of the type presented here is too simple to be used as a long-run consistency framework and a more sophisticated one is needed. More quantitative work is also needed to improve on existing knowledge of the relation between debt
Figure 1: TRADE-OFF BETWEEN MAX. P AND g* FOR LDC WITH HIGH DEBT, SMALL EXPORT SECTOR AND A LOWER THAN GROUP MEDIAN PER-CAPITA GNP

<table>
<thead>
<tr>
<th>Middle Income LDC</th>
<th>High Income LDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. P</td>
<td>Max. P</td>
</tr>
<tr>
<td>.45</td>
<td>.30</td>
</tr>
<tr>
<td>.30</td>
<td>.27</td>
</tr>
<tr>
<td>.27</td>
<td>.24</td>
</tr>
<tr>
<td>.24</td>
<td>.21</td>
</tr>
<tr>
<td>.21</td>
<td>.18</td>
</tr>
<tr>
<td>.18</td>
<td>.15</td>
</tr>
<tr>
<td>.15</td>
<td>.12</td>
</tr>
<tr>
<td>.12</td>
<td>.09</td>
</tr>
<tr>
<td>.09</td>
<td>.06</td>
</tr>
<tr>
<td>.06</td>
<td>.03</td>
</tr>
</tbody>
</table>

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Figure 2: DEBT SERVICING CAPACITY AS A FUNCTION OF EXPORT GROWTH, FOR LDC WITH HIGH DEBT, SMALL EXPORT SECTOR AND LOW PER CAPITA GNP RELATIVE TO GROUP MEDIAN

Middle Income LDC

High Income LDC
servicing capacity and economic variables, and thus to enable better planning. Needless to say, development planning which specifically concerns itself with maintenance of a reasonable debt servicing capacity is to the benefit of borrowers and lenders alike.

APPENDIX

Sources and Definitions of Data Included in Table 1

(1,2) Per capita GNP for 1974 as reported in World Bank Atlas, 1975, pp. 28-30.
(3) Exports' share in GNP — as reported in World Tables 1976 for group averages in Table 3, p. 409.
(4) Consumption/GNP ratio — deducted from average group savings rate as reported in World Tables 1976, Table 12, p. 481.
(7) Incremental capital/output ratio (k) — obtained by dividing the average rate of growth of GDP in the period 1965-73 by the average share of investment in GDP for the same period. Average data for LDC groups were obtained from World Tables 1976 as follows: GDP growth rates in Table 1, p. 392, and investment share in GDP from Table 3, p. 408.
(8) Average rate of interest — as reported in Table 9.A, p. 125, of World Debt Tables 1976 for LDC groups.
(9) Average amortization rate — from debt service data for LDC groups reported in Table 8.A, p. 124 of World Debt Tables 1976. Data on outstanding debt by country groups are reported in Table 4.A, p. 122 of the same source.
(10) Population growth rate — average for the period 1965-73 as reported in Table 1, p. 392, of World Tables 1976.
(11) Target GNP growth — for the high income LDCs figures were determined on the basis of growth experience in the period 1965-73 as reported in World Tables 1976, p. 392. The target for middle income LDCs was set slightly higher than average annual GNP growth in the period 1965-73 which was 5.7%.
(12) Export growth rate — averages reported for LDC groups in World Tables, Table 2, p. 401.
(13) Marginal consumption rates — assumed to amount to about .95 of consumption/GNP ratio at base year.

NOTES

1. The figures refer to non-oil-exporting LDCs.
2. This criticism refers only to the analytical growth model. Avramovic et al. present an excellent discussion of the various aspects of debt servicing capacity in their study.
3. All variables should have a time dimension, which is omitted here for convenience.
4. The assumption of a constant ICOR substantially simplifies the analysis and is common in models dealing with growth and foreign resources, e.g. Alter (1961), Avramovic et al. (1964), Chenery and Strout (1966), and McKinnon (1964). The latter assumes the same equation as (3) above.
5. Equation (4) implies a linear relation between national savings and Gross National Product. The same relation is implied by Chenery and Strout (equation 5).
6. Equation (9) can be maintained throughout since it is assumed that only the savings gap is limiting. Imports of consumption goods adjust to whatever level is implied by the model.
7. This formulation does not necessarily reflect a binding external constraint on exports, but rather the belief that in order to accelerate export growth, a more intensive policy of export promotion (through taxes, subsidies, credits, market research, etc.) needs to be implemented.
8. However, these variables will affect the level of debt at $t^*$. The term 'debt service problem' is interpreted here in its broader sense, referring to a situation such that either debt service obligations are not met, or when they are honoured the economy's development is significantly hindered and severe cuts in consumption are required. For a detailed discussion of different aspects of the debt problem of developing countries see Corea (1976).
9. The term default is used here for all events such that contractual payments are deferred in part, or some debt relief is provided in the form of rescheduling or refinancing. This is, of course, different from the legal notion of default. The fact is that in the post-World War II era very few defaults of sovereign borrowers took place, while there were quite a few cases of rescheduling or refinancing. See the review in Bittermann (1973).
10. Version (c) of the Feder and Just (1977) study is used here. Other versions include a slightly different composition of variables and the values of coefficients are somewhat different. A detailed explanation of the relation between these variables and debt servicing capacity is provided there.
11. World Tables 1976 (p. 472) reports an average debt service/imports ratio of .475 for developing countries.
12. See World Tables 1976, p. 548 for composition of the groups. The dividing line is the 1972 per capita GNP, where medium income countries are within the range $201-$375, while high and low income countries are above and below that range, respectively. The group of low income LDCs is not referred to in this study, since the assumptions underlying the model are not likely to apply in its case: structural coefficients and capacity utilization are changing rapidly, the foreign capital inflow has a higher grant element, etc.
13. The term 'structure' implies here a set of initial conditions and parameters which specifies the entire growth pattern according to the model presented earlier.
14. The choice of .25 as the critical probability is based on the observation in Feder and Just (1977) that all sample countries (except for one) which rescheduled their debt between 1965–1972, had a probability of 'default' higher than or equal to .25. The debt service ratio is singled out because of its popularity among economists and bankers as an important, if not most important, indicator of debt servicing capacity. The Feder and Just (1977) study confirms that this variable has indeed considerable weight, but so do other variables, such as per capita income.
15. While for some economies export possibilities are dictated by exogenous constraints, it has been shown by Balassa (1977) that for many LDC's there is scope for effective export promotion.
16. A similar conclusion is derived by O'Brien (1975), Mikesell (1962, p. 395), and Friedman (1977, pp. 75–77).

REFERENCES

——— (1976). World Debt Tables, publication EC-167/76.
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