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Transmission of the Effects of the Fiscal Deficit in Industrial Countries to the Fiscal Deficit of the Developing Countries

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Abstract

The paper shows that an increase in the aggregate fiscal deficit of the industrial countries may worsen the economic growth and fiscal balance of the developing countries that are burdened with external debt and facing current account constraints. The discussion is based on theoretical analysis and simulation exercises highlighting the relevant transmission mechanisms involved. Simulations show that higher fiscal deficits and interest rates in the industrial countries can explain some of the fiscal deterioration in the developing countries during the early 1980s, and the medium-term costs to the developing countries may be partly mitigated through flexible domestic economic policies.

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Contents

Summary

This paper shows that, for developing countries burdened with external debt obligations and facing an external current account constraint, an increase in the global interest rate resulting from the expansionary fiscal policy in industrial countries may cause an increase in interest payments by developing countries, leading to the worsening of the latters' balance of payments, economic growth, and fiscal balance. The analysis is based on an analytical discussion of the main transmission mechanisms involved and on simulation exercises showing the short- and medium-term effects of fiscal expansion in industrial countries on the economic growth and fiscal balance of developing countries that face an external current account constraint.

The paper finds that, for developing countries facing rigid current account constraints, higher debt-service payments may more than offset the boost to exports caused by higher demand in industrial countries resulting from expansionary fiscal policy and may result in import compression, a deterioration in the terms of trade, and slower output growth. The fiscal deficit of developing countries tends to increase owing, inter alia, to lower revenue from import duties and domestic-based taxes and to higher outlays on account of interest payments. The quantitative effects vary considerably among economies depending on the degree of external indebtedness, the import intensity of domestic output, and the structure of the tax system. The simulations also indicate that policy reactions of the government, in the form of allowing the exchange rate to adjust in line with external developments, may significantly reduce the medium-term costs of external shocks.

The simulations are broadly consistent with the stylized facts characterizing economic developments in the early 1980s and indicate that if the industrial countries, as a group, had held their fiscal deficits at the level of 1977, the fiscal deficit in developing countries by 1984 would have been significantly lower in relation to GDP. Nevertheless, the higher fiscal deficit in the industrial countries can explain only around one fifth of the fiscal deterioration in the developing countries in recent years.

I. Introduction

In recent years the aggregate fiscal deficits of both the industrial and the developing countries have increased markedly and have tended to move in a concerted fashion. While this may be in part a coincidence, there are a number of reasons to believe that the fiscal outturn in the developing countries (during the first half of the 1980s) was, at least partly, adversely affected by the deterioration in the aggregate fiscal deficit of the industrial countries. Burdened with external debt obligations and subjected to external financing constraints, the developing countries were vulnerable to external shocks in the form of higher interest rates and/or economic recession. 1/ Conventional analysis suggests that an increase in the fiscal deficit of the industrial countries leads to an increase in their imports from developing countries and to an improvement in the latter's terms of trade. However, for developing countries burdened with external debt and facing an external financing constraint, an expansionary fiscal policy in the industrial countries leading to an increase in the global interest rate may cause an increase in their interest payments, which could offset the favorable effects noted above, and worsen their balance of payments, lower their economic growth, and increase their fiscal deficits. This paper presents a theoretical discussion of the main transmission mechanisms involved, followed by a number of simulation exercises showing the short and medium-term effects of fiscal expansion in the industrial countries on economic growth and the fiscal deficit of the developing countries facing an external financing constraint.

The key finding of the paper is that an increase in the industrial countries' aggregate fiscal deficit that is unmatched by increased private sector savings is likely to worsen the fiscal balance of the developing countries. This observation may appear somewhat different from the standard analysis because both the analytical and simulation models presented highlight the role of the interest rate, the level of external debt, and the current account constraint, in addition to the conventionally emphasized transmission of output effect, in analyzing the transmission of the effects of higher fiscal deficit from the industrial to the developing countries. The size of the effect depends on the size of external debt and policy reactions in the developing countries. A fiscal expansion in the industrial countries may have some initial positive effects on the developing countries' exports, terms of

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1/ Large external borrowings to finance public sector development programs during the second half of the 1970s and to pursue countercyclical fiscal policies in the early 1980s led to a rapid accumulation of external debt by the developing countries. Total outstanding debt of the non-oil developing countries (excluding debt owed to the Fund) increased from less than $100 billion at the beginning of 1974 to more than $700 billion by the end of 1982 and, during the same period, long-term debt in relation to GDP and to exports of goods and services was doubled.

trade, and output and, consequently, on their fiscal balance, but these are likely to be more than offset in the aggregate by the effect of higher interest rates. Given a current account constraint, higher debt service payments lead to import compression, and to a reduction in output growth. The compression of imports may be achieved through quantitative restrictions and unchanged domestic product prices; on the other hand, if domestic prices in the developing countries are allowed to adjust without resorting to quantitative restrictions, the relative price of the developing countries' products or their terms of trade will deteriorate to keep imports in line with the current account constraint. On the fiscal side, these imply lower revenues, increased government expenditure on interest payments, and larger fiscal imbalances. If the developing countries allow the exchange rate to adjust in line with external developments, the medium-term costs (in the form of lower growth and higher fiscal deficit) could be significantly reduced. The simulations also indicate that if the industrial countries, as a group, had maintained their composite fiscal deficit at its 1977-79 level, the global interest rate would have been lower and the developing countries would have enjoyed slightly higher growth and lower fiscal imbalances both in the short and medium term. The simulations are also broadly consistent with the stylized facts which characterized the economic developments during much of the first half of the 1980s.

The plan of the paper is as follows. In Section II we develop a simple two-country analytical model to illustrate the linkages through which the key endogenous variables (e.g., interest rate, outputs, the terms of trade, and the determinants of the current account balance) are affected by an exogenous shift in the industrial countries' fiscal deficit. The model, under certain assumptions, can explain the stylized facts characterizing the financial developments in the industrial and developing countries in the early 1980s. Section III briefly sets out the specifications of key behavioral relationships and the working of the complete simulation model, which allows for extensions including the accumulation of capital and public sector debt (external and domestic) and their effects on the interest rate, exchange rate, output growth, and fiscal outturns in both the short and medium terms. Section IV describes a number of simulation experiments designed to analyze the quantitative effects of shifts in the fiscal deficit in the industrial countries and the sensitivity of these effects to changes in key parameters. Some concluding remarks are presented in Section V.

II. A Simple Model of the International Transmission of Fiscal Policies of the Industrial Countries

This section sets out a simple macroeconomic model that emphasizes the effects of fiscal policy in the industrial countries on the fiscal balance in the developing countries. The model starts from the proposition that an autonomous increase in the fiscal deficit in the industrial countries will boost their output in the short run, notwithstanding an increase in the real interest rate.

These developments affect the fiscal outturn of the developing countries in a number of ways. On the expenditure side, interest payments increase on both external and domestic public sector debt owing to the higher global interest rate; the foreign component of development expenditure also increases if the binding current account constraint leads to an exchange rate adjustment. On the revenue side, in the short run, revenue will increase if exports, imports, and domestic economic activities in the developing countries are favorably affected by the shift in aggregate demand in the industrial countries. However, the adverse effects of the higher interest rate may reverse the initial favorable effects of fiscal expansion in the industrial countries, and output and trade expansion may decline globally in both the short term and the medium term, with negative effects on the fiscal outturns for the developing countries.

The interrelationship between the fiscal situation in the developing countries and the fiscal policy in the industrial world may be highlighted by specifying a simple fiscal deficit relationship for the developing countries (D^*), along with a simultaneous system of equations determining the interest and exchange rates, and the output of the industrial and developing countries in terms of a two-country model. 1/ To highlight the linkages and the qualitative effects on the endogenous variables, we start with a simple two-country model with four equations, determining the interest rate, the relative price, and the output levels. The price of the industrial countries' product is assumed to be fixed and used as the numeraire, and the relative price movement or the terms of trade effect arises from variations in the price of the developing countries' products. The relative price is determined, inter alia, by the level of imports consistent with the current account constraint; if the relative price is maintained at a fixed level in the face of external shocks (for example, higher interest rates), the level of imports into the developing countries is to be determined quantitatively. For expositional clarity, we make a number of restrictive assumptions, some of which are greatly relaxed in the empirical analysis presented in Section III.

1/ Throughout this paper, the variables without asterisks refer to industrial countries, and those with asterisks indicate developing countries.

We assume that the credit market is fully integrated among the industrial countries and there is a single rate of interest which applies to all industrial countries. Ex ante, investment in the industrial countries is assumed to depend on the real interest rate (R):

$$I = I(R)$$

Private sector saving (S) in the industrial countries depends on the real interest rate (R) and income (Y). In line with the consensus that changes in the public sector deficit (D) are likely to be offset, at least partly, by alterations in private savings behavior (the Barro-Ricardo effect), we define the measured private saving to be

$$S = S(Y, R) + \theta.D,$$

where

θ = the Barro-Ricardo coefficient reflecting the private sector's induced response to public sector dissaving. 1/

The expression S(Y, R) is the component of private saving that corresponds to net wealth accumulation and θ.D is the "Barro-Ricardo component" reflecting the private sector's induced response to public sector dissaving.

Domestic output in the industrial countries is assumed to be demand-determined depending on domestic absorption (A), which is a function of income, the real interest rate, and the government deficit. This is a flexible output model with a fixed price for the industrial countries' output. Developments in the developing countries have no effect on the industrial countries' output.

$$Y = F\,[A(Y, R, D)]$$

Macroeconomic equilibrium in the industrial countries can be expressed in terms of a simple two-equation model of income and interest rate determination as

$$S(R, Y) - I(R) - (1 - \theta)\,.\,D + \overset{*}{SER}(R) - CA' = 0 \qquad (1)$$

$$Y - F\,[A(Y, R, D)] = 0 \qquad (2)$$

1/ Based on a simple model of aggregate consumption behavior with expected taxes and interest rates assumed to remain constant in the future, Blanchard (1985) and Masson and Knight (1987) have shown that θ should equal unity minus the ratio of the government's discount rate to that of the private sector.

where $SER^{*}(R)$ is the service sector deficit of the developing countries, CA' is the external sector current account balance excluding the service sector, and the current account constraint ($\overline{CA}$) implies that

$$CA' - SER^{*}(R) = \overline{CA}$$

$$S_Y,\ F_A,\ A_Y,\ A_D,\ SER_R^{*} > 0; \quad \text{and } (S_R - I_R) > 0 \quad 1/$$

$$A_R < 0; \quad 1 \geq \theta \geq 0$$

For the developing countries, the current account constraint is assumed to be fixed and equal to the financing available from industrial countries. 2/ If the interest rate increases, the service account balance would deteriorate, implying a reduction in imports, if it is not offset by a favorable growth in exports. The reduction in imports could be achieved either through a decline in the relative price (p) of the developing countries' product (in terms of the industrial countries' product) or by the imposition of quantitative restrictions (to avoid a deterioration of the developing countries' terms of trade). Quantitative restrictions, however, do not benefit exports while a reduction in the relative price does and, thus, helps ease import compression. Depending on the exchange regime under consideration, the current account constraint may be specified as

$$X^{*}(Y, \bar{p}) - M^{*}(Y, R, \bar{p}) - SER^{*}(R) = - CA' \qquad (3)$$

(fixed price, quantitative control)

or

$$X^{*}(Y, p) - M^{*}(Y, R, p) - SER^{*}(R) = - CA' \qquad (3')$$

(flexible price in the developing countries)

where

$$X_Y^{*},\ M_p^{*},\ M_Y^{*},\ SER_R^{*} > 0;\ X_p^{*},\ M_R^{*} < 0 \text{ , and}$$

p = relative price of developing countries' output in terms of the industrial countries' output.

1/ The assumption that $(S_R - I_R) > 0$ is weaker than assuming $S_R > 0$ and $I_R < 0$. A higher real interest rate reduces consumption, given the rate of time preference and expected future wage income; however, since current income is increased for households holding positive net claims, the sign of S_R may be ambiguous. Here, the weaker restriction implies that, if intended savings decline with higher interest rates, such savings fall by less than the intended investment.

2/ In line with the stylized facts of the early 1980s, this assumption reflects the severely limited availability of external financing from the industrial countries.

Output in the developing countries is assumed to be constrained by the availability of imports (equation (4)). A relaxation of the current account constraint and/or lower interest payments and higher exports would allow higher imports and, thus, higher growth.

$$Y^* = F^*(Y, R, M^*);\ F^*_Y,\ F^*_M > 0, \text{ and } F^*_R < 0 \qquad (4)$$

The fiscal deficit for the developing countries may be specified as

$$D^* = RY^*(Y^*, t_Y) + RIMP^*(M^*, t_m) + REX^*(X^*, t_x) - G^*(R, p) \qquad (5)$$

where

$$RY^*_{Y^*},\ RY^*_{t_Y},\ RIMP^*_{m^*},\ RIMP^*_{t_m},\ REX^*_{x},\ REX^*_{t_x},$$

$$G_R > 0; \text{ and } G^*_p < 0$$

where

RY^* = domestic-based revenue,

$RIMP^*$ = revenue from import duty,

REX^* = revenue from export duty, and

G^* = government expenditure and net lending,

and t_x, t_m, and t_Y are, respectively, the tax parameters for export (X^*), import (M^*), and domestic-based taxes. Equation (5) indicates that fiscal policies of the industrial countries influence the fiscal outturns of the developing countries through their impact on the interest rate, output, exchange rate, imports, and exports of the developing countries.

Equations (1)-(5) determine five endogenous variables: the output levels of the industrial and developing countries (Y and Y^*, respectively), the industrial countries' real interest rate (R), the relative price (p), and the budget deficit of the developing countries (D^*). The exogenous variables are limited to the fiscal deficit in the industrial countries (D), the current account constraint, the external debt of the developing countries, and the factors (not specified) that may influence the five endogenous variables noted above. In its present form, the model is partly recursive. Given the constrained level of the current account balance and the outstanding external debt of the developing countries, Y and R are determined simultaneously by equations (1) and (2); the relative price or the levels of imports and output in the developing countries can be obtained by substitution in equations (3) or

(3') and (4), respectively. Finally, the fiscal balance of the developing countries (D*) can be derived through substitution of these four endogenous variables in equation (5).

In this simple system the effect of a higher fiscal deficit on the industrial countries' output depends on the expansionary effects of the higher fiscal deficit, the service sector surplus, and the improvements in the terms of trade relative to the contractionary effect of a higher interest rate. If the private sector treats a portion of domestic government bonds as a component of its net worth, implying that full Barro-Ricardo equivalence does not hold, 1/ an increase in the fiscal deficit of the industrial countries would create an imbalance between global saving and investment, and may lead to a rise in the interest rate to restore equilibrium. 2/ If the elasticity of investment with respect to interest is low, the crowding-out of private investment would be so small that an increase in fiscal expansion would have a positive effect on domestic absorption and output in the industrial countries (see Appendix I for details). The conditions under which an expansionary fiscal policy leads only to a smaller increase in the interest rate also imply a greater expansionary effect on output.

Given the current account constraint as specified in equation (3) or (3'), an expansionary fiscal policy would worsen (improve) the terms of trade of the developing countries if the favorable output effect operating through higher exports of the developing countries is less (more) than the increased external debt servicing owing to higher interest rate, resulting in a decline (increase) in imports and a reduction (increase) in the developing countries' growth rate. Thus, on the one hand, the developing countries whose external debt servicing obligations are not tied to market interest rates may benefit from fiscal expansion in the industrial countries in the short run. On the other hand, for the heavily indebted developing countries with a large proportion of debt contracted at floating market rates, a higher interest rate may lead to severe import compression, lower output growth, and a deterioration in the budget deficit in the absence of additional adjustment measures.

This simple model does not, of course, fully capture the long-run impact of fiscal policy changes. While a higher real interest rate may be expected to continue, the effects on output, the exchange rate, and the current account may be altered or reversed substantially over time as the process of capital formation is adversely affected by higher

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1/ Empirical observations generally suggest that neither complete debt neutrality nor the full inclusion of government bonds in private net wealth is supported on the basis of the data; for more on empirical observations, see Kochin (1974), Tanner (1974), Buiter and Tobin (1979), and Masson and Knight (1986).

2/ The relationship between the fiscal deficit and interest rates was found to be significant for the United States by Muller and Price (1984), Leeuw and Holloway (1985), and Bovenberg (1988).

interest rates, and as the process of asset and wealth accumulation influences saving and investment behavior and the flows of the balance of payments. These longer-term aspects of the effects of fiscal policy changes are considered through simulation experiments in Section IV.

The model presented in this section is broadly consistent with the stylized facts of the period 1979-85. The average real interest rate increased by more than 4 percentage points during 1979-85, when the composite fiscal balance of the major industrial countries increased by more than 2 percentage points in relation to GNP (Table 1). In line with the higher interest rate, debt service payments of developing countries increased by 70 percent during 1979-85 in terms of U.S. dollars and, in relation to exports of goods and services, they increased rapidly from 14 percent in 1979 to 20.5 percent in 1985. The payment obligations of the heavily indebted countries increased at a much faster rate from around 30 percent of exports of goods and services in 1980 to about 50 percent by 1982. 1/ Furthermore, a deterioration in the terms of trade and a decline in gross capital formation also contributed to a marked slowdown in economic growth in the developing countries. Both reduced imports and slower economic growth contributed to a slower growth in revenue and, together with an increase in expenditure through higher interest payments, they led to a doubling of the fiscal deficit to around 5 percent of GDP.

Notwithstanding the qualitative inferences which may be made from these preliminary observations, a number of empirical questions remain unresolved. First, how significant, in quantitative terms, is the effect of a change in the fiscal deficit in the industrial countries on the fiscal outturn for the developing countries? Second, what are the long-run effects on the key endogenous variables, when the dynamic processes described above are taken into account? We need a dynamic empirical model to answer these questions even in a very simplified way, and such a model is considered in the next section.

III. The Simulation Model

The simulations were carried out on a medium-sized model incorporating 12 behavioral equations and 30 definitional equations or identities. In essence, the structure of the model is very similar to that of Section II. However, in order to take into account the longer-term effects of a fiscal expansion, that model has been expanded to include important stock-flow constraints, and the role played by relative prices has been expanded. For example, as shown in Section III.1 below, real interest rates and national income are still determined by

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1/ In the following years the debt service ratio for the heavily indebted countries declined to around 40 percent, owing to rescheduling agreements with the creditors and to increases in exports resulting from the world economic recovery.

Table 1 . Selected Variables for the Industrial and Developing Countries, 1979-85

	1979	1980	1981	1982	1983	1984	1985
Fiscal balance (central government) 1/							
Industrial countries							
Unadjusted fiscal balance	-2.8	-3.3	-3.6	-4.6	-5.4	-5.0	-4.9
Cyclically adjusted balance	-3.0	-2.9	-2.7	-2.7	-3.5	-3.7	-3.7
Developing countries	-2.4	-1.5	-3.6	-5.4	-5.6	-4.7	-4.6
Interest rate (nominal) 2/	9.9	12.7	14.2	11.7	9.2	9.7	8.5
Interest rate (real) 3/	0.8	1.0	4.3	4.7	4.3	5.1	4.4
Central government interest expenditure (in percent of total expenditure and net lending)							
Industrial countries	7.0	7.5	7.6	8.3	8.8	9.7	10.5
Developing countries	6.9	6.3	7.2	8.7	11.0	13.1	14.4
Of which:							
Non-oil developing countries	(7.6)	(6.9)	(8.2)	(9.8)	(12.4)	(14.8)	(16.3)
Real GDP/GNP							
Industrial countries 4/	3.4	1.3	1.4	-0.4	2.7	4.7	3.0
Developing countries 5/	4.2	3.5	2.1	1.6	1.4	4.1	3.2
Of which:							
15 heavily indebted countries	(6.1)	(5.0)	(0.5)	(-0.4)	(-3.4)	(2.2)	(3.1)
Debt service payments of developing countries							
In percent of exports of goods and services	14.1	12.9	16.2	19.5	18.9	20.1	20.5
Of which: 15 heavily indebted countries	(34.7)	(29.6)	(39.0)	(49.4)	(42.5)	(41.1)	(38.7)
In billions of U.S. dollars	82.6	100.5	127.4	138.1	127.6	142.1	140.3
Terms of trade for primary product exporters 6/	0.3	-7.4	-10.3	-5.9	1.5	3.9	-3.7
Gross capital formation (in percent of GDP)							
Developing countries	25.9	25.9	25.5	24.3	23.3	22.9	22.4
Of which:							
15 heavily indebted countries	(24.9)	(24.7)	(24.5)	(22.3)	(18.2)	(17.4)	(16.5)

Sources: International Monetary Fund, World Economic Outlook (April 1987), and Government Finance Statistics Yearbook (various issues).

1/ In percent of GNP/GDP; for the industrial countries, the data cover seven major industrial countries.
2/ Weighted averages of short-term nominal interest rates of the seven major industrial countries.
3/ The composite consumer price increase of the industrial countries has been used as the price deflator.
4/ Annual percentage change in the composite real GNP.
5/ Annual percentage change in the composite real GDP.
6/ Annual percentage change.

the interaction of savings and investment decisions with the current account in a similar fashion to equations (1) and (2) above. 1/ To bring in dynamic factors, real GDP is made a function of potential output which, in turn, depends on the capital stock and investment; and consumption depends on consumers' wealth, which reflects the size of previous government deficits, current account surpluses, and investment. Equally, the forms of the import and export equations in the empirical model are similar to those embodied in equation (5) of Section II. The main difference here is that we explicitly allow for the effects of import compression on exports, as described in Section III.2 below. Analogous to the analytical model, we consider both fixed and flexible-price specifications for the developing countries. We allow for some interaction among the financing of the fiscal deficit, money supply, and domestic price determination in the developing countries.

The behavioral equations and estimates of their parameters are based on a survey of the existing empirical literature. In cases where the estimated parameter values tend to vary among countries, we generally used a value in the mid-range. The data used are largely taken from the IMF, International Financial Statistics, Government Finance Statistics Yearbook, and from various issues of the World Economic Outlook. Stock variables, which are endogenous to the model in a dynamic context (e.g., private sector wealth, public sector debt, and capital stock), are estimated by accumulating the relevant flows. The baseline values of some key economic variables used in the simulations are set out in Table 2.

This section provides only a brief description of the structure of the model and its key equations, while a full description of the simulation model and a discussion of the associated parameters are provided in Appendix II. The model can be broadly divided into three parts: the real sector in the industrial countries, in which the real interest rate is determined; the trade sector, through which the effects of external shocks are transmitted to the developing countries; and the real and fiscal sectors in the developing countries, which describe how changes in the external environment affect developing countries.

1. The real sector in industrial countries

The real sector in industrial countries is composed of three basic relationships determining output, consumption, and investment. Capacity output is derived from a simple Cobb-Douglas function containing the capital stock and labor, with the capital stock endogenously determined from the investment function described below and labor supply taken as exogenous. The output function essentially describes changes in output

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1/ Except that the empirical model has an equation for consumption rather than savings, as consumption functions have been more commonly estimated in econometric work.

Table 2. Baseline Values of Main Economic Variables Used in the Simulations

	1977	1978	1979	1980	1981	1982	1983	1984
				(In percent of GDP)				
Industrial countries								
Fiscal deficit	-3.3	-3.4	-3.0	-3.5	-3.9	-4.4	-5.7	-5.0
				(In millions of U.S. dollars)				
Non-oil developing countries								
Exports 1/	124.0	139.8	178.3	212.3	206.0	200.2	205.6	235.4
Imports 1/	135.6	166.0	203.7	247.0	251.4	225.2	212.8	227.0
Interest payments	14.3	22.0	32.2	49.2	66.9	78.1	71.0	79.2
Current account deficit	-21.7	-31.6	-48.5	-75.2	-94.5	-72.1	-36.5	-21.9
External debt	359.0	390.6	439.1	524.9	621.1	708.0	748.5	793.4
				(In percent of GDP)				
Revenue 2/	19.4	19.6	19.6	19.9	20.1	20.4	20.4	19.9
Import taxes	3.3	3.3	3.3	3.5	3.3	3.4	3.1	2.9
Other	16.1	16.2	16.3	16.3	16.8	16.9	17.3	17.0
Expenditure	23.7	23.7	23.7	24.2	25.8	27.2	26.6	25.8
Interest	1.6	1.8	1.8	1.7	2.2	2.8	3.4	3.9
Other	22.1	21.9	21.8	22.5	23.6	24.4	23.2	21.9
Fiscal deficit	-3.6	-3.5	-3.2	-3.7	-5.0	-6.2	-5.6	-5.2

1/ Exports to and imports from industrial countries.
2/ Excluding grants.

from the baseline level, with higher real capacity output (YCR) leading to higher real output over a period (see Appendix II for detailed information). Output growth can also be temporarily disturbed by changes in real government expenditure.

$$\Delta \ln Y = \alpha_1 \ln(YCR/Y)_{-1} + \beta_1 \cdot \theta \cdot \Delta \ln(G/P) \quad \alpha_1, \beta_1 > 0$$

Based on empirical estimates for the United Kingdom made by Laidler and O'Shea (1980), a 1 percent increase in real government expenditure (G/P) is assumed to give rise to a 0.15 percent increase in real GDP, when θ, the Ricardian constant, is 0.5.

The consumption function is based on the formulation of Blinder and Deaton (1985):

$$(CP/P) = (W/P)^{\alpha_2} \cdot (YDIS/P)^{\beta_2} \cdot e^{\gamma_2 NR + \delta_2 EINF} \quad \alpha_2, \beta_2 > 0; \ \gamma_2, \delta_2 < 0$$

Real private consumption (CP/P) is positively dependent on real wealth (W/P) and real disposable income (YDIS/P), and negatively dependent on nominal interest rates (NR) and expected inflation (EINF). 1/ Disposable income is defined to exclude the portion of savings that take place to offset changes in the real government deficit (the Barro-Ricardo effect).

Since the interest elasticity of consumption, γ_2, is a key parameter in the simulations, a brief discussion of its value may be helpful. On purely technical grounds, γ_2 is expected to be negative in sign, as an increase in interest rates encourages saving. 2/ Blinder and Deaton, like other researchers, have significant difficulties in finding a stable and well-determined estimate. Their estimates (for the United States) vary from -2.3 to -0.8, with the former being slightly better in econometric terms than the latter. In our baseline simulation we assume $\gamma_2 = -0.8$, which appears intuitively reasonable and closer to other results (for example, Masson and Knight (1986)). The sensitivity of the results to the value of this parameter is examined in Section IV below.

1/ See Blinder and Deaton (1985) for a discussion of why the nominal, rather than real, interest rate appears to matter. In our model, the two are effectively the same. Other variables which Blinder and Deaton find significant (for example, the relative price of consumer durables) have been omitted.

2/ Note that the income effect of higher interest rates on wealth holders is taken into account in the definition of disposable income, YDIS.

The investment function is based on Masson and Knight's formulation:

$$\frac{I}{YC} = \alpha_3 \frac{Y}{YC} + \beta_3 \frac{K(-1)}{YC(-1)} + \gamma_3 R \qquad \alpha_3 > 0;\ \beta_3,\ \gamma_3 < 0$$

Investment is positively related to the gap between actual output and capacity output, and negatively related to the real interest rate (R) and to the capital stock (K) in the previous period. This equation implies that real private investment adjusts, with a lag, to an optimal capital stock, dependent on both real interest rates and expected output (proxied by actual output). 1/

Finally, the identity

$$CA = Y - C - I - G$$

closes the system. With the current account determined also by export and import equations, as described below, this relationship can essentially be seen as the equation determining the real interest rate, bringing domestic absorption into line with the current account.

2. Trade flows

Developing countries are assumed to face a rigid current account constraint in nominal terms, equal to the actual current account deficit in each year. With interest payments determined by interest rates and the outstanding debt, this determines the trade balance.

The price and volume of exports for developing countries are determined separately, following Khan and Knight (1986). Export volume is supply-determined, while export price reacts to equate that supply to world demand, with a lag. Export supply itself is a function of three factors--capital stock in the export sector (proxied by real GDP), relative prices, and the supply of imported inputs (proxied by import volume). Three points should be noted here. First, growth in industrial countries has an immediate impact on the export price, rather than on export supply (although this is subsequently affected by the corresponding improvement in relative prices). Second, import compression reduces export volume. Thus, if the developing countries are forced to reduce imports, this in turn reduces exports, leading to a vicious circle. Third, export prices for developing countries can and do differ from the domestic prices in both industrial and developing countries, allowing relative prices to play a role in the model.

When the nominal exchange rate is held constant, imports are determined simply as a residual given the current account balance, the

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1/ See Masson and Knight (1986) for a detailed derivation of this formulation.

available exports, and debt-servicing obligations. In the longer term, of course, such exchange rate rigidity is unrealistic. Therefore, in alternative simulations, a simple import demand equation dependent on real income and relative prices is added, with the exchange rate adjusting to achieve the required trade balance.

3. The fiscal and real sectors in developing countries

The specification of the fiscal sector in developing countries is relatively straightforward. Tax revenues are directly dependent on import value (in domestic currency) and GDP. Interest payments on government foreign debt are related both to the exchange rate and to a weighted average of market and concessional interest rates. Interest payments on domestic debt are related to domestic interest rates, which are initially assumed fixed in nominal terms 1/. Other government expenditures are assumed fixed in real terms. Changes in the government deficit in developing countries, induced by external shocks or otherwise, can be financed either by recourse to the sales of domestic debt 2/ or by borrowing from the domestic banking system. In the latter case, the increase in money stock adds to inflation through a simple price equation similar to that of Khan and Knight (1982). Real GDP in developing countries (Y^*) is specified as a function of import volume (MV^*).

$$\ell n(Y^*) = \alpha_4 \ell n(MV^*); \qquad \alpha_4 > 0$$

This formulation ignores many important factors, but it is sufficient for our purposes in allowing us to focus on the effects of import compression on developing country growth. The coefficient α_4 is set equal to 0.3 (see the survey by Goldsborough and Zaidi (1986)).

Overall, the model works broadly as the theoretical model described in Section II. However, in the longer term, the temporary boost to industrial countries' GDP caused by the fiscal expansion wears off and--reflecting reduced investment and thus lower capacity output--real GDP falls below the baseline level, lowering developing country exports. In addition, a sustained higher government deficit adds significantly to private sector wealth, and the higher interest payments boost disposable income. If the Ricardian constant is less than 1, both these factors tend to increase consumption, creating an upward pressure on interest rates and adding to the import compression faced by developing countries.

1/ The capital market in developing countries is assumed to be completely insulated from that of industrial countries, so developing countries' interest rates are independent of those in industrial countries. In the alternative simulation, however, domestic interest rate is assumed to change in line with domestic inflation.

2/ Not by borrowing abroad, as we assume that foreign borrowing by developing countries is fixed.

IV. The Simulation Results

Before turning to the simulation results themselves, some brief introductory comments may be helpful. First, the simulation model was calibrated to produce the actual outturn over the period 1976-84 with the given policy stance. The results of changes in policies are therefore all expressed in terms of differences from this baseline. Second, as noted above, the effects of a fiscal policy change depend critically on policy responses to that change in other areas in both industrial and developing countries. We assume that monetary policy in industrial countries is adjusted to maintain prices at the baseline level, 1/ while in developing countries it adjusts only to take into account any changes resulting from the monetary financing of the government deficit. In the first round of simulations, the exchange rate and the domestic interest rate in the developing countries are assumed fixed at the baseline levels. In later simulations, we examine the effects of allowing interest and exchange rates in the developing countries to adjust, in line with some simple policy rules described below.

1. A sustained increase in expenditure in industrial countries

The model was first used to examine the effects of a sustained debt-financed increase in government expenditure, sufficient to increase the fiscal deficit by about 1 percent of GDP in the first year, and maintained in real terms thereafter. 2/

a. The macroeconomic effects

The macroeconomic impact of the fiscal expansion can be divided into two stages. In the first year, the fiscal stimulus raises real GDP in the industrial countries by about 0.5 percent and the real interest rate by about 1.4 percentage points (Table 3 and Chart 1). The boost in industrial countries' demand results in some increase in developing countries' export prices, but this is more than offset by the effect of higher interest rates on their debt service payments. Consequently, in the short run, import volume falls--which further weakens exports--and results in a 0.4 percentage point fall in real GDP.

In the medium term, the effects of the initial fiscal stimulus on industrial countries' income die away, as economic activity moves back in line with underlying supply conditions. Government debt and government interest payments in industrial countries continue to mount and exert a significant effect on consumption, reducing the level of savings available to finance the deficit at current interest rates. At the same

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1/ This implies that changes in nominal and real interest rates in industrial countries are identical.

2/ The actual increase in expenditure applied was about 0.8 percent of GDP. However, the ensuing rise in interest rates increases the ratio of interest payments to GDP, accounting for the remaining 0.2 percent.

Table 3. The Effects of a Sustained Increase in Government Expenditure 1/

	Years After Initial Expansion			
	0	1	2	7
	(Deviations from the baseline values; in percent)			
	(Percentage difference)			
Industrial countries				
Real GDP	0.5	0.2	-0.1	-0.2
Real consumption	-0.5	-0.8	-1.1	-0.9
Real interest rate	1.4	1.4	1.7	2.1
	(In percent of GDP)			
Fiscal deficit	1.0	1.1	2.0	2.6
Government interest payments	0.2	0.3	1.1	1.7
	(Percentage difference)			
Developing countries 2/				
Real GDP	-0.4	-0.4	-0.5	-1.3
Real GNP	-0.7	-0.6	-0.8	-1.8
Consumer price index	0.2	0.5	1.4	2.7
Import volume	-2.0	-2.0	-3.1	-7.7
Export volume	-0.3	-0.5	-1.3	-3.3
Export prices	0.7	0.7	0.4	0.6
	(In percent of GDP)			
Government expenditure	0.2	0.2	0.2	0.4
Interest payments	0.1	0.1	0.1	0.1
Other	0.1	0.1	0.1	0.3
Government revenue	--	--	-0.1	-0.1
Trade taxes	--	--	-0.1	-0.2
Other	--	--	--	--
Fiscal deficit	0.2	0.2	0.3	0.6

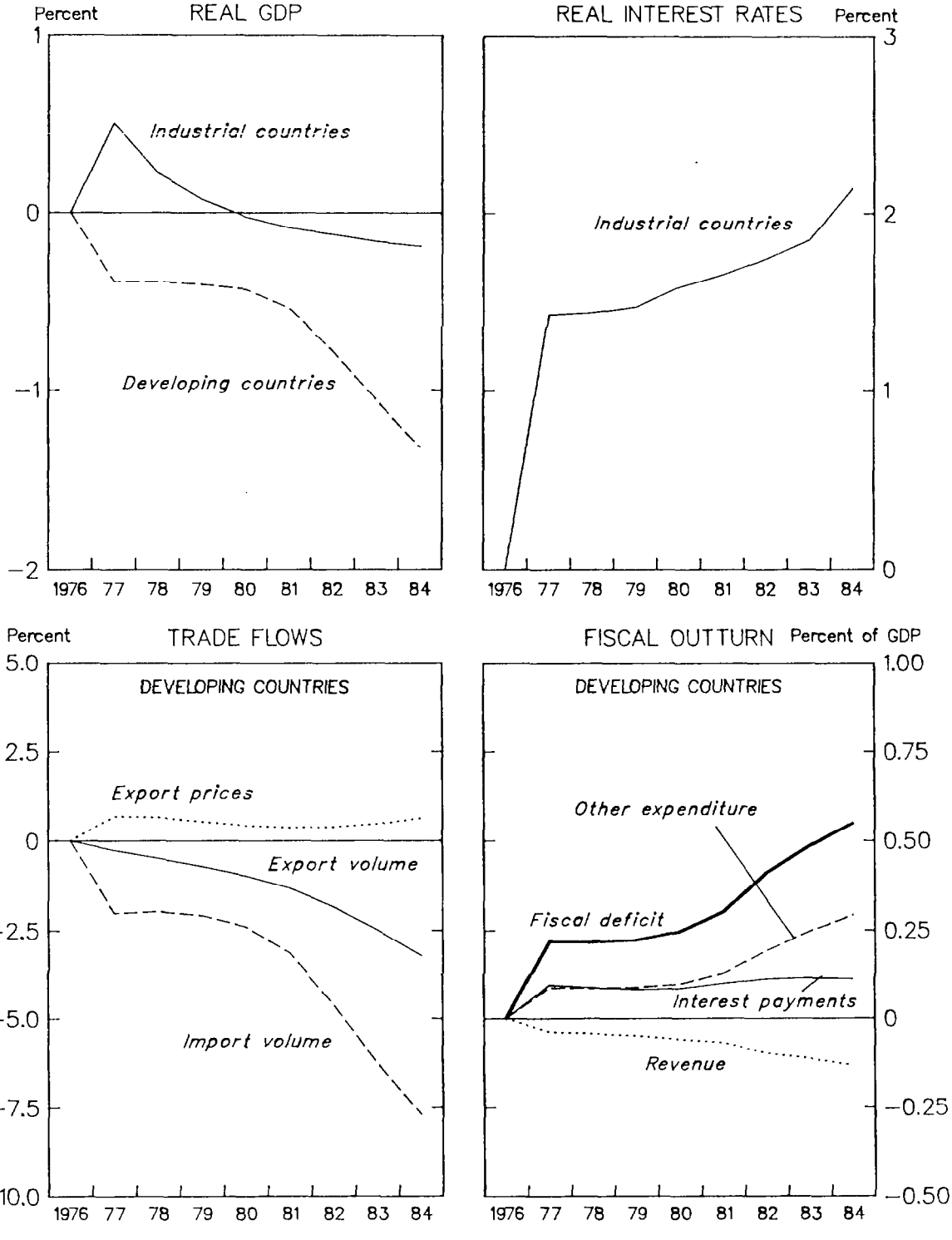
1/ Assumes a sustained debt-financed increase in government expenditure in the industrial countries, sufficient to increase the fiscal deficit by 1 percent of GDP in the first year.

2/ Fiscal deficit is assumed to be money-financed.

CHART 1

A SUSTAINED INCREASE IN GOVERNMENT EXPENDITURE

(Differences from baseline)



time, the reduction in capacity output caused by the reduced investment results in a fall in real GDP. Both these factors increase the global real interest rate (2.6 percentage points from the baseline) and weaken the demand for imports from the developing countries. Consequent further compression of imports in the developing countries reinforces the weakness of exports and significantly reduces the growth of real GDP (1.3 percent of GDP).

b. Effects on developing countries' fiscal deficit

The overall deficit deteriorates by 0.6-0.8 percent of GDP in the medium term. While the ultimate effect on the fiscal balance is broadly similar whether the deficits are financed by additional bank credit or by debt financing, the channels are somewhat different. In the money-financed case, real GDP falls by a large amount; the bulk of the increase in the deficit is due to an increase in expenditure in relation to GDP (as expenditure is assumed to be maintained in real terms). The increase in interest payments and the decrease in revenue contribute moderately toward fiscal deterioration in relation to GDP.

In the case of debt financing, lower recourse to monetary financing results in lower price inflation, increasing export profitability. Given the current account constraint and the assumption of a fixed nominal exchange rate, this implies somewhat higher imports and real GDP and, therefore, tax revenues. However, these favorable developments are more than offset by the growth in government debt, which results in rapid growth in interest payments, and the medium-term fiscal outturn is broadly similar to the money-financed scenario described above.

c. Sensitivity with respect to changes in the values of key parameters

Sensitivity analyses based on changes in six important parameters, and expressed in terms of the differences from the baseline scenario, show that changes in the values of three key parameters--the interest elasticity of consumption, the Ricardian constant, and the interest elasticity of investment--can have significant quantitative effects on the results (Table 4). The impact of changes in the first two of these parameters increases over time, as the effect of the fiscal expansion on wealth and disposable income increases. If the interest elasticity of consumption is zero, the entire burden of adjustment has to be borne by investment, requiring a very large increase in the interest rate. Changes in the interest elasticity of investment, however, have diminishing effects over time as neither wealth nor disposable income directly influences investment in the model.

Relaxing the current account constraint would, of course, significantly enhance growth in the short term; in the longer term, however, the favorable effect would fall substantially as a result of increased interest payments on the higher level of foreign debt if accommodating finance is not available. Finally, the greater the outstanding foreign

Table 4. Sensitivity Analyses

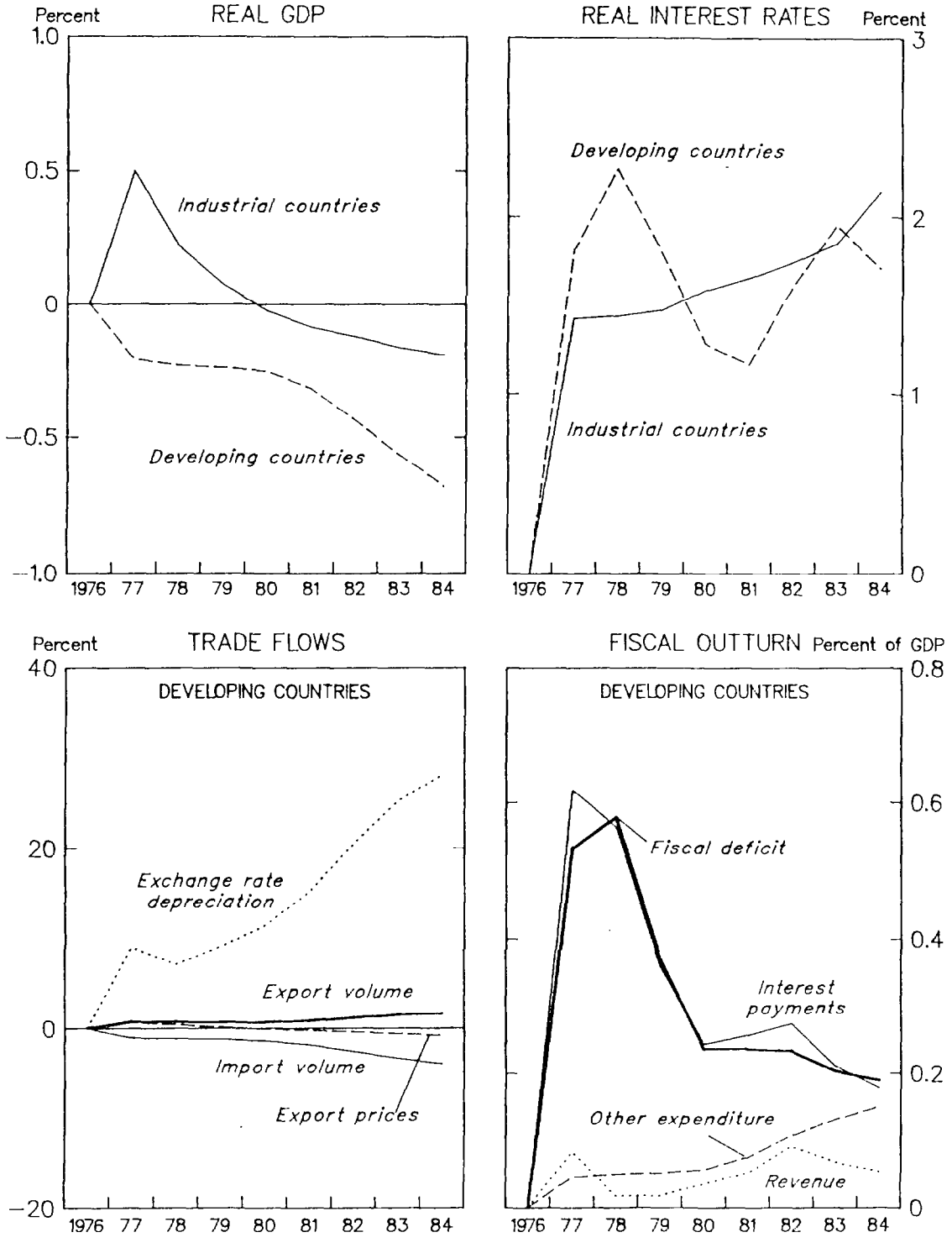
	Short Term 1/			Medium Term 2/		
	Real interest rates	Developing countries		Real interest rates	Developing countries	
		GDP	Deficit		GDP	Deficit
Baseline	1.4	-0.4	0.2	2.1	-1.3	0.6
Change long-term interest elasticity of consumption from:						
(a) -0.8 to 0	3.2	-1.1	0.6	15.4	-11.2	4.5
(b) -0.8 to -0.5	1.8	-0.5	0.3	3.2	-2.0	0.8
(c) -0.8 to -2.5	-0.7	-0.1	0.1	0.7	-0.4	0.2
Change interest elasticity of investment from:						
-0.8 to -0.4	1.8	-0.5	0.3	2.4	-1.5	0.6
Reduce Ricardian constant from:						
0.5 to 0.25	1.3	-0.3	0.2	2.9	-1.8	0.8
Eliminate import constraint on developing country exports	1.4	-0.3	0.2	2.1	-1.0	0.5
Relax current account constraint by 2 percent of imports	1.8	0.7	-0.1	2.3	-1.3	0.6
Increase original debt stock by 25 percent	1.4	-0.5	0.3	2.1	-1.5	0.6

1/ The first year.
2/ By the eighth year.

CHART 2

A SUSTAINED INCREASE IN GOVERNMENT EXPENDITURE WITH FLEXIBLE EXCHANGE AND INTEREST RATES IN DEVELOPING COUNTRIES

(Differences from baseline)



debt of developing countries, the larger the reduction in growth caused by the fiscal expansion in the industrial countries. The impact of higher interest payments on real interest rates is negligible.

Overall, the results are qualitatively, if not always quantitatively, robust to changes in parameter values within empirically plausible ranges.

2. The transmission of fiscal shocks with exchange and interest rate "flexibility" in developing countries

We define a flexible domestic interest rate policy as one which adjusts interest rates upward or downward from the baseline level in response to changes in inflation, effectively maintaining the real interest rate in each period. Similarly, a flexible exchange rate policy implies adjustments in the exchange rate to bring about the required strengthening of the trade balance in the face of higher interest payments, given the current account constraint.

The devaluation of the exchange rate boosts exports, reduces the degree of import compression, and reduces the fall in real GDP in the developing countries by approximately one half (Chart 2). The effects of these flexibilities (in the interest and exchange rates) on the fiscal deficit of the developing countries are, however, not unambiguously clear. 1/ The deficit increases in the initial years owing to sharply higher interest payments on foreign and domestic public debt resulting from the exchange rate depreciation and a higher nominal interest rate. In the medium term, under both the money-financing or debt-financing cases, the overall fiscal deficit increases marginally less than in the fixed price scenarios described earlier. Deficit financing through domestic bank borrowing increases inflation and requires a much larger nominal devaluation to achieve the necessary real depreciation of the exchange rate. In the bond-financing cases, inflation is lower and, consequently, the domestic interest rates and the fiscal deficit are initially lower. In the medium term, however, government debt and interest payments increase rapidly in relation to GDP, with consequent adverse effects on the fiscal deficit.

A policy of maintaining the domestic interest rate unchanged in nominal terms may improve the fiscal deficit in the short term. However, in the medium term, this policy would reduce the attractiveness of government bonds to the private sector and would eventually imply financing the deficit through inflationary means, with all the disadvantages that that entails.

1/ The quantitative results of the following simulations are subject to considerable margins of error, owing to a lack of information on the structure of government debt in developing countries. In the simulations, it is assumed that 50 percent of domestic government debt would be subject to the flexible interest rate policy.

3. The effect of maintaining industrial countries' fiscal deficits at the 1977 level

Finally, we consider the outcome of maintaining the industrial countries' fiscal deficit at its 1977 level (approximately 3 percent of GDP), assuming policies in developing countries remain fixed in the sense of Section IV.1. 1/ In the first few years, the effect would have been minimal since the industrial countries' deficit remained stable in relation to GDP (Chart 3). From 1980 onward, however, the containment of the fiscal deficit in the industrial countries would have significantly lowered the global interest rate and the developing countries' fiscal deficit.

The simulations suggest that real GDP in the industrial countries would have fallen by an average of about one third of 1 percent during 1980-83; real interest rates would have been 1 percentage point lower in 1981, and nearly 3 percentage points lower in 1983 (when the actual deficit peaked). Developing country interest payments would have fallen sharply, allowing imports to increase by 4 percent in real terms by 1984, and real GDP could have been about 0.8 percent higher than in the baseline.

The fiscal situation of developing countries also would have improved by about 0.4 percent of GDP by the end of the period. In all, about one fifth of the increase in the overall developing country fiscal deficit between 1977 and 1984 could be ascribed to the fiscal expansion in the industrial countries.

V. Conclusions

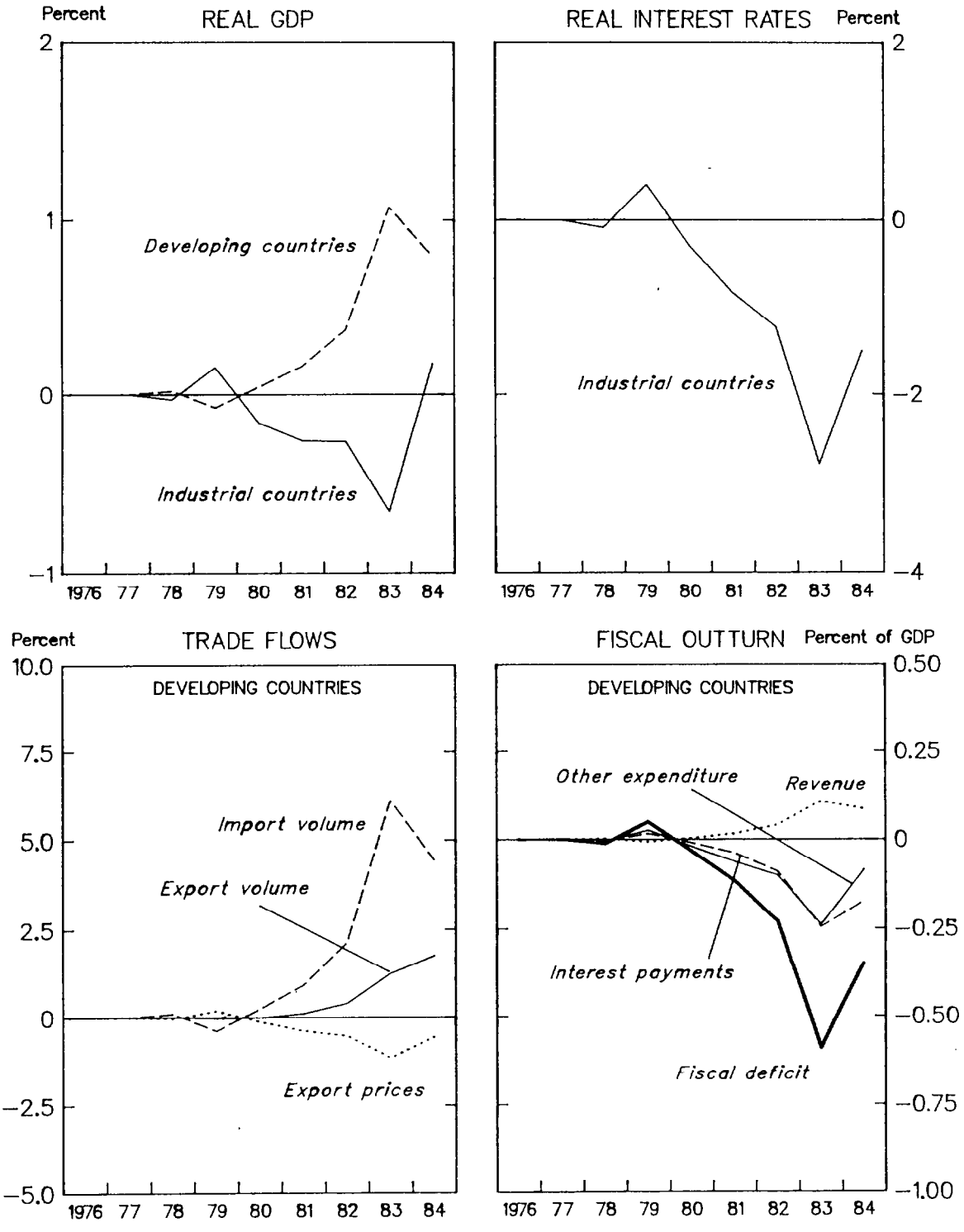
Both the analytical and empirical analyses presented in this paper suggest that, for plausible values of key parameters, an increase in the fiscal deficit of the industrial countries causes higher real interest rates leading to an increase in external debt service payments. Where developing countries face a current account constraint, these higher debt service payments generally more than offset the boost to exports caused by high demand in industrial countries, and result in import compression and slower growth. The fiscal deficit of the developing countries also tends to increase, owing to lower revenue (from import duties and domestic-based taxes) and higher outlays (in relation to GDP).

1/ A reduction in the industrial countries' fiscal deficit would, under flexible policies, imply an appreciation of the exchange rate and lower domestic interest rates in developing countries. Since the exchange rate is likely to have been overvalued and domestic interest rates are too low in developing countries, this would seem a perverse reaction and the assumption of fixed policies seems more reasonable.

CHART 3

MAINTAINING THE FISCAL DEFICIT IN INDUSTRIAL COUNTRIES AT ITS 1977 LEVEL AS A PERCENT OF GDP

(Differences from baseline)



The quantitative effects, of course, vary considerably among different economies depending, inter alia, on the size of their external debt, the dependence of their outputs on imports, and the share of taxes coming from international trade. The heavily indebted countries are likely to be the most adversely affected, while some other countries with limited commercial borrowing from external sources and external financing mostly from official or multilateral sources are probably not much adversely affected in the short run. In the aggregate, however, our simulations suggest that if the industrial countries had held their fiscal deficits at the level of 1977, the fiscal deficit in developing countries would have been almost half a percent of GDP lower by 1983-84. The simulations also indicate that if the exchange rate is allowed to adjust in response to external developments, the adverse effects on both output and the budget deficit would be sharply lower in the medium term compared with the fixed-price scenario.

However, it should be emphasized that the higher fiscal deficit in the industrial countries can explain only around one fifth of the fiscal deterioration in the developing countries in recent years. In many developing countries, the increase in public spending was due to investments in inappropriate or unsuccessful projects, the continued operation of inefficient projects and enterprises originating from past investments, or a general increase in public sector operations with social progress without a commensurate increase in the revenue base. Other external shocks, such as terms of trade deterioration (apart from the fiscal deficit-induced terms of trade effect discussed in this paper), economic recession in the industrial countries, trade restrictions, etc., also led to slower growth and a higher fiscal deficit in the developing countries during the same period. Furthermore, inadequate adjustments to external shocks or anti-recessionary policies in many developing countries might have also contributed to the higher fiscal deficit.

A number of policy recommendations follow from our analysis. First, reductions in the fiscal deficits of the industrial countries are likely to improve the growth prospects and fiscal position of developing countries because lower global interest rates will ease the availability of imports. This conclusion differs somewhat from the standard analysis, which suggests that higher fiscal deficits in industrial countries stimulate growth in developing countries; while the standard open-economy models emphasize the transmission of output effect, this paper also highlights the role of the interest rate, the burden of external debt, and the current account constraint. We are aware that this paper does not exhaustively cover all the channels through which international transmission may take place; however, we have limited our analysis to focus on the important ones based on stylized facts.

Second, when the developing countries face a rigid current account constraint, as we have assumed in this paper, increases in interest rates are particularly important in transmitting shocks from the industrial to the developing countries. The latter would benefit

substantially from policies aimed at lowering the global interest rate and from measures to increase capital flows to the developing countries. Third, the impact of higher fiscal deficits in industrial countries on developing countries is partly mitigated if the latter follows a flexible exchange rate policy.

An Analytical Exposition of the Model

The total differential of a simplified version of the system of equations (1)-(4) can be expressed in matrix form as:

$$\begin{bmatrix} S_Y & (S_R - I_R) & 0 & 0 \\ (1 - F_A \cdot A_Y) & (-F_A \cdot A_R) & 0 & 0 \\ X^*_Y & -SER^*(R) & -M^*_p & 0 \\ -F^*_{M^*} \cdot M^*_Y & -F^*_{M^*} \cdot M^*_R & -F^*_X \cdot X_p & 1 \end{bmatrix} * \begin{bmatrix} dR \\ dY \\ dp \\ dY^* \end{bmatrix} = \begin{bmatrix} (1-\theta) \\ F_A \cdot A_D \\ 0 \\ 0 \end{bmatrix} * dD$$

where a subscript (i) to a function (F) denotes differentiation of that function with respect to that variable (i.e., $F_i = \frac{\partial F}{\delta i}$).

Given the simplified structure of the model, the first two equations determining output and the interest rate in the industrial countries are simultaneous. Once these two equations are solved, the equilibrium values for Y and R can be substituted in equations (3) and (4), along with the current account constraint, to solve for the relative price and output level in the developing countries.

The total differential of the subsystem represented by equations (1) and (2) is

$$\begin{bmatrix} (1 - F_A \cdot A_Y) & (-F_A \cdot A_R) \\ S_Y & (S_R - I_R) \end{bmatrix} * \begin{bmatrix} dY \\ dR \end{bmatrix} = \begin{bmatrix} F_A \cdot A_D \\ (1-\theta) \end{bmatrix} * dD$$

The determinant of the coefficient matrix, Δ, is

$$\Delta = (1 - F_A \bullet A_y)(S_R - I_R) + S_Y (F_A \bullet A_R)$$

which, given the normal assumptions about partial derivatives, is of an indeterminate sign. If the sensitivity of absorption with respect to interest is small, Δ would be positive. A change in the fiscal deficit of the industrial countries has the following effects on the interest rate and output in the industrial countries:

$$\frac{dY}{dD} = \frac{(F_A \cdot A_D) \cdot (S_R - I_R) + (1 - \theta) F_A \cdot A_R}{\Delta}$$

$$\frac{dR}{dD} = \frac{(1 - \theta) \cdot (1 - F_A \cdot A_Y) - (F_A \cdot A_D) \cdot S_Y}{\Delta}$$

As expected, both the interest rate and output effects of an increase in the fiscal deficit are ambiguous, even if we assume $\Delta > 0$. However, output in the industrial countries would expand if the sensitivity of absorption with respect to fiscal deficit is high and the interest sensitivity of domestic absorption is relatively small. Moreover, the output effect would be larger the greater the Barro-Ricardo effect, which would tend to dampen the effect on the interest rate. If $\frac{dR}{dD} > 0$, the effect of fiscal expansion on the interest rate would be higher the smaller are θ and the sensitivity of absorption to fiscal deficit. Thus, the conditions under which an expansionary fiscal policy leads to a smaller increase in the interest rate would also lead to a greater expansionary effect on output.

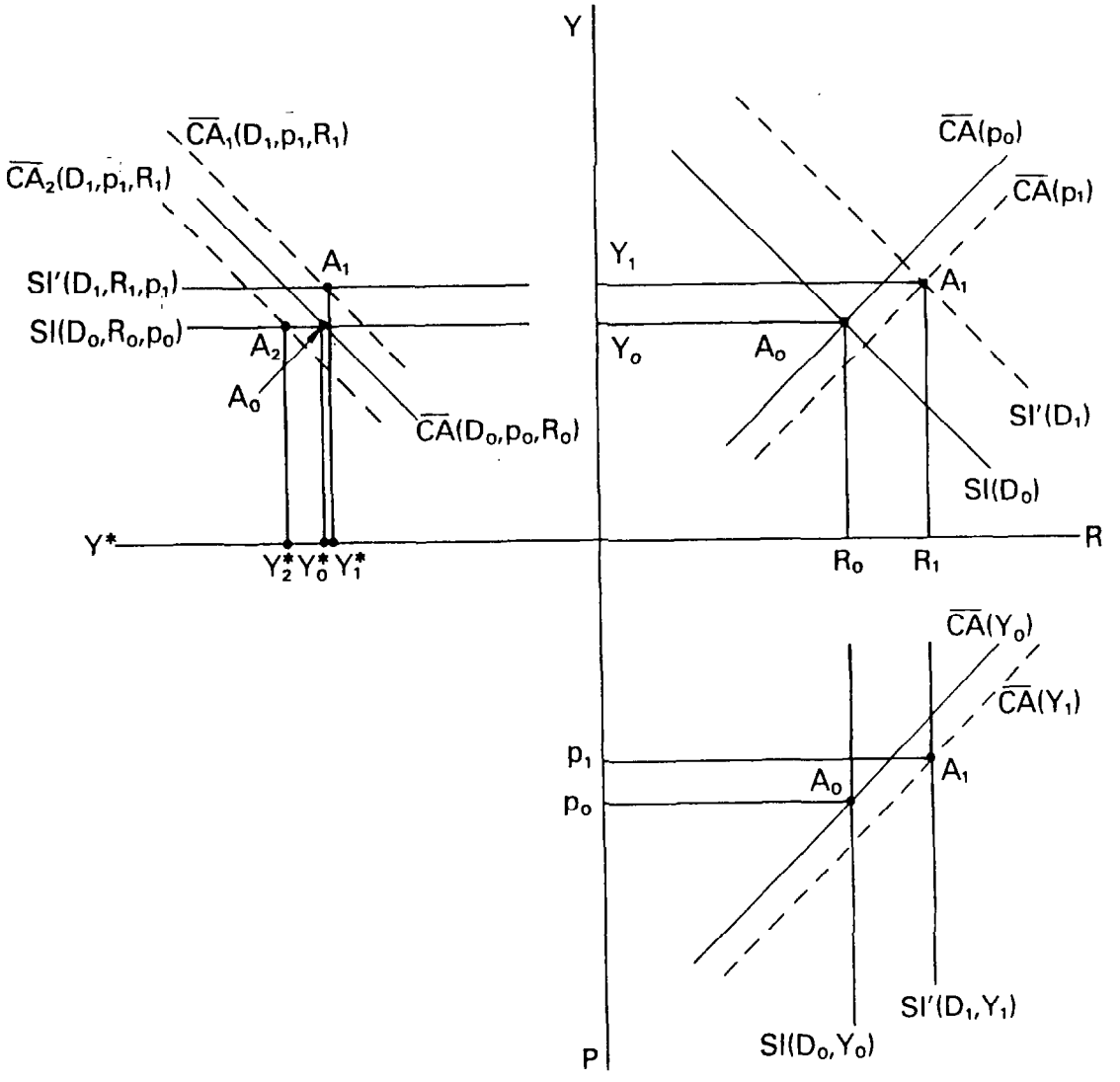
The effect of a change in the fiscal deficit on the relative price (of the developing countries' output in terms of the industrial countries' output) may be observed by taking the total differential of equation (3):

$$\frac{dp}{dD} = \frac{X^*_Y}{M^*_p} \cdot \frac{dY}{dD} - \frac{SER^*_R}{M^*_p} \cdot \frac{dR}{dD}$$

If we assume that $\frac{dY}{dD}$ and $\frac{dR}{dD}$ are both positive, then the relative price would decrease or increase depending on the relative strength of the negative effect from the interest rate increase and the positive effect from output expansion in the industrial countries. An increase in the interest rate would cause higher interest payments for the developing countries, and lead to a compression of imports through a reduction in

FIGURE 1

Effects of a Change in Fiscal Deficit on Output, Interest Rate, and Exchange Rate



the relative price of the developing countries' output in terms of the industrial countries' output. On the other hand, an increase in output in the industrial countries would allow for more exports from the developing countries, leading to an easing of import availability through an increase in the relative price given the current account constraint. If the interest rate effect dominates, $\frac{dp}{dD} < 0$, that is, the relative price or the terms of trade would deteriorate for the developing countries and the reverse would happen if the output effect dominates.

The effect of a change in the fiscal deficit on output in the developing countries can be similarly expressed as:

$$\frac{dY^*}{dD} = F_M^* \cdot M_Y \cdot \frac{dY}{dD} + F_M^* \cdot M_R^* \cdot \frac{dR}{dD} + F_M^* \cdot M_P^* \cdot \frac{dp}{dD}$$

Once again, the direction of change in output in the developing countries is ambiguous, and would remain so even if we assume (as is likely) that $\frac{dY}{dD}$ and $\frac{dR}{dD} > 0$ and $\frac{dp}{dD} < 0$. An expansion of output in the industrial countries resulting from a higher fiscal deficit would increase the exports of the developing countries and, through the current account constraint, increase the imports and output of the developing countries. An increase in the interest rate and a deterioration in the terms of trade would both reduce the imports of the developing countries and contribute to a reduction in output. Thus, an expansion in the fiscal deficit may easily contribute to a reduction in output in the developing countries through a higher interest rate.

The effects of an increase in the industrial countries' fiscal deficit on the global real interest rate, on the relative price, and on the levels of economic activity in the two groups of countries may be illustrated in terms of a four-quadrant diagram (Figure 1). In quadrant I (the upper right-hand quadrant), we show the locus of combinations of real interest rates and output of the industrial countries (SI) which, for a given public sector fiscal position (D), equate the ex ante private saving-investment balance with the ex ante current account balance for the industrial countries. The SI locus slopes downward because of our assumption that a rise in interest rate causes the desired investment to fall relative to intended savings, leading to an improvement in the current account balance in real terms; given the constraint on the current account, output must decline to ensure equality in the new desired pattern of savings and investment. The locus of the constrained current account balance, for a given level of the relative price, $\overline{CA}(p_0)$, slopes upward in (Y, R) space. The SI

locus for the industrial countries and the locus of current account constraint for the developing countries, given the initial fiscal balance (D_0), interest rate (R_0) and the relative price (p_0), are shown in (Y, Y^*) space in quadrant II. Analogously, the saving-investment locus for a given budget deficit and output in the industrial countries and the constrained current account balance for the developing country (given the industrial countries' output level) are shown in quadrant IV (the lower right-hand panel). The initial equilibrium interest rate (R_0), the relative price (p_0), and the output levels in the two countries (Y_0 and Y_0^*) are characterized by the intersection of the two loci in each quadrant (at points shown as A_0) for a given level of the fiscal deficit in the industrial countries.

This diagrammatic presentation, notwithstanding the underlying simplifications, enables us to capture simultaneously the effects of a change in fiscal deficit or of shifts in other exogenous variables in the industrial countries on the real interest rate, relative price, and output levels. Suppose that the industrial countries experience an expansionary fiscal policy or an autonomous increase in private sector investment, or some combination of the two. The effects of this increase are illustrated by shifts in the SI and $\overline{CA}$ curves in all three quadrants. Although the shift in each quadrant could be described in several stages, we show only the short-run final positions to reveal the analytical conclusions.

Starting from the first quadrant, the expansionary fiscal policy shifts the $SI(D_0)$ locus to $SI'(D_1)$, showing an increase in real interest rates to R_1 and an expansion of output of the industrial countries to Y_1 from R_0 and Y_0, respectively. In the fourth quadrant, the $SI(D_0, Y_0)$ locus would correspondingly shift to $SI'(D_1, Y_1)$, and the locus of the current account constraint would shift to $\overline{CA}(Y_1)$; the equilibrium relative price corresponding to the interest rate R_1 would decline to p_1. The new equilibrium levels of income would be determined in the second quadrant at A_1 or A_2, the intersection of $SI_1(D_1, p_1, R_1)$ with $\overline{CA}_1(D_1, p_1, R_1)$, or with $\overline{CA}_2(D_1, p_1, R_1)$. Thus, under this scenario, the new short-run equilibrium would involve a higher world interest rate, a deterioration of the developing countries' terms of trade, and output expansions in the industrial countries. The new short-run equilibrium, however, would not necessarily imply an increase in output for the developing countries even if output expands in the industrial countries. If the output expansion in the industrial countries is not very strong owing to offsetting negative effects from a higher interest rate, the secondary effects of this weak output expansion on the developing countries would easily be outweighed by the negative effects of the higher interest rate; the $\overline{CA}(D_0, p_0, R_0)$ curve

in the second quadrant may shift rightward to, say, $\overline{CA}_1(D_1, p_1, R_1)$. If the developing countries are heavily indebted, this kind of adverse shift is certainly possible, and the developing countries' output would decline as shown at the intersection of $\overline{CA}_1(D_1, p_1, R_1)$ and $SI'(D_1, p_1, R_1)$ in the second quadrant.

I. The Simulation Model

The basic model consists of the following equations: 1/

A. Industrial Countries

Fiscal policy

1. $GDEBT = GDEBT(-1) + GEXPO + GINT - GREV - MONFIN$

2. $GINT = GDEBT(-1) \bullet RN$

3. $GDEFR = (GDEBT/P - GDEBT(-1)/P(-1)) \bullet P$

4. $\ln GREV = \ln GREV(-1) + \underset{(1.0)}{A_1} \ln(Y/Y(-1))$

Real sector

5. $\ln YCR = \underset{(0.333)}{A_2} \bullet \ln (K(-1)/P(-1))$

6. $YC = YCR \bullet P$

7. $\ln(Y/Y(-1)) = \underset{(0.5)}{A_3}\ln(YCR(-1)/Y(-1)) + \underset{(0.296)}{A_4} \bullet \underset{(0.5)}{\theta} \bullet \Delta\ln(GEXPOR)$

8. $YGNP = Y \bullet P - UT + RN \bullet FA(-1) \bullet (1-F) + RF \bullet FA(-1) \bullet F$

9. $I/YC = \underset{(0.17)}{A_6} \bullet R + \underset{(0.34)}{A_7} \bullet YN/YC + \underset{(-0.13)}{A_8} * K(-1)/YC(-1)$

10. $\ln(CP/P) = A_9 \bullet \underset{(0.5)\ (0.53)}{A_{10}}\ln(YDIS/P) + \underset{(0.25)}{A_{11}}\ln(W/P) + \underset{(-0.14)}{A_{12}}NR$
$+ \underset{(-1.5)}{A_{13}}\ln(P/P(-1)) + \underset{(0.5)}{(1-A_9)}\ln(CP(-1)/P(-1))$

11. $YDIS = YGNP - GREV + GINT - \underset{(0.5)}{(1 - \theta)} \bullet D$

1/ The figures directly below the coefficients (within parentheses) indicate the values of the parameters used in the simulation exercises in the baseline scenario.

12. $K = K(-1) \cdot (1 - \theta_2) \cdot P/P(-1) + I$

(0.1)

13. $YN = Y \cdot P$

Financial sector

14. $W = (1 - \theta) \cdot GDEBT(-1) + FA(-1) + K(-1)$

(0.5)

15. $R = RN - \ln P + \ln P(-1)$

Real-external identity

16. $CA = YN - CP - I - GEXPO$

External sector

17. $CA = X - M - UT + RN \cdot FA(-1) \cdot (1-F) + RF \cdot FA(-1) \cdot F$

(0.333) (0.333)

18. $M = MP \cdot MV$

19. $\ln MP = A_{15} \cdot \ln YN + (A_{16} - A_{15}) \cdot \ln P + A_{17} \cdot \ln MV(-1)$

(1.188) (-0.469) (-0.263)

$+ A_{18} * \ln MP(-1)$

(0.369)

20. $\ln MV = A_{19} \cdot \ln(X/P) + A_{20} \cdot \ln(MP/P^*) + A_{22} \cdot \ln MV(-1)$

(0.157) (0.122) (0.695)

21. $CA + CA^* + CAOTR = 0$

22. $FA = FA(-1) + CA$

B. Developing Countries

Real sector and prices

23. $\ln Y^* = A25 \bullet \ln(X/P)$

(0.3)

24. $P^* = PL^*/E$

25. $YN^* = Y^* \bullet P^*$

Fiscal policy

26. $GREV^* = GREVT^* + GREVO^*$

27. $\ln GREVT^* = A30 \bullet \ln MP^*$

(0.98)

28. $\ln GREVO^* = A31 \bullet \ln Y^*$

(1.12)

29. $IMP^* = X + XOTR$

30. $D^* = G^* - GGRANT^* - GREV^*$

31. $GINT^* = RN \bullet (1 - \theta_1) \bullet GDEBTF^*(-1) + RNC \bullet \theta_1 \bullet GDEBTF^*(-1)$

(0.333)

$+ RN^* \bullet GDEBTDL^*(-1) \bullet E$

32. $G^* = GINT^* + GEXPOR^* \bullet PD^*$

33. $GDEBTL^* = GDEBTL^*(-1) + E \bullet (D^* - MONFIN^*)$

Monetary policy

34. $MONL^* = MONL^*(-1) + MONFIN^* \bullet E$

35. $\ln MONDR^* = A_{32} \bullet \ln Y^* - A_{33} \bullet \ln(P(-1)/P(-2))$

(1.21) (1.21)

36. $\Delta \ln PL^{*} = A_{34}(\ln(MON^{*}(-1)/PL^{*}(-1) - \ln MONDR^{*}) + A_{35}\,\Delta \ln(PE)$
(0.33) (0.2)
$+ A_{36}\ln(P(-1) \cdot E(-1)/PL^{*}(-1))$
(0.27)

External sector

37. $FA^{*} = FA^{*}(-1) + CA^{*}$

38. $FINT^{*} = RN \cdot FA^{*}(-1) \cdot (1-F) + RF \cdot FA^{*}(-1) \cdot F$
(0.333) (0.333)

39. $UT^{*} = UTOTR + UT$

40. $YGNP^{*} = Y^{*} + UT^{*} - FINT^{*}$

In addition, the following equation for developing country import demand was used in these simulations in which the exchange rate was allowed to float:

41. $\ln(MV^{*}) = A_{40} \cdot \ln(IMP^{*}(-1)/P(-1)) + A_{41} \cdot \ln YR \cdot A_{42}\ln(p/P^{*})$
(0.627) (0.327) (0.145)

C. Rest of the World

External sector

42. $FAOTR = -FA^{*} - FA$

43. $CAOTR = RN \cdot FAOTR(-1) \cdot (1-F) + RF \cdot FAOTR(-1) \cdot F$

A variable coefficient was added into each equation to ensure that it replicated the baseline data.

D. Definition of variables and some coefficients

The following key defines the variables used in the model. Unless otherwise indicated, the variables with asterisks indicate that they refer to developing countries; the suffix R indicates that the variable is in real terms; the suffix L indicates that the variable is in the currency of the developing country; and the suffix OTR indicates that the variable refers to the rest of the world.

CA	=	current account deficit
CAOTR	=	current account deficit of the rest of the world (including the global discrepancy)
CP	=	private consumption
D	=	government deficit
E	=	exchange rate: units of the developing countries' currency per unit of the industrial countries' currency
F	=	proportion of foreign debt at fixed interest rates
FA	=	foreign assets
FINT	=	foreign interest payments
GDEBT	=	government debt
GDEBTD	=	government domestic debt
GDEBTF	=	government foreign debt
GDEFR	=	real government deficit (increase in real government debt)
G	=	government expenditure and net lending
GEXPO	=	government expenditure on goods and services (excluding interest payments)
GGRANT	=	government grants
GINT	=	government interest payments
GREV	=	government revenue
GREVO	=	government revenues from nontrade taxes
GREVT	=	government revenues from trade taxes
I	=	investment
IMP	=	imports
IMP*	=	total exports to developing countries
K	=	capital stock
M	=	imports of industrial countries from developing countries
MON	=	broad money stock
MOND	=	money demand
MONFIN	=	financing of the deficit through bank borrowing
MP	=	import prices
MV	=	import volume
P	=	consumer price index
R	=	real interest rate, defined as nominal rate less actual inflation
RF	=	average interest rate on fixed-rate foreign debt
RN	=	nominal interest rate
RNC	=	concessional interest rate on developing country borrowing
UT	=	unrequited transfers
W	=	wealth
X	=	exports of industrial countries to developing countries
Y	=	gross domestic product (real)
YC	=	capacity output (nominal)
YDIS	=	disposable income (nominal)
YGNP	=	gross national product
YN	=	gross domestic product (nominal)

θ = Ricardian coefficient
θ_1 = proportion of foreign debt held on concessional terms
θ_2 = rate of depreciation.

II. Values of Parameters Used in Simulations and Data Sources

The behavioral equations and estimates for their parameters are derived from various sources, sometimes with minor adjustments. The parameters in equations (4)-(5), (9), and (27)-(28) are estimated directly from the data based on Knight and Masson (1986). The parameters in equation (9) are approximate averages of those derived in the paper for the United States, Federal Republic of Germany, and Japan.

The relationship determining output in the industrial countries (equation (7)), as noted in the text, has essentially been improvised by the authors. It assumes that half of the difference between real and capacity output is eliminated within a year, but the speed of adjustment can be affected by changes in real government expenditure (see Laidler and O'Shea (1980) for a similar fiscal specification; the value of A_{42} was taken from their estimates).

Private sector consumption behavior (equation (10)), is based on the "no surprise" consumption function estimated for the United States by Blinder and Deaton (1985). Variables which are not relevant for the analysis in this paper were omitted.

The behavioral relationships determining the developing countries' export price (equation (19)), export volume (equation (20)), and the imports of the developing countries (equation (41)), are based on Khan and Knight (1981).

The equation determining real output in the developing country (equation (23)) is based on Goldsborough and Zaidi (1986); their survey of the literature concludes that the value of the parameter A_{25} was between 0.14 and 0.28 for countries subject to foreign exchange rationing. The demand for money function (equation (35)) and the equation determining the price level (equation (36)) in the developing countries are taken from Khan and Knight (1981).

The data used were largely taken from the IMF, International Financial Statistics, the Government Finance Statistics Yearbook, or from the World Economic Outlook (April 1987). Some stock figures were estimated by accummulating the relevant flows. The exchange rate E was derived as the ratio of an aggregate GDP deflator for developing countries and an estimated deflator in U.S. dollars (GDP in U.S. dollars divided by real GDP). Full details are available from the authors on request.

References

Blanchard, Oliver J., "Debt, Deficits, and Finite Horizons," Journal of Political Economy (Chicago), Vol. 93 (April 1985), pp. 223-47.

Blinder, Alan S., and Angus Deaton, "The Time Series Consumption Function Revisited," Brookings Papers on Economic Activity: 2 (1985), The Brookings Institution (Washington), pp. 465-521.

Bovenberg, A. Lans, "Long-Term Interest Rates in the United States: An Empirical Analysis," forthcoming in Staff Papers, International Monetary Fund (Washington, June 1988).

Buiter, Willem H., and James Tobin, "Debt Neutrality: A Brief Review of Doctrine and Evidence," in Social Security versus Private Savings, ed. by George M. von Furstenberg (Cambridge, Massachussetts: Ballinger, 1979), pp. 39-63.

de Leeuw, Frank, and Thomas M. Holloway, "The Measurement and Significance of the Cyclically Adjusted Federal Budget and Debt," Journal of Money, Credit and Banking (Columbus, Ohio), Vol. 17 (May 1985), pp. 232-42.

Goldsborough, David, and Iqbal Zaidi, "Transmission of Economic Influences from Industrial to Developing Countries," Staff Studies for the World Economic Outlook, International Monetary Fund (1986), pp. 150-93.

Khan, Mohsin S., and Malcolm Knight, "Stabilization Programs in Developing Countries: A Formal Framework," Staff Papers, International Monetary Fund (Washington), Vol. 28 (March 1981), pp. 1-53.

Kochin, Lewis A., "Are Future Taxes Anticipated by Consumers? Comment," Journal of Money, Credit and Banking (Columbus, Ohio), Vol. 6 (August 1974), pp. 385-94.

Laidler, David, and Patrick O'Shea, "An Empirical Macro-Model of an Open Economy Under Fixed Exchange Rates: The United Kingdom, 1954-70," Economica, Vol. 47 (May 1980), pp. 141-58.

Masson, Paul R., and Malcolm Knight, "International Transmission of Fiscal Policies in Major Industrial Countries," Staff Papers, International Monetary Fund (Washington), Vol. 33 (September 1986), pp. 387-438.

Muller, Patrice, and Robert Price, "Public Sector Indebtedness and Long-Term Interest Rates," paper presented at the World Bank-Brookings Workshop (unpublished; Washington, September 1984).

Tanner, J. Ernest, "An Empirical Investigation of Tax Discounting: A Comment," Journal of Money, Credit and Banking (Columbus, Ohio), Vol. 11 (May 1979), pp. 214-18.