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Theoretical Aspects of Growth in Developing Countries: External Debt Dynamics and the Role of Human Capital

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Abstract

This paper formulates a simple aggregate growth model that is capable of assessing the impact of macroeconomic policies on the long-term performance of a developing country. The model emphasizes expenditures on human capital and the dynamics of external debt, and yields empirically testable hypotheses on the relative importance of various determinants of long-term growth performance. The analytical results suggest a number of implications that are relevant to the design of growth-oriented adjustment programs.

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Contents

I. Introduction

The need for growth-oriented adjustment policies in developing countries, particularly those with structural rigidities and heavy external debt obligations, has become a focal point of discussion in government, banking, and academic circles. Such policies involve structural measures that take time to put in place and have their impact on growth with a long lag. Thus, growth-oriented adjustment policies need to be formulated from a medium- and long-term perspective.

Naturally, the formulation of appropriate structural adjustment policies with regard to both contents and priorities would have to be country-specific. At the same time, it would also be useful to learn lessons and draw policy implications from experiences of other developing countries. A thorough examination of these experiences would be a monumental task, as they differ widely across countries and over time, are extremely complex, and involve developments at both micro and macroeconomic levels. At the macroeconomic level, an examination of the growth experiences of developing countries over the past decade and a half reveals certain interesting patterns. First, the average annual growth rate of real GNP per capita was nearly 5 percent for countries in the Middle East and about 4 percent for countries in Asia and Europe, while it was less than 2 percent for those in Africa and the Western Hemisphere. Second, over the period as a whole, investment expenditures exceeded domestic savings and external debt grew rapidly in all the countries except certain oil-producing countries in the Middle East. Third, the nominal interest rate charged on external borrowing was high (10 percent per annum) for countries in the Western Hemisphere and low (5 percent) for those in Africa and the Middle East; the difference appears to be attributable largely to the degree of country risks involved and the extent of commercial borrowing versus official development assistance. For countries in Asia and Europe, the interest rate averaged 7 percent per annum. Fourth, in the developing world, there appears to be a positive correlation between the level of per capita income, the rate of domestic savings and the growth rate of exports, but a negative correlation between per capita income, the external debt accumulation and the growth rate of population. Finally, developing countries, on average, devoted over one fifth of their budgetary resources to the development of human resources.

This paper investigates the interrelations among the above macroeconomic developments, in the context of the growth process of developing countries. Basically, the paper formulates an aggregative growth model that is capable of examining the impact of major macroeconomic structural policies on the long-term growth performance of an economy. This model emphasizes the critical role of expenditures on human capital and the

dynamics of external debt. Key variables representing the unique characteristics of developing economies are featured. Thus, the model highlights the roles played by the private and public sectors in generating domestic savings and the fact that investment activity in many of these countries is often constrained by the availability of domestic savings.

The rest of the paper is organized into three parts. As motivation for the theoretical analysis, Section II surveys in more detail the growth performance and related developments in developing countries during 1970-85. Section III reviews neoclassical growth theory and builds on it by specifying a model incorporating both the real and financial sectors of an open economy. Moreover, the development of human resources is highlighted and formally integrated into the model. The model's stability and equilibrium conditions are analyzed and the dynamics of adjustment in output growth and external debt to long-run equilibrium is discussed. Comparative dynamic exercises are then performed to determine the direction of responses of the equilibrium capital-labor ratio, the proportion of external debt to the stock of capital, and the growth rate of per capita income to changes in domestic policies and in the external environment. The final section draws some implications for the design of growth-oriented adjustment policies, and outlines the directions of further research work. Mathematical derivations are presented in Appendix I, while country groups and data sources are contained in Appendix II.

II. Growth Performance and Related Developments, 1970-85

The purpose of this section is to motivate the theoretical analysis by highlighting the growth performance and related developments in the developing countries over the past fifteen years. Table 1 summarizes, for different regions and income groups, the respective means and standard deviations of: per capita real GNP growth; domestic savings, gross capital formation, external current account balances, and government total revenue, all as percent of GNP; budgetary share of expenditures on human capital; growth rate of real exports; ratios of long-term external debt to GNP and to exports; nominal and real interest rates on long-term external debt; and the rate of population growth. Data for each group are based on individual countries' annual averages for the period 1970-85. 1/

The average annual growth rate of per capita output ranged from nearly 5 percent in the Middle Eastern region to about 4 percent in Asia and Europe and to 1.4 percent in Africa. The high rate of per capita output growth in the Middle Eastern countries reflected a rapid expansion in

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1/ For a listing of the countries covered and sources of data, see Appendix II.

Table 1. Long-Term Growth and Related Indicators: Mean and Standard Deviation (S.D.)

(In percent)

	Growth Rate of Per Capita Income 1/	Domestic Savings Ratio 2/	Gross Capital Formation 2/	External Current Balance 2/	Total Government Revenue 2/	Budgetary Share of Expenditure on Human Capital 3/
			(by Region)			
Countries in entire sample						
Mean	2.7	19.2	21.9	-2.6	25.5	16.4
(S.D.)	(3.1)	(9.2)	(5.9)	(8.0)	(16.9)	(8.4)
Africa						
Mean	1.4	18.2	21.9	-3.7	24.2	16.6
(S.D.)	(3.3)	(9.8)	(7.6)	(4.9)	(8.3)	(6.1)
Asia						
Mean	3.7	18.4	22.7	-4.3	19.3	13.8
(S.D.)	(2.4)	(5.4)	(6.8)	(2.8)	(5.8)	(7.3)
Europe						
Mean	4.1	22.8	25.2	-2.4	24.7	13.3
(S.D.)	(1.9)	(5.8)	(4.7)	(4.2)	(9.5)	(4.9)
Middle East						
Mean	4.6	31.1	22.8	8.3	57.4	9.3
(S.D.)	(3.3)	(15.1)	(5.3)	(19.4)	(28.3)	(4.5)
Western Hemisphere						
Mean	1.7	15.2	19.8	-4.5	20.0	21.4
(S.D.)	(3.1)	(5.8)	(4.2)	(3.9)	(12.5)	(10.0)
			(by Income Group)			
High Income						
Mean	4.0	23.4	24.6	-1.3	32.9	14.5
(S.D.)	(3.1)	(11.0)	(6.7)	(11.6)	(22.7)	(8.2)
Middle Income						
Mean	2.0	16.0	19.5	-3.5	19.9	21.1
(S.D.)	(3.3)	(5.2)	(5.0)	(2.8)	(9.4)	(9.3)
Low Income						
Mean	1.4	16.3	20.1	-3.7	20.3	14.8
(S.D.)	(2.2)	(7.1)	(4.0)	(4.2)	(6.5)	(6.7)

Sources: Appendix II.

1/ Annual average growth rate.
2/ As percent of GNP.
3/ As percent of current revenue.

Table 1 (concluded). Long-Term Growth and Related Indicators: Mean and Standard Deviation (S.D.)

(In percent)

	Growth Rate of Exports 1/	External Debt/GNP Ratio	External Debt/Export Ratio	Nominal Interest Rate on External Debt	Real Interest Rate on External Debt 2/	Population Growth Rate 1/
			(By Region)			
Countries in entire sample						
Mean	7.1	17.4	77.8	7.0	-3.5	2.4
(S.D.)	(5.3)	(13.2)	(74.8)	(3.8)	(7.6)	(1.0)
Africa						
Mean	5.1	23.1	83.5	4.7	-6.7	2.9
(S.D.)	(5.4)	(13.0)	(59.6)	(1.9)	(5.4)	(0.6)
Asia						
Mean	9.9	15.0	102.2	6.9	-1.8	2.3
(S.D.)	(4.0)	(9.9)	(121.2)	(3.6)	(5.5)	(0.6)
Europe						
Mean	7.1	8.6	52.8	7.5	1.6	1.0
(S.D.)	(3.1)	(3.9)	(72.3)	(4.4)	(3.9)	(0.6)
Middle East						
Mean	10.6	20.7	74.2	2.9	-13.6	3.6
(S.D.)	(4.3)	(19.6)	(61.2)	(2.6)	(12.7)	(1.4)
Western Hemisphere						
Mean	5.6	16.8	66.8	9.8	-0.7	2.3
(S.D.)	(6.0)	(13.8)	(48.2)	(3.0)	(5.4)	(0.9)
			(by Income Group)			
High Income						
Mean	8.1	10.8	35.0	8.8	-2.6	2.0
(S.D.)	(4.8)	(12.2)	(32.6)	(4.1)	(10.3)	(1.3)
Middle Income						
Mean	6.4	18.7	85.9	6.2	-4.8	2.7
(S.D.)	(6.4)	(11.7)	(56.3)	(2.8)	(5.4)	(0.6)
Low Income						
Mean	6.5	25.2	128.4	5.1	-3.7	2.7
(S.D.)	(5.0)	(11.6)	(96.1)	(3.1)	(4.6)	(0.5)

Sources: Appendix II.

1/ Annual average growth rate.
2/ Nominal interest rate adjusted for changes in export prices.

oil production in the 1970s and the boom in investment activity following the two episodes of sharp increases in oil prices. In sharp contrast, African countries suffered severe stagnation, aggravated by the oil shocks and external debt problems. The countries in the high-income group achieved an average annual growth rate of 4 percent, while those in the low-income group grew by only 1.4 percent. 1/

The highest domestic savings ratio at 34 percent was recorded by the Middle Eastern region, reflecting the high savings ratio of oil-producing countries. The lowest rate at 18 percent was observed in African countries, most of which were also in the low-income group. Thus, the data appear to provide considerable credence to the vicious circle hypothesis of poverty, as expounded by Nurkse (1953) and others. In other words, most of these countries were too poor to save sufficiently, resulting in low rates of investment with adverse impacts on the growth of real output and the level of per capita income.

The variation of the investment-GNP ratio was rather small among the regions, but was considerable among different income groups; the high-income group, on average, devoted one fourth of aggregate spending to investment, while the middle- and low-income groups allocated one fifth. Once again, these data appear to suggest that the lower-income countries have suffered from the stagnation in investment, output, and saving.

A deficit in the external current account was experienced by all the regions except the Middle East, with the deficit amounting to 4.5 percent of GNP in Asia and the Western Hemisphere. At the same time, there was an inverse relationship between the level of per capita income and the size of the external current account deficit, raising questions about the efficiency with which external resources were used.

The revenue performance varied widely among the geographical regions. Total revenue (consisting of both tax and nontax revenue) amounted to the equivalent of nearly 60 percent of GNP in the Middle East, reflecting revenues from oil production. In the other regions, the revenue-GNP ratio ranged from about 19 percent in Asia to 25 percent in Europe. By income group, government revenue amounted to one third of GNP in the

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1/ Low-income group: countries with average per capita nominal GNP of US $560 or less; middle-income group: countries with average per capita nominal GNP of more than US $560 but less than US $1,100; high-income group: countries with average per capita nominal GNP of US $1,100 or above. The selection of the cut-off income levels is somewhat arbitrary and was chosen to have some balance in the number of sample countries in each group so that meaningful averages could be computed.

high-income group and to about one fifth of GNP in the middle- and low-income groups, suggesting some progressivity in the world revenue system.

The proportion of budgetary resources devoted to expenditures on human capital (through the provision of educational services and related infrastructure) ranged from about 21 percent in the Western Hemisphere to 9 percent in the Middle East. The high proportion observed in the Western Hemisphere appears to reflect the region's emphasis on education, while the low proportion in the Middle East reflected the region's development strategy to improve the physical infrastructure of the economy. The national governments in Africa and Asia, on average, devoted about one-sixth of total revenue to improving human capital. Governments in the middle-income group spent about one-fifth of revenue on human capital, while those in the high- and low-income groups allocated one-seventh.

The export performance varied across regions and income groups. The annual average growth of exports in real terms ranged from 10 to 11 percent in Asia and the Middle East to only 5 percent in Africa. By income group, the variation in the export performance was rather small, with the annual growth rate between 6 and 8 percent.

Consistent with the developments in the external current account balance, the extent of external indebtedness had an inverse relationship with the level of income. The ratios of long-term public and publicly-guaranteed debt to exports and to GNP were 130 and 25 percent, respectively, in the low-income group, while they were only 35 and 11 percent in the high-income group, suggesting that low-income countries have been experiencing heavy external obligations.

The nominal interest rate on long-term external debt varied significantly across the regions. The highest rate was charged to countries in the Western Hemisphere, reflecting both high country risks and a large share of commercial borrowing in the total. The lowest interest rate accorded to African countries reflected the dominance of concessional loans. The real interest rate (the nominal rate less changes in export prices) was negative in all the regions except Europe; however, the real rate varied substantially across regions, reflecting large differences in both nominal interest rates and changes in export prices among the regions. The variations in the real interest rate by income group were relatively small.

These macroeconomic developments obviously raise several questions of interest to policymakers. Are there well-defined causal relationships among these developments? What factors can account for different growth patterns experienced by different groups? What can be said about the process of accumulating physical capital and external debt? What role does human capital play in economic growth? Answers to these questions

are by no means simple, but certainly an attempt to answer any of them would require a coherent analytical framework, which is explored in the next section.

III. The Model

1. The basic neoclassical growth model

Neoclassical growth theory attaches considerable importance to domestic savings and exports in explaining the process of capital accumulation. Typically, a higher capital intensity is associated with a higher rate of domestic savings. Higher domestic savings can be achieved, for example, by strengthening the government's financial position and mobilizing the private sector's financial resources. 1/ The importance of the export performance has also been highlighted in the literature for several reasons. First, the export sector serves as a vehicle for technology transfer through the importation of capital goods, as elucidated by Bardhan and Lewis (1970), Chen (1979), and Khang (1987), among others. Second, by raising the capacity to service external debt and thus by improving creditworthiness, the expansion of the export sector induces higher flows of foreign credits that make an even higher rate of investment obtainable. Also, the transfer of efficient foreign technologies and the availability of foreign exchange have featured prominently in recent experiences of economic development. Third, countries with superior export performance generally show superior growth performance, as documented by Balassa (1978), Krueger (1978), and Bhagwati and Srinivasan (1979). Being open-economy extensions of the basic Solow-Swan growth model (Solow (1956) and Swan (1956)), however, the contributions cited above yield the basic neoclassical result that, in the long run, per capita income will grow at an exogenously determined rate of labor-augmenting technical progress.

a. With exogenous technical change

Most neoclassical growth models assume that labor-augmenting technical change is exogenously determined. To illustrate the workings of such models, consider Panel A, Figure 1. The vertical and horizontal axes measure, respectively, the growth rates of capital and labor (in efficiency units), and the capital-labor ratio. The relationship between the rate of capital accumulation and the capital-labor ratio (the KK curve) is downward-sloping because of diminishing marginal productivity of capital.

1/ See McKinnon (1973) for the Korean experience and Kopits (1987) for the Turkish experience in mobilizing domestic public and private savings.

Labor growth (the NN curve) is horizontal at g_0^* for all levels of the capital-labor ratio because, by assumption, it is independent of this ratio, i.e., no resources are devoted to improving the quality of the labor force. Assume that the initial equilibrium is at point A(k_0^*, g_0^*). 1/

Now suppose that the domestic saving rate rises for some reason. The higher savings rate shifts the KK curve upward to K'K', and the new equilibrium is established at point C(k_1^*, g_0^*), characterized by a higher capital-labor ratio but an unchanged growth rate of output. The dynamics of adjustment in this ratio is traced by the arrows from A to B to C. The growth rate of the capital stock (the warranted rate) initially jumps to B, exceeding that of the labor force by an amount equal to AB. This rise in the growth of the capital stock is only temporary and cannot be sustained over time, because the labor input ultimately becomes a bottleneck in the production process. As the capital-labor ratio rises, the marginal productivity of capital declines, and firms will slow the rate of investment until the growth of the capital stock is brought down to the constant rate of growth of the labor force (the natural rate) at point C. The dynamic adjustment of the natural rate is traced by the movement from A to C. Thus, in the long run, the rise in the saving rate raises capital intensity but leaves the growth rate of per capita output unaffected, the latter being fixed by the exogenous rate of labor-augmenting technical change.

b. With endogenous technical change

In the real world, technological progress can be capital- and labor-augmenting. The latter typically requires resources to be channeled into education, training, and health services. The labor input, in efficiency units, can grow as the amount of resources spent on human resource development increases. The improvement of human capital, particularly through education, was highlighted in the 1960s by Denison (1962), Lewis (1962), and Schultz (1962), among others. Conlisk (1967) formally integrated the endogenous development of human resources by making the rate of labor-augmenting technical change depend on per capita income.

The workings of the modified model are illustrated in Panel B, Figure 1. As before, the KK curve slopes downward. But now the NN curve, instead of a horizontal line, is drawn as an increasing function of the capital-labor ratio, reflecting the fact that society devotes a positive fraction of its per capita income to improving the quality of labor. The

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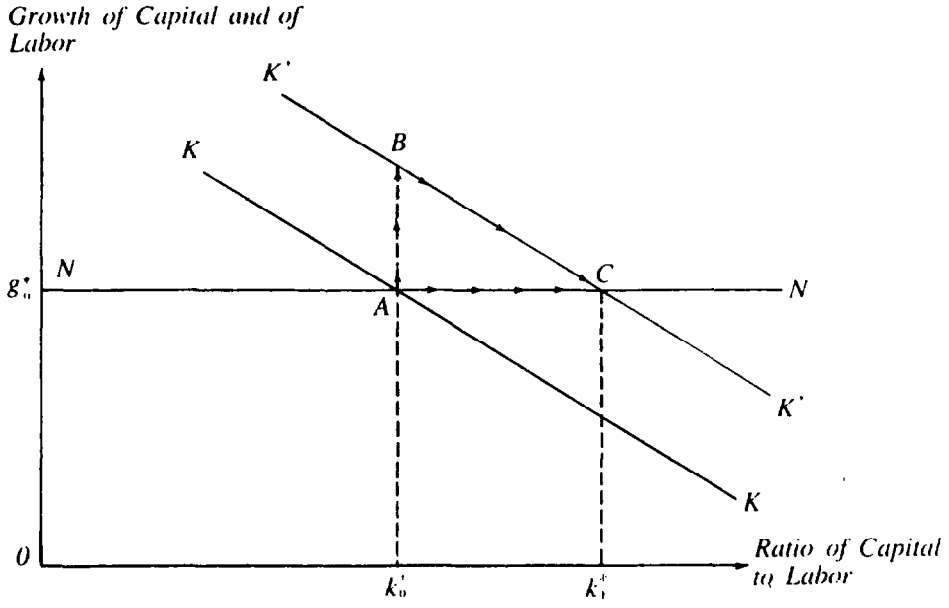
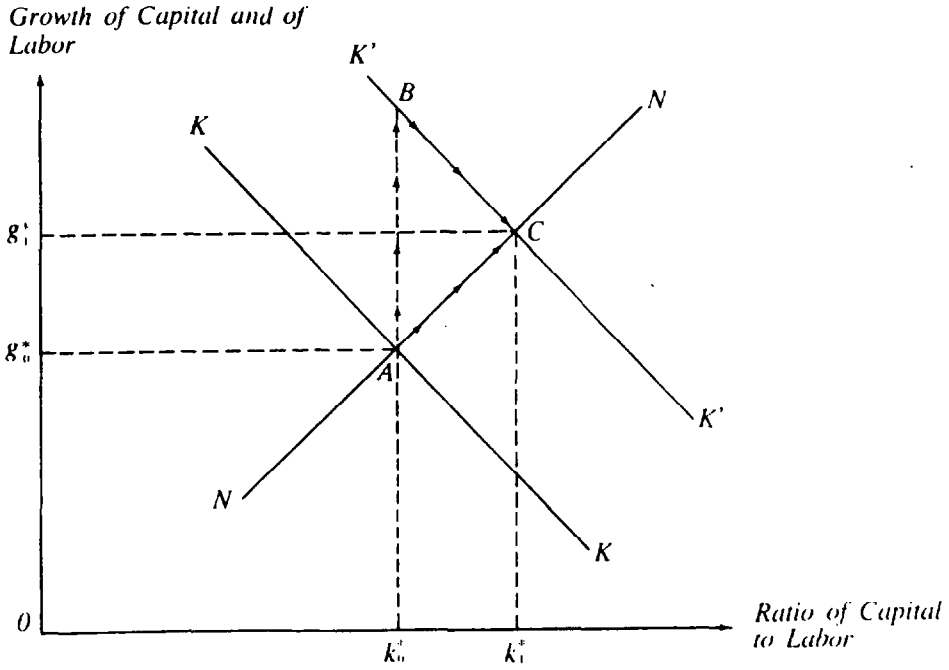
1/ Typically, $g_0^* = n + \lambda$, where n is the rate of population growth and λ is the exogenous rate of labor-augmenting technical progress.

Figure 1. The Neoclassical Growth Model

Panel A: Exogenous Technical Change



Panel B: Endogenous Technical Change



proportion itself may be an increasing function of the ratio of capital to labor, on the reasonable assumption that as labor's productivity increases with a rise in capital intensity, the economy will devote a larger share of output to augment the effective labor force. As before, the rise in the domestic saving rate shifts the KK curve upward, intersecting the NN curve at point C. But, unlike before, the new equilibrium is characterized by a higher growth rate of output (with the growth rate increasing from g_0^* to g_1^*).

The dynamic adjustment of the warranted rate is traced by the movement from A to C through B. As before, the higher saving rate will initially result in a higher capital-labor ratio, but the natural rate rises instead of remaining constant as in the standard model described in the preceding subsection. The dynamic adjustment of the natural rate is traced by the movement from A to C. An increase in the natural rate is the consequence of two factors. First, when the domestic saving rate is raised, the resulting increase in the rate of investment and, hence, in the level of capital intensity, will lead to an increase in per capita output. Given that a portion of this increase in per capita output is devoted to the development of human resources, the rate of growth of the effective labor force increases. Second, an improvement in labor productivity, induced by a higher capital-labor ratio, provides an incentive to raise the share of resources spent on human capital. When the growth of the capital stock falls following an increase in the capital-labor ratio, the growth of the labor input rises. After adjustments are completed, the warranted and natural rates converge to a point such as C. Therefore, in the model with endogenous technical change, both the capital intensity and the long-run growth of per capita output increase when the domestic saving rate is raised.

The present paper endogenizes the long-run growth rate of per capita income by assuming that the rate of labor-augmenting technical change depends on expenditures on human capital. As the growth rate rises, financial resources necessary for such expenditures would become more readily available, reflecting increases in per capita income and the tax base. In time, the contribution of the private corporate sector also increases as it sets up its own vocational training programs. 1/

2. Model specification

The model economy consists of four sectors: corporate, household, government, and banking sectors. In broad terms, production of a composite non-capital good is carried out by the corporate sector, utilizing

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1/ For example, in many newly industrialized countries such as Korea and Singapore, some large firms began to establish their own training institutions to train their employees as the general level of income rose.

an imported capital good and labor. 1/ State enterprises are included in this sector. Receipts from the sale of output are used to pay wages to the household sector in exchange for labor services and rents to the corporate sector for capital services; in addition, part of output is used to service external debt. The corporate sector also pays income taxes and transfers dividends to the government, and saves the remaining resources for investment purposes. Since investment requirements are typically larger than corporate savings, this sector relies heavily on domestic bank loans and foreign borrowing to finance imports of capital goods.

The household sector uses part of its income to pay taxes to the government, buys goods and services, and saves the remainder. Unlike the government and corporate sectors whose entire savings are invested in physical capital, the household sector holds its savings in the form of domestic money balances as it is assumed to have no direct access to the international financial market. 2/

The government sector collects taxes from the corporate and household sectors, and receives dividends from state enterprises and other nontax revenues. After servicing its external obligations, the government allocates part of the remaining resources to expenditures on human capital, such as education and health services, and other current expenditures, and saves the remaining portion. Government savings, supplemented by borrowing from the domestic banking system and from sources abroad, are utilized to build infrastructure, which is used by the corporate sector in the production process. As payment for such use, taxes and dividends are remitted by the corporate sector.

The banking sector plays an intermediary role between the household and foreign sectors on the one hand, and the government and the corporate sectors, on the other. Banks receive deposits from the household sector and borrow from abroad, and advance these funds to the government and corporate sectors for the importation of capital goods.

A more formal presentation of the above-mentioned economy is as follows. The economy produces a composite non-capital good (Q), utilizing

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1/ This is a simplification of the reality that most developing countries need to import capital goods as their availability in the domestic economy is extremely limited.

2/ It is also assumed that there are no domestic bond markets, although the presence of an unofficial money market may be allowed. This issue is picked up later in the paper.

an imported capital good (K) and labor (N). Foreign technology is embodied in K. 1/ The economy produces output according to a neoclassical production function (F) with the usual properties, i.e., the function is linearly homogeneous and twice continuously differentiable, with positive but diminishing marginal products:

$$(1) \quad Q = F(K, N) \qquad F_K, F_N > 0; \; F_{KK}, F_{NN} < 0.$$

In the labor market, the demand for labor is assumed to be always met by the supply at a given level of real wages. Nominal wage adjustments are institutionally determined, and real wages are assumed to be equal to the marginal product of labor. Similarly, real returns on capital are assumed to be determined according to the marginal product of capital. These flexible real returns on capital and real wages clear the commodity and labor markets. 2/

The purchase of K is financed by domestic savings and foreign borrowings. Thus, real national income or real GNP (Y) is equal to output (Q) less the real value of interest payments on external debt (reD^{f*}/P):

$$(2) \quad Y = Q - reD^{f*}/P$$

where r is the average cost of net foreign credits (weighted by the various components of D^{f*}); e is the exchange rate expressed in local currency per unit of foreign currency; and D^{f*} is the stock of net external liabilities (external debt minus claims on foreigners, including official international reserves), expressed in foreign currency.

1/ The feasibility of defining an aggregate capital stock even though capital goods are heterogeneous according to their vintages has been shown by Fisher (1965) for twice differentiable production functions that are subject to constant returns to scale. Part of K is imported by the private sector and the remainder by the government, as discussed above.

2/ These assumptions imply that variations in the price (P) of domestic output reflect the difference between nominal wage adjustments and changes in the marginal productivity of labor. The assumption of continuous market clearing assumes away short-term problems of relative price dynamics; however, our interest is on the time path of the economy, the endogeneity of real output, and the long-term macroeconomic effects of government policies.

The increase in K is equal to gross investment (I) less depreciation, which is assumed to be a proportion (δ) of the capital stock (K).

$$(3) \quad dK/dt = I - \delta K$$

where d/dt is a differential operator with respect to time. Gross investment (I) in real terms is financed by the real values of corporate savings $[(P/eP^*)S_c]$, government savings $[(P/eP^*)S_g]$, flows of domestic bank credit $[(P/eP^*)(dD/dt)/P)]$, foreign borrowing by the corporate sector $[(dD^{fc*}/dt)/P^*]$, and foreign borrowing by the government sector $[(dD^{fg*}/dt)/P^*]$.

$$(4) \quad I = (P/eP^*)[S_c + S_g + (dD/dt)/P] + (dD^{fc*}/dt)/P^* + (dD^{fg*}/dt)/P^*,$$

where P^* is the exogenously given price of the investment good in foreign currency, S_c and S_g are corporate and government savings, respectively, measured in real terms, D is the nominal stock of domestic bank loans, and D^{fc*} and D^{fg*} are foreign currency-denominated stocks of outstanding external debt owed by the corporate and government sectors, respectively.

Assuming that capital is paid its marginal product, and that a constant fraction of corporate disposable income is saved, the saving behavior of the corporate sector is given by:

$$(5) \quad Sc = s_c[(1 - \tau_c - tr)\Pi_k Q - (reD^{fc*}/P)]$$

where s_c is the corporate saving rate; τ_c the corporate income tax rate; tr the rate of corporate transfers to the government from the state-owned enterprises; Π_k the corporate sector's share in total gross income (output); and eD^{fc*}/P the real value of corporate external debt.

Labor (household) receives income equal to its marginal product, pays income tax to the government, saves a fraction of disposable income in the form of money balances, and has no external debt. Thus, household saving (S_n) behavior is expressed by:

$$(6) \quad S_n = (dM/dt)/P = s_n(1 - \tau_n)\Pi_n Q$$

where $(dM/dt)/P$ is monetary savings in real terms; s_n the household savings ratio; τ_n the personal income tax rate; and Π_n (= $1 - \Pi_k$) the labor share in total gross income. In this economy, it is assumed that the household sector holds its savings exclusively in the form of bank deposits. 1/ The corporate sector is assumed to invest all of its savings

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1/ Direct claims on firms by lending to the unofficial money market (UMM) may be allowed; see van Wijnbergen (1983).

in physical capital, since its marginal product is assumed to be greater than the real deposit interest rate, as often is the case in developing countries. Consequently, the corporate sector does not have deposits and has to borrow from the domestic banking system and/or abroad.

The simplified portfolio behavior described above is an attempt to capture the notion that a crucial element in the growth process is the ability of the government to divert the savings of wage earners away from current consumption toward money balances, which are, in turn, used by the banking system to make advances to the government and corporate sectors for the importation of the capital good. A flexible interest rate policy is an essential instrument to accomplish this important task. 1/

The level of government resources available for the purchase of capital goods 2/ is defined as the gap between total revenue from both tax and non-tax sources and expenditures on servicing external debt, on human capital, and on other current spending.

$$(7) \quad S_g = (1 - c_g - h_g)\{[(\tau_c + tr)\Pi_k + \tau_n\Pi_n + ntx]Q - (reD^{fg*}/P)\}$$

where c_g and h_g are the budgetary shares of consumption expenditure and of spending on human capital, respectively; 3/ ntx is the sum of non-income tax and all nontax revenues as a proportion of gross output, and eD^{fg*}/P is the real value of government external debt.

Changes in aggregate real bank credit are equal to changes in the real money stock and in the real value of net foreign liabilities of the banking system.

1/ When UMM assets are allowed, the effect of an increase in the deposit interest rates on the availability of funds to finance investment [equation (4)] would depend on the degree of substitutability among currency, deposits, and UMM assets in the portfolio of the household sector.

2/ Excluding schools, health facilities and other infrastructure that improve the productivity of labor, which are included in expenditures on human capital.

3/ These budgetary shares may be allowed to vary with changes in the capital-labor ratio. For instance, the share of expenditures on human capital may increase with the marginal productivity of labor, which is a positive function of the capital-labor ratio. Such endogenous responses would serve to reinforce the stability of the model, without affecting its main conclusions.

$$(8) \quad (dD/dt)/P = (dM/dt)/P + e(dD^{fb*}/dt)/P$$

The above equation restates the balance sheet identity between assets and liabilities of the banking system in flow terms. 1/

Changes in the availability of foreign capital to the domestic bank and nonbank sectors are assumed to depend on the marginal productivity of capital $(P/eP^*)(F_K)$, net of depreciation (δ), and the marginal cost of funds (r) in the international capital market. This relationship can be expressed as follows:

$$(9) \quad [d(D^{f*}/P^*K)/dt]/(D^{f*}/P^*K) = (P/eP^*)F_K - \delta - r$$

The marginal cost of capital is equal to the world interest rate (r^*) plus a risk premium (ϕ), which is assumed to be a positive function of the debt-export ratio. The use of exports in lieu of GNP may be appropriate in an economy whose currency is not convertible; it is exports that ultimately determine the capacity to repay external obligations.

$$(10) \quad r = r^* + \phi(eD^{f*}/PX)$$

The labor input in the production function is measured in efficiency units, and is defined as a product of the working population (L) and a productivity or skill-augmentation factor (T).

$$(11) \quad N = TL$$

L is assumed to grow at an exogenous rate of n.

$$(12) \quad dL/dt = nL$$

1/ Note that we define this identity in terms of domestic assets and domestic and foreign liabilities. Consequently, the identity differs from the customary one in which domestic liabilities equal net domestic credit and net foreign assets.

Increases in T depend on expenditures on human capital as well as other factors. For the time being, such expenditures are represented by the proportion of per capita government revenue spent on education. 1/

$$(13) \quad dT/dt = h_g[(\tau_c + tr)\Pi_k + \tau_n \Pi n + ntx]Q/L + \lambda T.$$

As in the models reviewed in subsection (b) above, the development of human capital plays a key role in the growth model of this paper. As already mentioned the variable input N is measured in "quality-corrected" or "technical change-augmented" units. The growth of N is derived by differentiating equation (11) with respect to time and substituting into the resulting differential equation the relationships (12) and (13):

$$dN/dt = \mu_1 Q + \mu_2 N$$

where

$$\mu_1 = h_g[(\tau_c + tr)\Pi_k + \tau_p \Pi_n + ntx]$$

$$\mu_2 = n + \lambda$$

The term $\mu_1 Q$ may be interpreted as an endogenous growth component, since it makes dN/dt depend on output Q. The term $\mu_2 N$ may be interpreted as an exogenous growth component, since it does not depend on Q. If $\mu_1 = 0$ (i.e., no resources are devoted to improving labor skills and providing health services), then $(dN/dt)/N = \mu_2$ (i.e., N would grow exogenously at constant rate μ_2). The general expression used in the model of this paper allows for both an endogenous and an exogenous growth component in dN/dt. The endogenous growth component captures any endogenous labor-augmenting technical change, while the exogenous growth component captures any exogenous technical change (λ) and exogenous population growth (n).

The remaining equations are definitions.

1/ Total public and private spending on education is the appropriate variable. However, in most developing countries, the government sector bears the major responsibility for educational expenditures, particularly at the primary and secondary levels.

(14) $k = K/N$

(15) $q = Q/N$

(16) $y = Y/N$

(17) $d^f = D^{f*}/P^*K$

(18) $D^{fg*} = \alpha(1 - \beta)D^{f*}$

(19) $D^{fb*} = \beta D^{f*}$

(20) $D^{fc*} = (1 - \alpha)(1 - \beta)D^{f*}$

Equations (14)-(16) express the real stock of capital, output, and income in relation to the effective labor input, while equation (17) defines the ratio of external debt to the stock of capital. Equations (18)-(20) are expressions for simple rules that the government follows in managing external debt; it fixes certain proportions of total net external debt (D^{f*}) held by itself (D^{fg*}), the banking sector (D^{fb*}), and the corporate sector (D^{fc*}). β is the share of bank debt in the total, and α is the share of government debt in nonbank debt.

Since the focus of the paper is on economic growth, no attempt is made to model the inflationary process. The price of domestic output adjusts to achieve equality between the marginal products of capital and labor and their respective factor prices in real terms. This by no means implies that inflation is unimportant nor that it is unaffected by real and monetary developments. The introduction of inflation, and in particular inflationary expectations, would greatly complicate growth models of the type studied in this paper, but nevertheless should be incorporated in a larger and more realistic model. 1/

3. Reduced model, equilibrium, and stability

The model comprises 20 equations in 20 endogenous variables and time. 2/ Appendix I shows that this system can be reduced to two differential equations in the capital-labor ratio, k, and the real external debt-capital ratio, d^f.

1/ For such a model with exogenous technical change and no imported capital goods, see van Wijnbergen (1983).

2/ In this model, exports (X) are assumed equal to aggregate domestic savings (S). Allowing for only a fraction, b, of imports (Z) in investment goods (I), $I = bZ$, the relationship becomes $X = S+[(1-b)/b]I$. The major conclusions of the paper are unaffected by this modification.

$$(21)\quad (dk/dt)/k = [(P/eP^*)s_1(f(k)/k) - s_2 red^f]/(1 - d^f) + [d^f/(1 - d^f)][(P/eP^*)f'(k) - \delta - r] - h_g s_3 f(k) - \delta/(1 - d^f) - (n + \lambda) = U(k, d^f)$$

$$(22)\quad (dd^f/dt)/d^f = (P/eP^*)f'(k) - \delta - r = V(k, d^f)$$

where:

$$s_1 = [s_c(1 - \tau_c - tr) + (1 - c_g - h_g)(\tau_c + tr)]\Pi_k + [s_n(1 - \tau_n) + (1 - c_g - h_g)\tau_n]\Pi_n + (1 - c_g - h_g)ntx$$

$$s_2 = [(1 - c_g - h_g)\alpha + s_c(1 - \alpha)](1 - \beta)$$

$$s_3 = (\tau_c + tr)\Pi_k + \tau_n\Pi_n + ntx$$

$$r = r^* + \phi[d^f/(X/K)(P/eP^*)]$$

Appendix I also shows that, under certain reasonable assumptions about the size and sign of some parameters, this reduced model possesses an equilibrium solution which is unique and globally stable. The phase diagram representing equations (21) - (22) is illustrated in Panel A, Figure 2.

The UU curve gives combinations of k and d^f such that the rate of increase in the capital stock (warranted rate of growth, denoted by g_w) is equal to the rate of increase in the effective labor force (natural rate of growth, denoted by g_n). Thus, along this curve the capital-labor ratio remains unchanged, i.e., $\dot{k} = 0$. The VV curve traces combinations of k and d^f such that the ratio of external debt to capital stock remains unchanged, i.e., $\dot{d}^f = 0$. As a result, the proportionate growth of real external debt, (denoted by $\tilde{D}^f$,) is equal to the warranted rate of growth. Points along the VV curve include loci of sustainable external debt ratios. 1/

1/ Such that the marginal product of capital, net of depreciation, is just equal to the cost of capital.

The UU curve is drawn steeper than the VV curve because, for a given increase in k, a larger decline in the external debt-capital ratio is required to bring the warranted rate in line with the natural rate of growth, i.e., for $\dot{k} = 0$, compared with the requirement of a stationary external debt-capital ratio, i.e., for $\dot{d}^f = 0$. Intuitively, the reasons are the following. An increase in k reduces both the rate of domestic investment and the rate of foreign borrowing owing to diminishing returns of "owned" and "borrowed" capital, as well as to the induced rise in the cost of capital associated with a higher risk premium that is, in turn, brought about by a decline in the output-capital ratio.

As the warranted growth rate of capital falls, however, the natural rate of growth rises because of a higher rate of labor-augmentation induced by the increase in labor's average productivity. Therefore, if the economy is to remain on the UU curve, it is necessary for the warranted rate to increase to the level of the natural rate. For this to occur, the external debt-capital ratio must decline substantially to: (i) restore and raise the level of disposable income and, hence, domestic savings, and (ii) restore and raise the level of foreign borrowing through a reduction in the risk premium and, hence, in the cost of capital. For the ratio of external debt to capital to remain stationary at the new lower level, it is sufficient that the cost of capital be brought down to the lower marginal product of capital associated with a higher capital intensity. This requires a smaller decline in the external debt-capital ratio (effect (ii) above). An intersection of these two curves, such as at point E, means that the economy is in the steady state or in long-run equilibrium, i.e., $dk/dt = 0$ and $d(d^f)/dt = 0$, with $k = k^*$ and $d^f = d^{f*}$. With a given d^{f*}, the warranted rate of growth schedule is positioned as the $KK(d^{f*})$ curve in Panel B, Figure 2. This curve intersects the natural rate of growth schedule (the NN curve) at point B (k^*, g^*). Thus, at B, $\tilde{D}^f = g_n = g_w = \tilde{Q} = \tilde{Y} = \tilde{X}$. Real external debt grows at the same rate as effective labor, capital, output, income, and exports. The capital-labor ratio, the interest payments ratio and the real stock of debt per unit of capital are all constant. The equilibrium values of the capital-labor ratio, the ratio of real external debt to the capital stock, and the growth rate of income are denoted by k^*, d^{f*}, and $[(dY/dt)/Y] = g^*$, respectively. 1/

Given the conditions imposed on the production function and reasonable economic assumptions about the sizes and signs of some partial derivatives (see Appendix I), a unique intersection point at $E(k^*, d^{f*}) > (0,0)$ is established. The next question is the stability of this equilibrium. To

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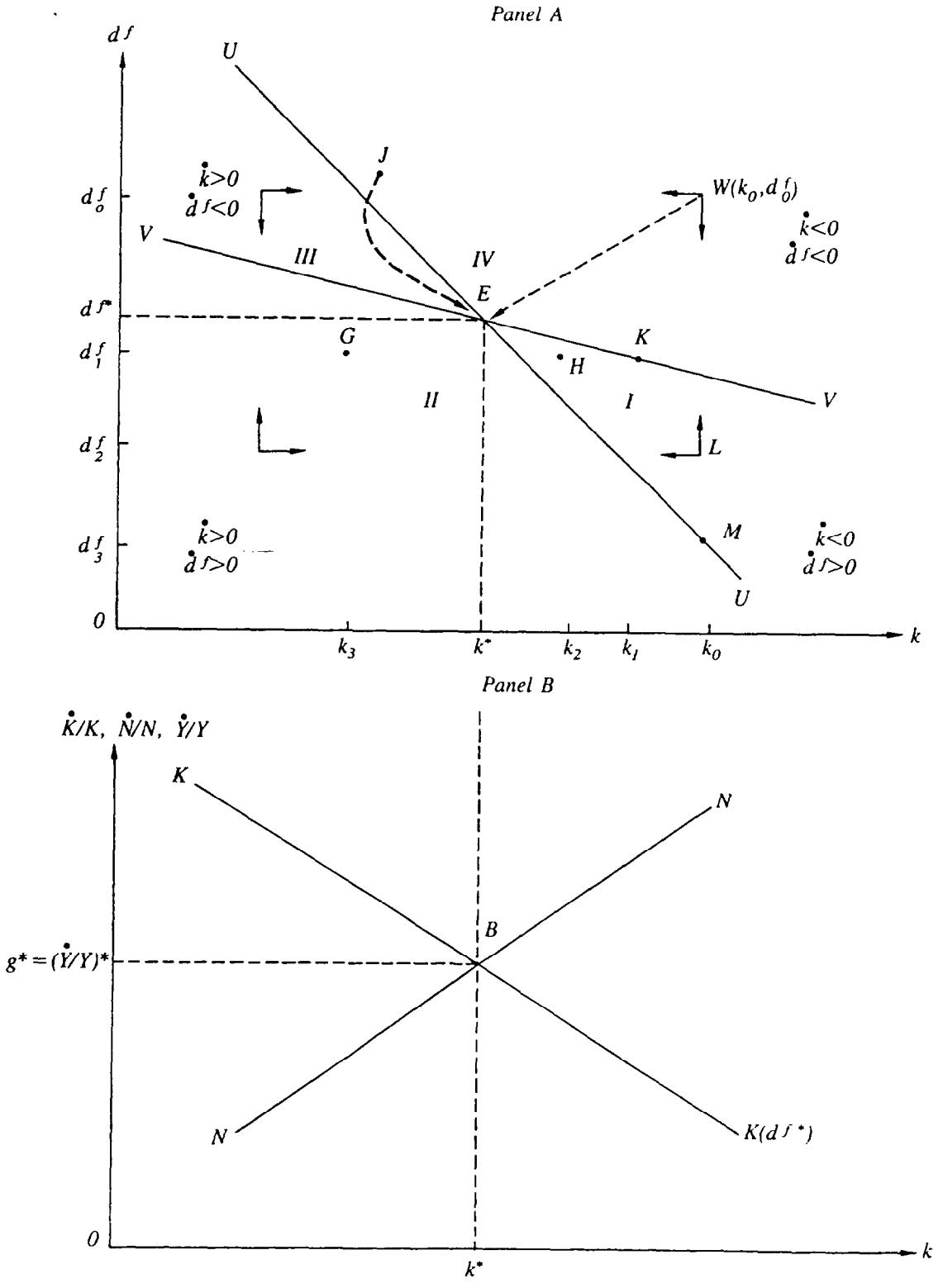
1/ See Appendix I for the equations determining the rate of growth of income.

Figure 2. Long-run equilibrium



help understand the stability issue, the disequilibrium regions I, II, III, IV shown in Panel A, Figure 2, may be given the following economic interpretation.

At any point below the VV curve (i.e., in regions I and II), d(df)/dt takes on a positive value, indicating that the ratio of external debt to capital stock tends to increase over time. To see this, consider point K (k_1, d_1^f) on the VV curve, so that the ratio of external debt to capital remains unchanged. Next, consider point H located in region I or point G located in region II. At either point, the value of k is lower than at point K ($k_3 < k_2 < k_1$) for the same value of d^f ($= d_1^f$), with the result that the marginal product of capital is higher. At the same time the ratio of output to capital and thus the ratio of export to capital is higher, reducing the ratio of external debt to exports and hence the risk premium. Both the higher marginal product of capital and the lower cost of external borrowing lead to an increase in external borrowing per unit of capital (i.e., $\dot{d}^f > 0$). The mechanism works in the opposite direction at any point above the VV curve (i.e., in regions III and IV).

At any point above the UU curve (i.e., in regions I and IV), dk/dt takes on a negative value. In order to verify this, consider point M (k_o, d_3^f) on the UU curve. Now take either point L located in region I or point W located in region IV. At either point L or W, the value of d^f is higher than at point M ($d_o^f > d_2^f > d_3^f$) for the same value of k ($= k_o$). The higher ratio of external debt to capital will increase the risk premium, raising the cost of external borrowing. This in turn increases the interest payments on the external debt of the corporate and government sectors, leading to a decline in disposable income and thus in domestic savings. Both the increase in the cost of external borrowing and the decline in domestic savings result in a lower rate of capital formation, thus reducing the capital labor ratio (i.e., $dk/dt < 0$). The opposite is true at any point below the UU curve (i.e., in regions II and III).

Given the dynamics discussed above, the arrows can be positioned as shown in the phase diagram in Panel A, Figure 2. Starting from any point off E, the dynamics of the model is such that k and d^f would tend to move to E(k^*, d^{f*}). Therefore, the point E is globally stable. 1/

To have a clearer idea of the dynamics of adjustment, consider the point W(k_o,d_o^f) as the initial position of the economy. At W, $k_o > k^*$ and $d_o^f > d^{f*}$. The external debt-capital ratio and thus the risk premium are higher than their respective equilibrium values. Consequently, the

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1/ For a formal proof, see Appendix I.

interest burden on debt is excessive, resulting in lower levels of national income and hence of domestic savings to finance investments; moreover, foreign borrowing per unit of capital is discouraged by the high risk premium associated with an unsustainable debt/export ratio. 1/ The warranted rate falls short of the natural rate of growth. Therefore, the rates of change in k and in d^f turn negative; both k and d^f decline towards k* and d^{f*}, respectively.

The steady decline in k and d^f is an essential element of the adjustment process, easing the interest burden on debt, releasing some domestic resources for investment, and raising the marginal and average productivity of capital (thus lowering the risk premium). As these adjustment efforts bear fruit, the debt-export (or the debt-domestic saving) ratio moves downward. In this event, the risk premium will narrow, setting the stage for the resumption of foreign borrowing. The process of adjustment continues until the economy reaches equilibrium at E, where the debt-export ratio stabilizes at its sustainable equilibrium level, and participation in the international capital market returns to normal. The path W-E illustrates one such adjustment process in which the capital intensity and the ratio of external debt to capital steadily decline toward their equilibrium levels. Another possible adjustment path is traced by J-E, where the debt-capital ratio falls steadily toward its equilibrium value, while capital intensity initially declines and then rises to its steady state level.

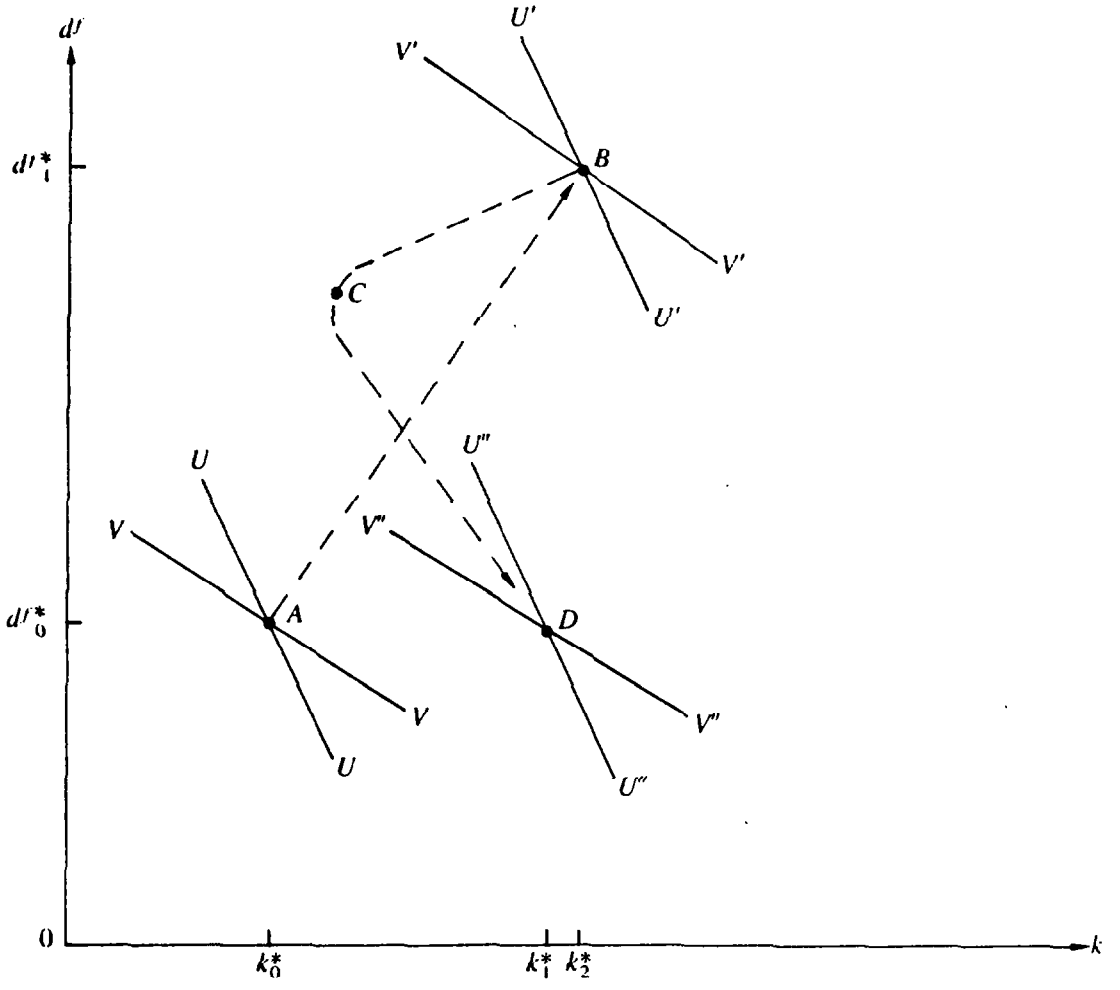
4. External debt dynamics

The dynamic aspects of external debt in the model are illustrated in Figure 3. Starting from an initial equilibrium point such as $A(k^*_0, d^{f*}_0)$, suppose that an exogenous technological development raises the marginal and average product of capital. This shifts both UU and VV curves upward to, say, U'U' and V'V', respectively. The new equilibrium is reached at point $B(k^*_2, d^{f*}_1)$, where the steady-state values of both capital-intensity and the ratio of external debt to capital are higher.

Relatively liberal external trading and financial systems are crucial for the economy to move from A to B. Under such a favorable environment, exports per unit of capital rise, the risk premium and, hence, the cost of capital decline. In response to the higher marginal product of capital and the lower cost of credit, external borrowing increases (i.e., $d(d^f)/dt>0$) and external debt grows. The debt-capital ratio rises from d^f_0* to d^f_1*. The capital-labor ratio goes up and economic growth is stimulated.

2/ It is possible that the debt-export ratio is so high that medium- and long-term lending, at least its commercial component, ceases altogether.

Figure 3. External debt dynamics



Now, suppose that a subsequent financial market shock shifts the VV curve downward from V'V' to V"V". 1/ Moreover, the export markets are more difficult to penetrate. 2/ Because of these adverse external developments, the U'U' curve also shifts downward to U"U". The new equilibrium is established at point D(k_1^*, d_0^{f*}).

The dynamic response of the external debt-capital ratio from d_1^{f*} to d_0^{f*} may be described as follows. At point B, both the ratio of external debt to capital and the level of capital intensity are excessive and unsustainable in relation to the new equilibrium position. The high external debt ratio is reflected in a high risk premium and a correspondingly high cost of capital. Furthermore, the marginal product of capital at point B is lower than that at point D. The lower marginal product of capital and the higher cost of credit discourage external borrowing. The large interest burden on debt reduces the amount of domestic resources available for investment; together with declining foreign capital inflows, the growth of the capital stock falls short of that of labor. Consequently, both the external debt ratio and capital intensity tend to fall.

The decline in both d^f and k is an important part of the macroeconomic adjustment to the new equilibrium at point D. As the interest burden eases, domestic resources are released for investment purposes. Furthermore, the rate of decline of d^f slows as the marginal and average products of capital recover (and thus narrowing the risk premium) *pari passu* a fall in k. Since the cost of capital still exceeds its marginal product (net of depreciation), d^f continues to fall. Meanwhile, after a point, such as C, the capital-labor ratio stops declining and starts rising. The reasons are that the increasing share of output (net of debt service) 3/ allocated to capital accumulation and the incipient recovery in foreign borrowing stimulate investments. Capital intensity recovers and settles at a level (k_1^*) below the previous level (k_2^*).

The decline in capital intensity is an element in the process of rationalizing investments by the corporate and government sectors, with resulting efficiency gains. The steady decline in the ratio of external debt to capital is an integral part of adjustment to a sustainable debt-export or debt-capital ratio at d_0^{f*}. Economic growth slows, but this is to be expected as the economy adjusts to a permanent deterioration in the external environment.

1/ As happened, for example, following the debt crisis of 1982, aided by the decline in the terms of trade.

2/ Owing, for instance, to rising protectionism in the forms of quotas and tariffs and to slow growth in industrial countries.

3/ Owing to decreases in interest payments on external debt arising from the falling stock of debt and its cost.

5. Comparative dynamics

Some "comparative dynamic" exercises may now be performed to analyze the sensitivity of the dynamic equilibrium point $E(k^*,d^{f*})$ to changes in domestic policies and in the external environment. Table 2 summarizes their effects on the long-run equilibrium values of the capital intensity, the external debt-capital ratio, and per capita real economic growth.

a. Tax policies

The long-run effects of tax policies are taken up first. Revenue measures are captured by, inter alia, the tax parameters τ_c (corporate) and τ_n (personal). Expenditure policies are actions on the parameters c_g (share of consumption expenditures in the budget) and h_g (budgetary share of expenditures on the improvement of human capital). Measures to increase revenue will shift the UU curve upward to the right in Panel A of Figure 4 as they raise the savings rate and thus the investment rate. The VV curve also shifts upward as higher output and exports reduce the risk premium. The two curves intersect at point G (k^*_s,d^{f*}_s). The equilibrium level of capital intensity and the debt-capital ratio rise.

This result can be demonstrated by examining the relative magnitude of the shifts in the KK and the NN curves in Panel B. In Panel B, the warranted rate of growth first shifts upward to the right under the combined impact of higher domestic savings and an increase in the rate of foreign borrowing, then shifts back down somewhat due to a higher level of interest payments associated with a higher stock of real external debt. The natural rate of growth shifts upward to the left as increased tax revenues can now support a higher rate of labor augmentation. The warranted rate intersects the natural rate of growth at point $H(k^*_s,g^*_s)$--at a higher equilibrium growth rate of output, exports, and income. In Panel A, the new VV curve will intersect the new UU curve at point G, which is associated with a higher debt-capital ratio and a higher capital intensity, making the new equilibrium stable. 1/

The positive effects of income tax increases on long-run equilibrium economic growth depend on certain conditions. For example, as shown in Appendix I, in the cases of τ_c and τ_n, these conditions are:

$(B/k)(1 - c_g - h_g - s_c) - h_g \geq 0$, and $(B/k)(1 - c_g - h_g - s_n) - h_g \geq 0$, respectively, for $k > 0$, where $B = P/(1 - d^f)eP^*$.

1/ If the new UU and VV curves intersect each other at a point associated with a lower debt-capital ratio and a higher capital intensity, the system is unstable as a lower debt-capital ratio will decrease the risk premium, raise disposable income and domestic savings, which in turn will shift the UU curve further and further to the right.

Table 2. Effects of Structural Parameters on Capital Intensity, Ratio of External Debt to Capital, and Per Capita Output Growth in Steady-State

	k^*	d^{f*}	g^*-n
τ_c 1/	+	+	+
τ_c 2/	-	-	-
τ_n 3/	+	+	+
τ_n 4/	-	-	-
c_g	-	-	-
s_n	+	+	+
s_c	+	+	+
h_g	-	+	+
r	-	-	-
n	-	+	-
δ	-	-	-
λ	-	+	+

1/ If $(B/k)(1 - c_g - h_g - s_c) - h_g \geq 0$.
2/ If $|(B/k)(1 - c_g - h_g - s_c)| \geq 2 h_g$.
3/ If $(B/k)(1 - c_g - h_g - s_n) - h_g \geq 0$.
4/ If $|(B/k)(1 - c_g - h_g - s_n)| \geq 2 h_g$, where $B = P/(1-d^f)eP^*$.

If the first term on the left-hand side of these inequalities is negative, as may be the case in a number of countries, the conditions for the negative growth effects of tax measures are: $|(B/k)(1 - c_g - h_g - s_c)| \geq 2h_g$, and $|(B/k)(1 - c_g - h_g - s_n)| \geq 2h_g$. An economic interpretation of these conditions is straightforward. Ignoring the term (B/k), the first set of conditions states that, for income tax increases to promote economic growth, the saving rate of the government must exceed the sum of its rate of expenditures on human capital and the rate of saving of the private (corporate and household) sector. The second set of conditions states that, for income tax increases to depress economic growth, the dissaving rate of the government must be at least as large as twice its rate of expenditures on human capital plus the rate of private saving. Intuitively, these conditions are necessary because increases in income taxes reduce private disposable incomes, and hence savings of the private sector, and also because government expenditures on physical and human capital both benefit from increases in tax revenues. In certain countries where government current expenditures virtually exhaust total current revenue, these conditions also underscore the importance of combining tax reforms with a reduction in the budgetary share of consumption expenditures in order to improve the chances of achieving a higher rate of economic growth.

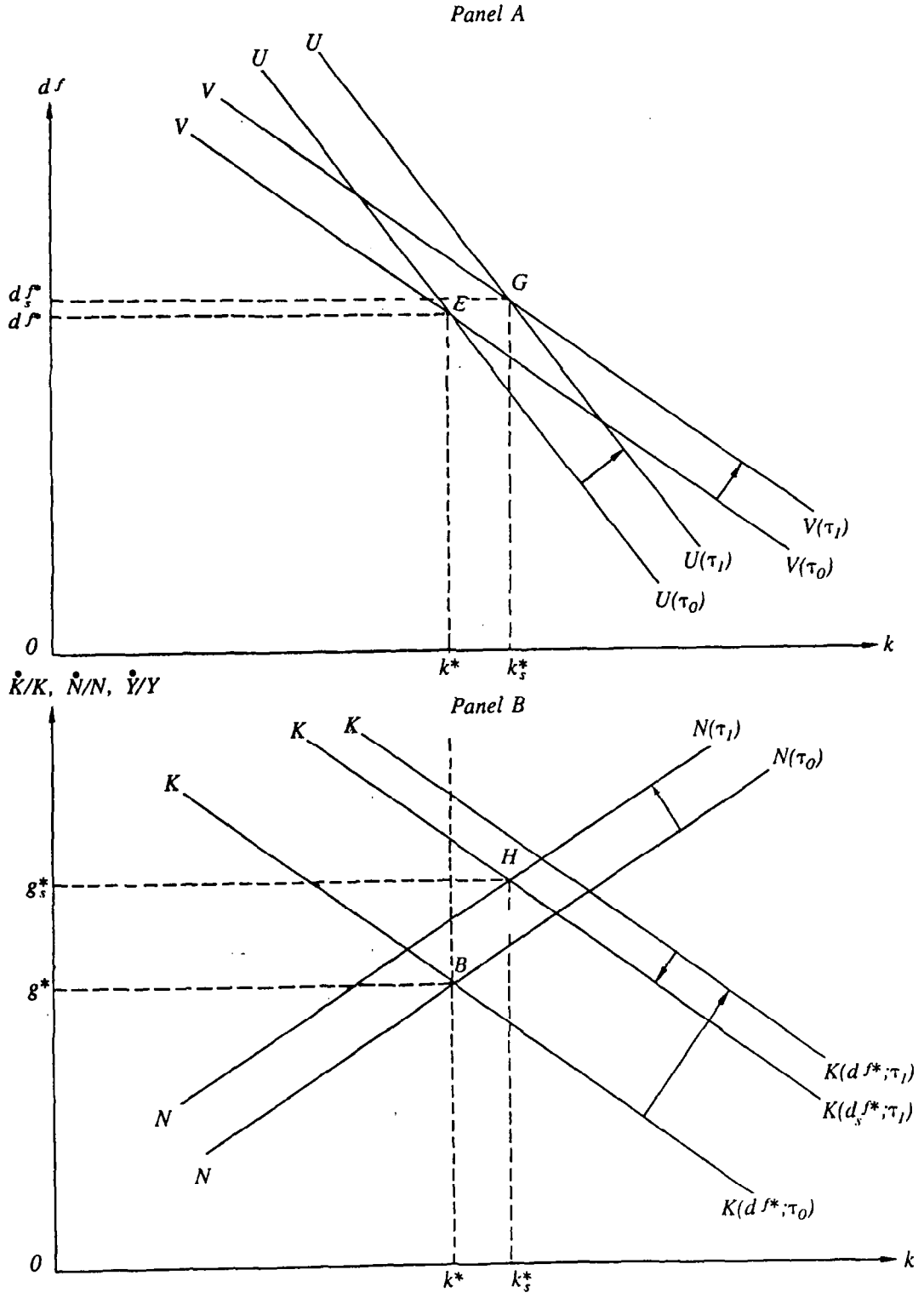
b. Consumption spending policies

The effects of an increase in government consumption expenditure are unambiguously negative on equilibrium capital intensity, debt per unit of capital, and the long-run growth of output and income. In panel A, Figure 4, both the UU and VV curves shift downward, resulting in a lower equilibrium level of capital intensity and a lower debt-capital ratio. The reduction in the rate of foreign borrowing is the result of a higher risk premium induced by a lower level of output and exports. In Panel B, the KK curve for the warranted rate of growth shifts downward to the left when c_g rises, then recovers somewhat when the equilibrium debt ratio falls, and finally intersects the stationary NN curve at an equilibrium point below and to the left of B, i.e., at a lower equilibrium growth rate of income corresponding to the lower capital-labor ratio.

c. Expenditures policies for human capital

An increase in the budgetary share of expenditures on human capital shifts the UU curve downward and leaves the VV curve unaffected. The equilibrium capital intensity declines and the equilibrium debt-capital ratio rises. In Panel B, the NN curve shifts upward. The KK curve shifts downward somewhat under the impact of larger interest payments associated with a higher debt-capital ratio. The two curves intersect at a point above and to the left of B, with a lower equilibrium capital intensity and a higher equilibrium growth rate of income. The latter is financed by a

Figure 4. Effects of income tax increases ($\tau_1 > \tau_0$)[1]



[1] *Assuming that* $(B/K)(1-c_g-h_g-s_i)-h_g \geq 0$ *for* $i=c,n$.

higher flow of foreign financing of capital formation owing to an increase in the marginal productivity of capital associated with the lower level of capital intensity, and by a higher level of domestic savings resulting from a higher output-capital ratio.

d. Financial sector reform

Successful financial sector reform, of which a flexible interest rate policy and a stable financial climate are integral elements, would be reflected in a higher proportion of household disposable income saved in bank accounts, i.e., in a higher s_n. The growth in the number of banks and their branches (monetization) also tends to raise s_n. The long-run effects on equilibrium capital intensity, debt-capital ratio and the growth rate of income are thus positive.

e. External policies and developments

External policies and developments are captured by an exogenous shift in the world demand for exports and the cost of borrowing from abroad (r), which is in turn determined by movements in the foreign interest rate (r*) and the parameters surrounding the risk assessment factor $\phi(.)$. An exogenous increase in the growth rate of export volume is analogous to an increase in the domestic saving rate and thus would raise the equilibrium levels of capital intensity, external debt-capital ratio, and the rate of economic growth. An increase in the foreign interest rate or in the risk assessment factor will have opposite effects.

f. Population growth

Finally, an increase in the population growth rate or in the exogenous rate of labor-augmenting technical change reduces the equilibrium capital intensity and raises both the debt-capital ratio and the equilibrium rate of economic growth. The rise in the debt ratio owes to an improvement in the marginal productivity of capital, which encourages external borrowing. However, the increase in output growth brought about by an increase in population growth will be less than unity because of the decline in equilibrium capital intensity. Thus, the equilibrium growth rate of per capita output falls. 1/

The above comparative dynamic results assume that the economy faces no restrictions on at least some of its exports. Many developing countries

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1/ The equilibrium growth rate of per capita output is $g^*-n = h_g s_3 f(k^*) + \bar{\lambda}$. The effect of an increase in population growth (n) on per capita output growth is $\partial(g^*-n)/\partial n = h_g s_3 (\partial f/\partial k^*)(\partial k^*/\partial n) < 0$ since h_g, s_3, and $\partial f/\partial k^*$ are all positive and $\partial k^*/\partial n$ is negative.

presently experience a variety of quantitative restrictions on their exports. When restrictions are imposed on all exports 1/, the warranted rate of growth schedule is positioned by the given export-capital ratio. Therefore, any changes in government consumption, household or in corporate saving rates will have no effect on the economy. An increase in the exogenously given growth rate of exports, however, will lead to a higher equilibrium level of capital intensity, external debt ratio, and per capita economic growth. The economic effects of changes in the other structural parameters are similar to those obtained above.

IV. Concluding Remarks

The objective of this paper has been the development of an aggregate growth model that is capable of assessing the impact of major macroeconomic policies on the long-term performance of a developing country. The reduced form derived from this model helped to identify some of the key contributing factors in long-term growth performance. These factors included the domestic savings and export performance, the rate of expenditures on human capital, the cost of capital and the rate of population growth. The analysis of the theoretical model suggests a number of implications that are relevant to the design of growth-oriented macroeconomic adjustment programs.

First, a sustained increase in exports is brought about by an equally strong expansion of aggregate domestic savings, and vice versa, and this is crucial to growth-oriented adjustment efforts. The mobilization of domestic savings over the years would greatly facilitate the achievement of growth potentials in many developing countries. Obviously, there are many ways to raise domestic savings. In countries where government current expenditures virtually exhaust total revenues, it is advisable to combine tax reforms aimed at raising the revenue-income ratio with measures to reduce the budgetary share of consumption expenditures. In other countries, financial deepening through an integration of unofficial money markets may be a key to allow households to hold their savings in financial assets.

Second, where trade restrictions are present, it is essential that they be eliminated, regardless of whether they are imposed by developing countries themselves or by their trading partners. The removal of trade restrictions would certainly help to enhance the effectiveness of domestic policies aimed at raising levels of aggregate domestic savings and exports

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1/ This is an unlikely situation since restrictions are generally placed on some types of exports of developing countries, e.g., textiles, rather than on all exports.

and improving the efficiency of resource allocation. How to expand the export sector would, of course, depend on the situation in which each country is placed; for example, in certain countries, adjustments may need to be made in the exchange rate and the trading systems, while in other countries, an improvement in monetary and fiscal incentive schemes may be required. These measures have to be complemented by market-opening policies in industrial countries and in the developing countries themselves.

Third, expenditures on human capital play a critical role in the development process. In an economy facing a secular decline in export earnings, such expenditures would become a particularly crucial element of the growth process, because they would increase labor productivity, reduce the capital-labor ratio, and raise the marginal product of capital. The higher marginal product of capital will permit a higher sustainable rate of foreign borrowing, which will increase the warranted rate of growth to a higher natural rate. The development of human capital is also essential when the external debt burden is already excessive. An improvement in the quality of labor would enhance the profit opportunities of the corporate sector, and raise domestic savings and exports. This would have a salutary effect of reducing the foreign borrowing requirement to the level dictated by the improvement in the marginal productivity of capital.

Fourth, the theoretical analysis suggests that flexibility in the real returns of capital and real wages is necessary for increased efficiency in the use of capital and labor. This means that integration of the unorganized money market into the official financial market should be pursued, and that domestic prices should be allowed to adjust to reflect changes in prices of imported capital goods and in the cost of capital.

Fifth, a general reduction in the world market interest rate or a reduction in the risk premium would naturally reduce the cost of external borrowing and help ease the burden of external debt. In this context, both the international community and the developing countries themselves have active roles to play.

While the theoretical analysis presented in this paper has contributed to a greater understanding of the growth process in developing countries and has led to important implications for the design of structural policies at the macroeconomic level, empirical work would be desirable in furthering the understanding of the issues involved. 1/ In addition, some extensions would be useful. First, an endogenous treatment of inflation and inflationary expectations in the analysis would shed much light on the inflationary problems that many developing countries are facing and on their implications for the appropriate growth strategy. While this would complicate the growth model, it would enable us to determine the inflationary impact of

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1/ Such work is currently being undertaken by the authors.

alternative domestic and external policies and developments. Second, the role of intermediate imports could be introduced formally in the production function, *a la Bardhan and Lewis* (1979). *This would allow a more* explicit consideration of the impact of import restrictions on the growth performance as well as on inflation. Extensions of these types are clearly necessary to fully understand the process of growth in developing countries and what policy actions can be undertaken by governments to raise growth rates in these countries.

APPENDIX I

Mathematical Derivations

Equations (1) - (20) in the text comprise a complete system in 20 unknowns and time, namely:

$$Q,Y,K,N,L,T,I,S_c,S_g,M,D,D^{f*},D^{fc*},D^{fg*},D^{fb*},\ q,y,k,d^f,r.$$

The relationship X = S, where X is real exports and S is real aggregate domestic saving (corporate, household, government) is implicit in the model because the excess of domestic investment over domestic saving is identical to the excess of imports over exports and, in the model, investment is equal to imports. The price of domestic output and capital's rental rate adjust to equate real factor prices to the relevant marginal products, which are functions of k.

Because of the assumption of linear homogeneity of the production function F, it can be written as:

(A1) $\quad q = f(k); \qquad f' > 0;\ f'' < 0$

where $F_K = f'$.

Differentiating equation (14) in the text with respect to time yields:

(A2) $\quad (dk/dt)/k = (dK/dt)/K - (dN/dt)/N.$

The equation for (dK/dt)/K is obtained by successive substitution into equation (3) of equations (4)-(10), (14), (17)-(20) in the text, and equation (A1). The equation for (dN/dt)/N is derived by differentiating equation (11) and substituting into it equations (12)-(13) in the text, using equation (A1).

Equilibrium

Partially differentiating equations (21) and (22) in the text with respect to k and d^f and evaluating in the neighborhood of the steady state yields:

(A3) $\quad U_k = Bs_1(kf' - f)/k^2 - (s_2 d^f r_k + Cd^f(f''(P/eP^*) - r_k) - e_g s_3 f' < 0,$

since $r_k > 0$, i.e., an increase in k will reduce X/K = S/K and thus raise the risk premium.

$$(A4) \qquad U_d f = Cd^f V_d^f - Cs_2(r + d^f r_d^f) - C^2\delta - s_2 r d^f C^2 + BCs_1 f/k < 0,$$

since $r_d^f > 0$, i.e., an increase in the debt-capital ratio raises the risk premium, and assuming, quite reasonably, that the sum (in absolute value) of the first four terms on the right-hand side of (A4) exceeds the last term. In economic terms, this means that a rise in the external debt-capital ratio will reduce the rate of capital accumulation because of diminishing returns to "borrowed" capital.

$$(A5) \qquad V_k = (P/eP^*)f'' - r_k < 0;$$

$$(A6) \qquad V_d f = - r_d^f < 0.$$

In the steady state,

$$(A7) \qquad dk/dt = U(k,d^f)k = 0; \text{ and}$$

$$(A8) \qquad d(d^f)/dt = V(k,d^f)d^f = 0.$$

The slope of the dk/dt=0 curve is equal to:

$$(A9) \qquad -U_k/U_d^f < 0,$$

and that of the $d(d^f/dt)=0$ curve is equal to:

$$(A10) \qquad -V_k/V_d^f < 0.$$

(A9) and (A10) are obtained by totally differentiating (A7) and (A8) with respect to k and evaluating the slope $d(d^f)/dk$ in the neighborhood of the steady state.

It is reasonable to assume that the absolute value of the (negative) effects of a rise in capital intensity on the rate of capital accumulation exceeds that on the rate of foreign borrowing, since the former includes

as well the reduction in domestic savings owing to a decline in the output-capital ratio. Thus, $|U_k| > |V_k|$. From (A9) and (A10), it remains to be shown that $|V_d f| > |U_d f|$ for the absolute value of (A9) to be greater than that of (A10). It is reasonable to assume that the absolute value of the (negative) effect of a rise in the debt-capital ratio on the rate of external borrowing is at least as great as that on the rate of investment, since the latter includes as well some positive level of domestic saving, which partly compensates for the negative impact on the rate of investment of a rise in the debt-capital ratio. Given these considerations, the slope of the $dk/dt = 0$ curve is drawn steeper than that of the $d(d^f/dt) = 0$ curve in Panel A, Figure 1 of the text. Thus, there is only one intersection between the two curves, which establishes a unique equilibrium point such as $E(k^*, d^{f*})$.

Stability

Let A be the matrix of partial derivatives defined by (A3)-(A6), with $a_{11} = U_k$, $a_{12} = U_d{}^f$, $a_{21} = V_k$, and $a_{22} = V_d{}^f$. A necessary and sufficient condition for global stability is that the eigenvalues of A have negative real parts, and a necessary and sufficient condition for this is that:

(i) $\quad tr(A) < 0$; and

(ii) $\quad det(A) > 0$.

The trace condition is met, and in view of the assumptions made in the preceding paragraph, the determinant condition is also satisfied.

Comparative dynamics

To determine the directional effects of an increase (decrease) in any structural parameter, $_p$, on the equilibrium capital-labor ratio, k^*, and the debt-capital ratio, d^{f*}, solve equations (A7) and (A8) for k^*_p and d^{f*}_p. Using Cramer's Rule,

$$k^*_p = - (a_{22}U_p - a_{12}V_p)/det(A); \text{ and}$$

$$d^{f*}_p = - (a_{11}V_p - a_{21}U_p)/det(A).$$

Once the signs of k^*_p and d^{f*}_p are determined, the effects on the equilibrium growth rate of capital, labor, output, and income can be obtained from the capital and labor growth equations:

$$[dK/dt)/K]^*_p = (\tilde{K}_k^*)k_p^* + (\tilde{K}_{df}^*)d_p^{f*} + \tilde{K}_p; \text{ and}$$

$$[dN/dt)/N]^*_p = (\tilde{N}_k^*)k_p^* + \tilde{N}_p,$$

where $\tilde{K} = (dK/dt)/K$ and $\tilde{N} = (dN/dt)/N$.

The conditions for increases in income taxes to raise capital intensity and the rate of economic growth are derived as follows:

$$k^*_{\tau_n} = [1/\det(A)](- a_{22}U_{\tau_n} - a_{12}V_{\tau_n})$$

$$d^{f*}_{\tau_n} = [1/\det(A)](- a_{11}V_{\tau_n} - a_{21}U_{\tau_n})$$

where:

$$U_{\tau_n} = f\Pi_n[(B/k)(1 - c_g - h_g - s_n) - h_g];$$

$$V_{\tau_n} = -r_{\tau_n} > 0.$$

For $k^*_{\tau_n} > 0$, it is necessary that $U_{\tau_n} \geq 0$. If $U_{\tau_n} \geq 0$, then $d^{f*}_{\tau_n} > 0$.

Similarly, for increases in τ_c:

where:

$$U_{\tau_c} = f\Pi_k[(B/k)(1 - c_g - h_g - s_c) - h_g]; \text{ and}$$

$$V_{\tau_c} = -r_{\tau_c} > 0.$$

Country Groups

By Region

Africa	Asia	Europe	Middle East	Western Hemisphere
Algeria	Burma	Cyprus	Egypt	Argentina
Ghana	Fiji	Greece	Israel	Barbados
Cote D' Ivoire	India	Malta	Jordan	Bolivia
Kenya	Indonesia	Portugal	Kuwait	Brazil
Liberia	Korea	Turkey	Saudi Arabia	Chile
Madagascar	Malaysia	Yugoslavia	Syrian Arab Republic	Colombia
Mautitius	Pakistan			Costa Rica
Morocco	Philippines			Ecuador
Nigeria	Singapore			El Salvador
Senagal	Solomon Islands			Guatemala
Tanzania	Sri Lanka			Honduras
Togo	Thailand			Jamaica
Tunisia				Mexico
				Nicaragua
				Peru
				Trinidad & Tobago
				Uruguay
				Venezuela

By Income Level

High Income Group	Middle Income Group	Low Income Group
Algeria	Bolivia	Burma
Argentina	Colombia	Egypt
Barbados	Ecuador	Honduras
Brazil	El Salvador	India
Chile	Ghana	Indonesia
Costa Rica	Guatemala	Kenya
Cyprus	Cote D'Ivoire	Liberia
Fiji	Jordan	Madagascar
Greece	Mauritius	Morocco
Israel	Nicaragua	Pakistan
Jamaica	Nigeria	Philippines
Korea	Peru	Senegal
Kuwait	Syrian Arab Republic	Solomon Islands
Malaysia	Tunisia	Sri Lanka
Malta	Turkey	Tanzania
Mexico		Thailand
Portugal		Togo
Saudi Arabia		
Singapore		
Trinidad & Tobago		
Uruguay		
Venezuela		
Yugoslavia		

APPENDIX II

Data Sources and Definitions of Variables

Data Sources:

A: International Monetary Fund: Data Fund; BOP FILE

B: International Monetary Fund: Data Fund; GFS FILE

C: International Monetary Fund: Data Fund; IFS FILE

D: International Monetary Fund: World Economic Outlook

E: United Nations: Statistical Yearbook

F: UNESCO: Statistical Yearbook

In addition, various country sources and the Fund's reports, particularly Recent Economic Developments, are utilized.

Definitions of Variables:

Growth rate of real GNP (sources C and E).

Growth rate of population (source C).

Ratio of domestic savings to GNP, where domestic savings are defined as a sum of gross capital formation (source C) and external current account balance (sources A, C, and E).

Budgetary share in the government's total revenue (source B) of expenditure on human capital, where the expenditure is defined as a sum of current and capital spending on education (sources B and F).

Growth rate of the volume of exports (source C).

External debt (source D)/exports (source C).

Interest rate on external debt (source D).

Export prices (source C).

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