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An Extended Scenario and
Adjustment Model for Developing Countries

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Abstract

This paper discusses three important extensions to the developing country scenario and adjustment model used in the World Economic Outlook exercises. First, the model is augmented to include fiscal and monetary sectors and now explicitly captures links among government policy, investment, output and inflation. Second, the external sector is modified to allow domestic demand factors to influence imports, as well as allowing flexibility in the financing of imports. Third, the model system is extended to the group of net-creditor countries, and for the oil exporters within this group, oil exports are modeled separately. The revised model is estimated for each of the 95 developing countries and parameter estimates for each of the main equations are presented. The paper also reports the results of four simulation exercises to illustrate how the new model system may be used to quantify the effects of changes in domestic policies and in the external environment.

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Summary

This paper discusses three important extensions of the developing country scenario and adjustment model used in the World Economic Outlook exercises. First, to analyze the impact of changes in domestic policies, fiscal and monetary sectors are introduced and private and public components of aggregate demand are modeled separately. Government revenue is determined endogenously and takes into account the lagged adjustment of revenue to inflation. Government expenditure is divided into current expenditure, which is endogenously determined, and capital expenditure, which is treated as an exogenous policy variable. With regard to the monetary sector, the stock of money is endogenously determined and prices are determined by the interaction of the money demand and supply functions. Government policy influences output directly through the effect of changes in expenditure on aggregate demand and indirectly through the effect of changes in the stock of money and prices on domestic absorption and exports. A change in the government's capital expenditure also affects the economy's productive capacity and the supply of exports.

Second, the external sector is modified to take account of the effect of domestic factors on imports. This is implemented by specifying that imports are externally constrained--and thus determined residually--only when the option of using reserves or foreign borrowing is not available to the country. The model is therefore made more flexible, so that, depending on the availability of reserves or new loans, imports may switch from being residually determined by external financial flows and export earnings, as in the original version of the model, to being determined in a behavioral manner by a mixture of domestic and external factors.

Third, the model system is extended to net creditor countries, whose imports are assumed to be determined primarily by domestic factors. The equation for private absorption is also modified to take account of the absence of external constraints, and for the oil exporters within this group, a specific equation is developed for oil exports. Both export and import equations for the oil exporters are estimated using pooled cross-section time-series data and with cross-country equality restrictions on the slope parameters.

The revised model is estimated separately for each of the 95 developing countries, and parameter estimates are presented for all developing countries, grouped both by geographical region as well as by analytical group, with countries classified according to their predominant export. The paper also presents the results of four simulation exercises to illustrate how the new model system may be used to assess the effects of changes in domestic monetary and fiscal policies and in the external environment.

I. Introduction

A set of developing country models, LDCMOD, developed by Adams and Adams (1989), have been utilized extensively in the *World Economic Outlook* for analyzing the impact on net-debtor developing countries of changes in their external environment. These models have been used to prepare alternative scenarios which quantify, for instance, the likely effect on developing countries of changes in industrial country growth, international interest rates, and the international price of oil. ^{1/} In addition, the models have been used for updating of the IMF staff's projections for individual countries following changes in assumptions regarding the external environment. This is necessitated by the fact that for a large number of mainly medium and small developing countries, staff projections are not available for each semi-annual WEO round, and, in a few cases, may not even be available annually.

This paper reports the results of efforts under way to extend and augment these models in the following three ways. First, to allow an analysis of the effect of changes in domestic policies, and particularly to assess the impact of slippages in the implementation of Fund programs, the models are extended to include fiscal and monetary sectors. The equations for these sectors incorporate error-correction specification which allows policies to have differential short- and medium-term effects. Secondly, a key assumption in the models that imports are residually determined by the foreign exchange available in each country is modified, allowing flexibility in financing imports. Thirdly, the models are extended to the net-creditor countries, most of which are oil exporters. For these countries, oil exports are modelled separately from their non-oil exports, and imports are assumed to be determined by domestic factors.

The models are estimated separately for each of the 95 developing countries. The need to estimate these models for many small- and medium-sized countries for which reliable time-series data on many key variables were not available, imposed a serious constraint in specifying some of the equations. Nevertheless, the estimated models do appear to be robust, and can be highly useful for both simulation and projection adjustment purposes, as well as for analyzing the implications of changes in domestic fiscal and monetary policies.

The rest of the paper is structured as follows: Section II summarizes the main features of the existing model system, and discusses the extensions noted above. Section III specifies the domestic sector including equations for private absorption, government sector, and money, prices and the exchange rate. Section IV specifies the external sector, in which the current and the capital accounts of the balance of payments are modelled separately. Separate equations are specified for exports and imports of goods and nonfactor services, net transfer receipts, net investment income flows, debt and non-debt creating capital flows, and the accumulation of international reserves. For each of the equations in Sections III and IV,

^{1/} See, for example, IMF (1990) and (1991).

estimated parameter coefficients are presented for all developing countries, grouped both by geographical region as well as by analytical group with countries classified according to their predominant export. Section V reports the results of four simulation exercises including the implications of an increase in fiscal deficits as well as monetary expansion, the impact of a fall in world oil prices, and higher growth in industrial countries. Appendix I provides a list of the 95 developing countries and the various country groups and regions referred to in the paper; Appendix II provides a complete listing of the model variables and the equations.

II. Main Features of the Model

The existing model system includes a detailed set of behavioral equations and identities describing the domestic and external sectors of a prototype net-debtor developing economy. 1/ An identical structural model is estimated using historical data for each individual country, but differences across countries are captured by the different parameter estimates. Owing to data limitations and problems with outliers, some of the parameters are constrained to be within a range determined by theoretical considerations.

Output is modeled by disaggregating it into internationally tradable and nontradable goods, but no distinction is made between private and public expenditures. Demand for nontradables is determined endogenously as a function of income, the real exchange rate, and external borrowing. Output is then divided into consumption and investment using historical weights. Inflation is determined by excess demand in the goods market, defined as the deviation of actual from potential output, where the latter is a function of capital stock and the real exchange rate. 2/

LDCMOD has a detailed external sector, including separate equations for import and export volumes, official and private transfers, investment income receipts and debits, non-debt-creating capital flows, new borrowing, and change in reserves. An important feature of the model is the assumption that imports are determined residually by the amount of foreign exchange available. This reflects the external constraints faced by most developing countries following the oil shocks of the 1970s and the international debt problem of the 1980s.

In this paper, LDCMOD is extended in three main directions. First, to permit the model to analyze the impact of changes in domestic policies, fiscal and monetary sectors are introduced and private and public components of aggregate demand are modeled separately. Government revenue is

1/ For a list of net-debtor, and net-creditor countries, see Appendix I.

2/ For alternative specifications of models for developing countries, see, for instance, Khan, Montiel, and Haque (1991), Peterson et al (1991), and NIESR (1993).

determined endogenously and takes into account the lagged adjustment of revenue to inflation. Government expenditure is divided into current expenditure, which is endogenously determined, and capital expenditure, which is treated as an exogenous policy variable.

With regard to the monetary sector, the stock of money is endogenously determined (although, for simulation purposes, it is also possible to consider it as a policy variable) and the model incorporates the role of public sector financing in the determination of the money stock. Prices are determined by the interaction of money demand and supply functions. Government policy influences output directly through the effect of changes in expenditures on aggregate demand, and indirectly through changes in the stock of money and prices, which in turn influence domestic absorption and exports. A change in government's capital expenditure also affects the economy's productive capacity and the supply of exports.

Second, the external sector is modified to take account of the effect of domestic factors on imports. This is implemented by specifying imports to be externally constrained--and thus determined residually--only when the option of using reserves or foreign borrowing is not available to the country. The model is, therefore, made more flexible so that, depending on the availability of reserves or new loans, imports may switch from being residually determined by external financial flows and export earnings as in the original version of the model, to being determined in a behavioral manner by a mixture of domestic and external factors. In addition, the nominal exchange rate, rather than being exogenous, now adjusts endogenously to maintain purchasing power parity in the long run. This is important for an analysis of changes in government policies that may involve large changes in domestic prices relative to foreign prices over a number of years.

Finally, the model system is extended to the group of net-creditor countries. A key assumption here is that the imports of these countries are primarily determined by domestic factors. The equation for private absorption is also modified to take account of the absence of external constraints, and for the oil exporters within this group, a specific equation is developed for oil exports. Both export and import equations for the oil exporters are estimated by pooled cross-section time-series data and imposing cross-country equality restrictions on the slope parameters. Using panel data for this group of countries should improve the reliability of estimates, given the similarities between these countries, and homogeneity of their main export. ^{1/}

In the following sections, the extensions to the model system, including parameter estimates for the new or modified equations, are discussed in detail. The model is estimated separately for each of the 95 developing countries (87 net debtor and 8 net creditor). The estimation

^{1/} The possibility of extending the models along the above lines was pointed out by Adams and Adams (1989).

period is 1973-91 for most countries and equations. 1/ Where the modifications are not significant, the specifications are discussed in less detail and the reader is referred to Adams and Adams (1989). Estimation is carried out by ordinary least squares. Owing to data limitations for many countries, more sophisticated estimation techniques--for example, to take account of simultaneity between equations--were not employed. Moreover, in many cases, stringent constraints had to be imposed on the range of permissible parameter values in view of the limited number of observations and to remove the effects of outlying observations, and extreme estimates. Particular difficulty was encountered in the case of some high-inflation countries in the Western Hemisphere and Africa, especially in estimating the equations for money and prices. Imposing these constraints ensured stability of the estimated models which was important for undertaking the simulation exercises.

III. Domestic Sector

A key extension of the model system relates to the separate modeling of the private and public components of aggregate demand, allowing the model to be used for the analysis of fiscal and monetary policies. A second important innovation in modeling the domestic sector is the attention paid to the interaction between fiscal deficits, monetary growth, inflation, and output. Chart 1 illustrates this interaction, abstracting from other parts of the model. An increase in the exogenous component of public expenditure leads to a higher fiscal deficit and monetary growth, and thus higher inflation. In the short run, as public expenditure increases, the effect on aggregate demand is positive despite crowding out of private absorption. In addition, higher public investment expenditure raises the capital stock, increasing potential output as well as enhancing the supply of exports. In the medium run, further crowding out takes place as higher inflation leads to a reduction in private absorption and, by lowering competitiveness, exports. Inflation also leads to a deterioration of the fiscal balance, both directly due to the lagged response of nominal government revenue to higher prices, and indirectly through lower revenue from taxes and tariffs as GDP and exports are adversely affected in the medium run. These various interrelationships are discussed in detail in the following sections. 2/

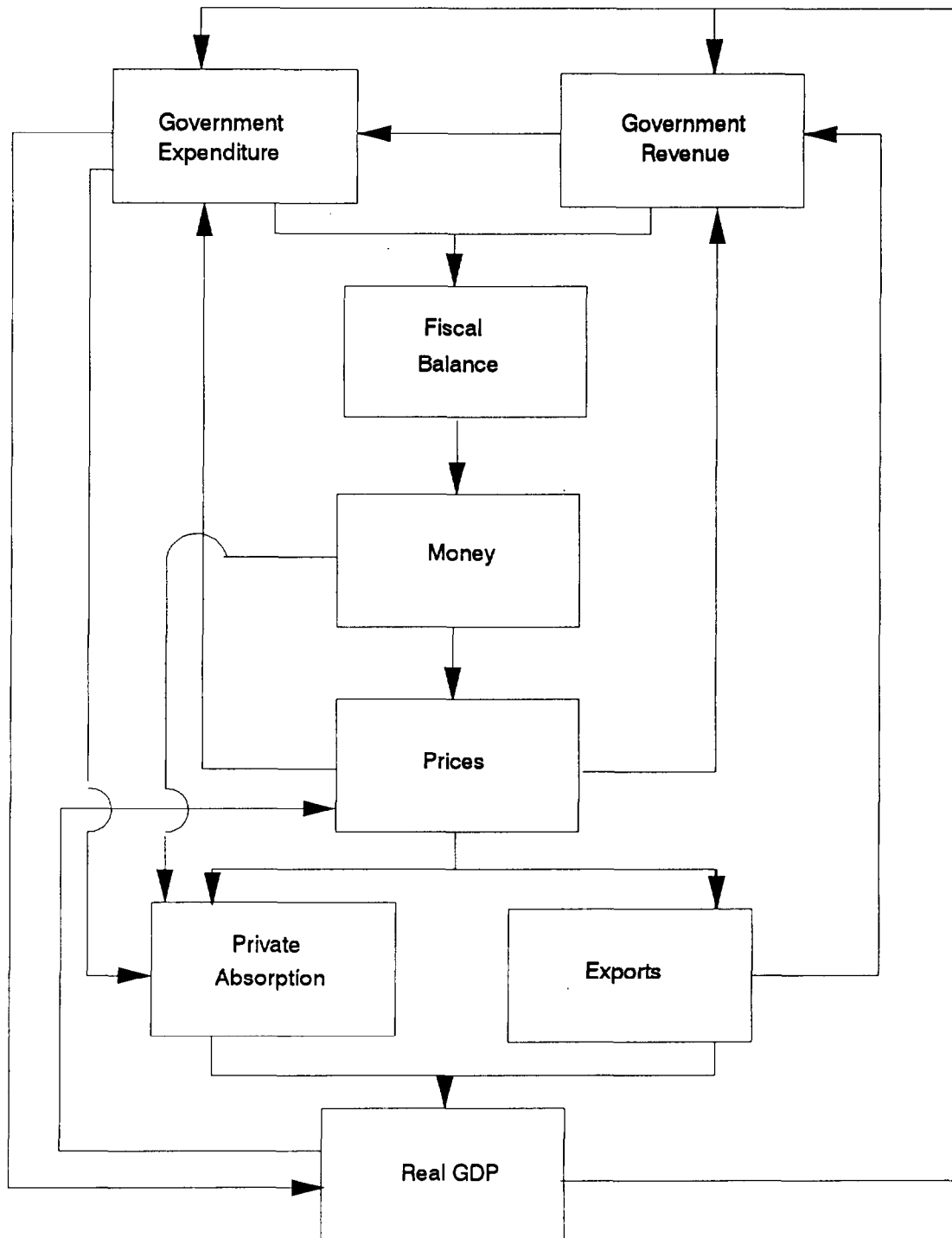
1. Private absorption

Modeling the investment and consumption components of private absorption separately proved impractical because of data problems for a number of countries and the difficulty in identifying a stable investment function, owing in part to the structural differences between the 1970s and

1/ In Adams and Adams (1989), estimation period was 1973-88.

2/ Details of the complete model structure, including all the behavioral equations and the identities, as well as definitions of variables, are provided in Appendix II.

Chart 1. Dynamics of Budget Deficits, Money Growth, Inflation, and Real Output



the finance-constrained environment of the 1980s. Therefore, private absorption is modeled in its aggregate form. In doing so, the degree of crowding out that may result from government activity is taken into account. In the case of many developing countries, evidence suggests that such crowding out may take place directly as resources are claimed by the government, or indirectly, through the price system, in particular through higher interest rates and inflation. ^{1/} Based on this evidence, the formulation adopted here takes account of both the direct and indirect effects of fiscal expenditure on private absorption. Furthermore, the role of financial wealth and access to external loans in determining private absorption is also taken into account, yielding the following specification:

$$\text{NAPR} = F(\text{RI}, \text{GCENL}/\text{PGDP}, \text{TXP}/\text{PGDP}, \text{FMB}/\text{PGDP}, \text{RB}) \quad (1)$$

where NAPR, RI, GCENL, PGDP, TXP, FMB and RB denote, respectively, absorption by the private sector in real terms, real income, total nominal government expenditure, GDP deflator, export prices, nominal money stock, and real external borrowing. ^{2/} Real government expenditure is expected to influence private absorption negatively. ^{3/} The ratio of export prices to GDP deflator, as a proxy for the real exchange rate, captures the effect of terms of trade changes on private expenditures and is expected to have a positive coefficient. The real money supply is used as a proxy for financial wealth (or permanent income) in the absence of a more comprehensive measure. Finally, external borrowing is included in order to capture the effect of external constraints on absorption of net debtor countries. It is expected that access to foreign loans would have a positive effect on real absorption. External borrowing is excluded in the case of net-creditor developing countries, which are assumed not to face external financial constraints. The equation is estimated in log-linear form. With total private sector absorption determined by equation (1), output is allocated to private consumption and investment spending according to fixed shares, estimated using historic data.

Table 1 presents the parameter estimates--obtained from estimating separately the absorption function for each of the 95 countries--averaged

^{1/} See, for example, Haque and Montiel (1991) for a discussion of these issues and evidence in the case of Pakistan.

^{2/} The stochastic term in this equation, and elsewhere in the paper, is suppressed for expositional purposes. All the equations are estimated under the assumption that the error term appears linearly and satisfies the standard OLS properties. Note that for expositional ease the notation used in the text is occasionally a simplification of that used in Appendix II (which is based on the estimation and simulation programs).

^{3/} Throughout this paper data on central, rather than general, government expenditures are used as for most countries time-series data for the latter were not available.

Table 1. Average Estimated Coefficients for Real Private Absorption 1/

	Real Income	Real Exchange Rate	Real Stock of Money	Government Expenditure	Real New Borrowing
Net debtor developing countries	0.79	0.24	0.17	-0.42	0.11
By region					
Africa	0.72	0.27	0.23	-0.52	0.11
Asia	0.80	0.24	0.20	-0.39	0.14
Europe and non-oil Middle East	0.80	0.20	0.08	-0.48	0.13
Western Hemisphere	0.80	0.23	0.09	-0.42	0.04
By predominant export					
Primary products	0.80	0.22	0.15	-0.48	0.11
Manufactures	0.80	0.22	0.17	-0.37	0.09
Services and remittances	0.80	0.20	0.09	-0.66	0.23
Diversified exports	0.80	0.37	0.27	-0.41	0.13
Net creditor developing countries	0.50	0.51	0.19	-0.43	--

1/ Estimation is undertaken for individual countries using annual data for the period 1973-91. The coefficients are averaged using as weights the share of each country's purchasing power parity (PPP) valuation of GDP in the regional or group GDP.

for the four developing country regions (Africa, Asia, Europe and non-oil Middle East, and Western Hemisphere), four country groups according to predominant export of the countries, and for net creditor countries. These estimates suggest that, for net debtors as a whole, the elasticity of private absorption with respect to income is 0.79, and with respect to relative prices it is 0.24. The average elasticities both for real money and real new borrowing are small and positive, but vary considerably across regions. 1/ The elasticity with respect to government expenditure is negative, suggesting a crowding-out of private expenditures resulting from fiscal expansion. Net creditors as a group have a lower income elasticity but a higher price elasticity compared with the net debtors, reflecting the importance of oil prices in determining absorption among the oil exporters in this group.

2. Government sector

In developing countries, general government spending, including expenditures by central and state governments, amounts to on average 30 to 40 percent of GDP. While the share of central government spending is lower, it still amounts to 20 to 30 percent of GDP in the net debtor countries (Table 2). The share among net creditors is approximately 10 percentage points higher, reflecting the relatively more important role played by government amongst the major oil exporting countries. Unlike many conventional models which are based on aggregate government expenditure, a distinction is made here between government current and capital expenditure. Because capital expenditure is more likely to be used as a policy instrument by the authorities, it is treated as an exogenous policy variable. 2/ This seems consistent with the evidence of the last decade on the behavior of public sector investment. 3/

In addition to the distinction between government current and capital expenditures, a second important feature is to allow the possibility of inflation-induced deficits, which arise from a differential impact of inflation on real government expenditure and receipts. 4/ Existing

1/ The low coefficient for real money in the case of Western Hemisphere reflects in part the fact that for countries with very high inflation, this coefficient had to be constrained to modify the impact of large movements in money supply and prices.

2/ For simulation purposes, real government capital expenditure is assumed to be exogenous and equal to its baseline value, except in the fiscal scenario, where nominal capital expenditure is used as a policy variable.

3/ See Jadhav and Singh (1990) and Kumar (1992) for a detailed discussion and evidence on this issue. For evidence on regional variation in total public sector investment, and differences in the productivity of public and private investment see Khan and Kumar (1993).

4/ The adverse effect on government revenues owing to inflation is the well-known Tanzi effect (Tanzi (1978)).

Table 2. Government Expenditure in Developing Countries 1/

(In percent of GDP)

	1986	1989	1992
Net debtor countries	25.0	23.2	21.8
By region			
Africa	27.1	26.9	29.7
Asia	23.8	21.2	19.9
Europe and non-oil Middle East	38.1	32.9	36.0
Western Hemisphere	23.4	23.4	19.1
By predominant export			
Primary products exports	21.0	22.4	20.9
Exporters of manufactures	24.5	23.1	20.8
Services and remittances	36.5	32.0	30.2
Diversified exporters	24.7	23.7	27.5
Net creditor countries	36.4	29.2	31.2

1/ Data are for central government only.

empirical evidence suggests that in the short run the price elasticity of nominal expenditure tends to be larger than the price elasticity of nominal receipts. That is, a rise in the price level causes a greater short-run increase in nominal government expenditure than in nominal revenue, leading to a widening of the fiscal deficit, which in turn leads to higher prices via an increase in the money supply. ^{1/} As discussed below, this important two-way relationship between budget deficits and inflation is captured by the equations for government expenditure and revenue, and those for inflation and the money supply.

Nominal government current expenditure, GCE, is therefore modeled as a function of the domestic price level, as well as GDP and lagged government revenue. The last variable is included on the assumption that the government adjusts its expenditure partly in line with its revenue. To capture the short- versus long-run effects of changes in the price level, an error-correction formulation is adopted. The long-run elasticity with respect to prices is set equal to unity to ensure the long-run homogeneity of degree 1 of nominal expenditure with respect to prices. The following specification is utilized for estimation purposes:

$$\Delta \log(\text{GCE}) = a_0 + a_1 \Delta \log(\text{GDP}) + a_2 \Delta \log(\text{PGDP}) + a_3 \Delta \log(\text{GCR}/\text{PGDP}) \\ - \delta_1 [\log(\text{GCE}_{-1}) - b_1 \log(\text{GDP}_{-1}) - b_2 \log(\text{PGDP}_{-1}) - b_3 \log(\text{GCR}_{-1}/\text{PGDP}_{-1})] \quad (2)$$

where GCR denotes nominal government revenue. The impact of a change in the independent variables is measured by the a_i 's in the short run and by the b_i 's in the long run. b_2 , the long-run elasticity with respect to the price level, is set to equal 1. The difference between the short- and long-run elasticities reflects the speed and extent of adjustment of current government expenditure to each of the explanatory variables. For example the mean-lag of the impact of a change in GDP on GC is equal to $(b_1 - a_1)/b_1 \delta_1$. Thus, the larger is the error-correction coefficient δ_1 , or the smaller is the difference between the short-run and the long-run elasticities, the faster will be the speed of adjustment following a shock to the system. ^{2/}

^{1/} See Aghevli and Khan (1978) for an elaboration of this hypothesis and empirical evidence.

^{2/} Due to lack of available data, the above specification does not take account of the effect of interest payment on expenditure. During the 1980s, in a number of middle-income developing countries, an increasing proportion of fiscal deficit was financed by domestic borrowing, rather than by monetization (Guidotti and Kumar (1991)). This has led to a sharp increase in the ratio of gross domestic debt to GDP and mounting interest payments, which in turn have had an adverse effect on other forms of expenditures.

Nominal government revenue, consisting of tax and nontax receipts, is specified to be a positive function of prices and domestic activity, as well as of imports and exports. The rationale for including the latter two variables is provided by the very significant proportion of government revenue derived from trade taxes in many developing countries. ^{1/} Thus, total nominal revenue is modeled as follows:

$$\begin{aligned} \Delta \log(\text{GCR}) = & \alpha_0 + \alpha_1 \Delta \log(\text{GDP}) + \alpha_2 \Delta \log(\text{PGDP}) + \alpha_3 \Delta \log(\text{M}) + \alpha_4 \Delta \log(\text{X}) \\ & - \delta_2 [\log(\text{GCR}_{-1}) - \beta_1 \log(\text{GDP}_{-1}) - \beta_2 \log(\text{PGDP}_{-1}) \\ & - \beta_3 \log(\text{M}_{-1}) - \beta_4 \log(\text{X}_{-1})] \end{aligned} \quad (3)$$

where M and X are imports and exports in real terms. As in the case of government expenditure, long-run elasticity with respect to the price level, β_2 , was set equal to unity to ensure homogeneity.

Data on government accounts for many developing countries are available only for relatively short periods of time. This meant that reliable estimates of the error-correction coefficients and the long-run elasticities in equations (2) and (3) could not be obtained for each individual country. Instead, based on estimation results for countries with longer data series, and to ensure comparable dynamic properties of the model across countries, the error-correction coefficients in both equations were set equal to 0.30 for all countries. A similar procedure, with appropriate homogeneity conditions, was used to obtain the long-run elasticities. Thus, in the expenditure equation, long-run elasticities with respect to government revenue and GDP, b_1 and b_3 , were set equal to 0.50, and in the revenue equation long-run elasticities with respect to GDP, imports and exports, β_1 , β_3 and β_4 , were respectively set equal to 0.50, 0.25, and 0.25. These are generally larger than the short-run elasticities reported below.

Equations (2) and (3) were estimated conditional on the above long-run elasticities and the error-correction coefficients. The estimated parameters for these functions are shown in Tables 3 and 4, and confirm that for all regions, short-run price elasticities of nominal revenue are smaller than the corresponding elasticities of expenditures. For the net debtors, in the short run, a 1 percent increase in the price level leads to a 0.93 percent increase in nominal expenditure but a 0.81 percent increase in nominal revenue, indicating that inflation leads directly to a deterioration of fiscal balances. In the long run, as noted above, nominal revenue and expenditure increase in proportion to the price level. Short-run income elasticities average around 0.35 in both equations, except for net creditors where in the revenue function, the elasticity is higher. The coefficients on exports and imports in the revenue equation show some variation across

^{1/} See, for instance, Buiter (1986).

Table 3. Average Estimated Coefficients for Central Government Current Expenditure 1/

	Real GDP	GDP Deflator	Real Government Revenue
Net debtor countries	0.35	0.93	0.36
By region			
Africa	0.39	0.95	0.33
Asia	0.33	0.91	0.38
Europe and non-oil Middle East	0.30	0.97	0.43
Western Hemisphere	0.39	0.94	0.33
By predominant export			
Primary products	0.32	0.94	0.36
Manufactures	0.34	0.92	0.37
Services and remittances	0.39	0.91	0.41
Diversified	0.40	0.93	0.36
Net creditor countries	0.30	0.96	0.40

1/ Estimation is undertaken for individual countries using annual data for the period 1973-91. The coefficients are averaged using as weights the share of each country's purchasing power parity (PPP) valuation of GDP in the regional or group GDP.

Table 4. Average Estimated Coefficients for Central Government Revenue 1/

	Real GDP	GDP Deflator	Real Exports	Real Imports
Net debtor countries	0.36	0.80	0.14	0.12
By region				
Africa	0.39	0.72	0.14	0.13
Asia	0.37	0.79	0.13	0.11
Europe and non-oil Middle East	0.20	0.70	0.10	0.10
Western Hemisphere	0.35	0.89	0.15	0.15
By predominant export				
Primary products	0.39	0.84	0.15	0.13
Manufactures	0.30	0.83	0.14	0.13
Services and remittances	0.38	0.64	0.11	0.12
Diversified	0.35	0.64	0.11	0.14
Net creditor countries	0.55	0.89	0.30	0.14

1/ Estimation is undertaken for individual countries using annual data for the period 1973-91. The coefficients are averaged using as weights the share of each country's purchasing power parity (PPP) valuation of GDP in the regional or group GDP.

regions, with Africa and Western Hemisphere having relatively high elasticities underlining the important role which trade taxes play in several countries in these regions. Net creditors have a significantly higher coefficient on exports than net debtors, reflecting the importance of oil exports for government revenues.

The balance on the government's budget, GCB, is given by the following identity:

$$GCB = GCR - GCENL \quad (4)$$

where GCENL is the sum of government nominal current and capital expenditures.

3. Money, prices, and the exchange rate

The common practice of estimating an equation for the stock of money as a function of income and the interest rate is justified on the grounds that the money stocks is determined essentially by demand factors. In many low-income developing countries, however, money markets are not well developed; in others, especially in Asia and Latin America, while financial markets have developed and broadened in recent years, supply-side factors, including public sector financing requirements, remain important in determining the stock of money. The approach adopted here, therefore, is to explicitly take account of the supply-side factors in determining the money stock. Given the supply of money, domestic prices are then determined by the demand for real money. ^{1/}

Two main sources of money supply are domestic credit expansion and changes in official foreign exchange reserves. While reserves are determined primarily by the balance of payments (discussed below), domestic credit is essentially determined by government policy. Credit to the public sector, in particular, depends largely on the magnitude of fiscal deficits, reflecting government expenditure and tax policies. In view of these considerations, the following equation was estimated for the stock of money:

$$\Delta FMB/NGDP = c_0 + c_1(GCB/NGDP) + c_2(\Delta R.e/NGDP) + c_3(\Delta FMB/NGDP)_{-1} \quad (5)$$

^{1/} The determination of the stock of money also depends, of course, on the exchange rate regime. In a fixed exchange rate system, money stock is endogenous because the central bank has to provide the foreign exchange or domestic money that is demanded at the fixed rate. Thus even when capital mobility is less than perfect, the central bank has only limited ability to change the money supply. In this paper, the interdependence between the exchange rate regime and money stock is not taken into account.

where ΔFMB is the change in the nominal stock of broad money, $NGDP$ is nominal GDP, GCB is the nominal government balance and is used as a measure of credit extended to the public sector, ΔR is change in the nominal stock of foreign exchange reserves, and e is the nominal exchange rate; dividing by nominal GDP scales the variables appropriately. The short-run elasticities with respect to the explanatory variables are given by c_1 and c_2 , while the long-run values are $c_1/(1-c_3)$ and $c_2/(1-c_3)$. The estimated coefficients are presented in Table 5. The coefficient on the government balance indicates that a 1 percent increase in deficit for net debtor countries leads to an increase in broad money of 0.58 percent in the short run and 0.78 in the long run. As expected, the change in foreign reserves has a small positive effect.

The price equation is derived as an inverted demand-for-money function. Thus, from the long run relationship: $FMB/PGDP = GDP/v$, where v is the velocity of money, the following error-correction specification is obtained: 1/

$$\Delta \log(PGDP) = d_0 + d_1 \Delta \log(FMB) + d_2 \Delta \log(GDP) - \delta_3 [\log(PGDP_{-1}) - \log(FMB_{-1}) + \log(GDP_{-1})] \quad (6)$$

The long-run elasticities with respect to money and GDP are set equal to 1 and -1, respectively, consistent with the assumption of a constant long-run velocity of money. Based on preliminary estimates and an examination of simulation properties of the model, the error-correction coefficient was set equal to -0.70 for all countries, implying a relatively fast adjustment of prices to changes in the stock of money. 2/

This specification of the price equation captures the inflationary dynamics associated with government policy as discussed earlier; in particular, policy affects prices through monetary growth resulting from the monetization of budget deficits. The estimated parameters for the price equation are shown in Table 6. These short-run elasticities with respect to money and GDP are markedly lower than the long-run elasticities of 1 and -1, respectively. For net debtor countries as a whole, a 1 percent increase in money supply leads to a 0.21 percent increase in prices in the short run. This effect is similar across different regions except for the Western

1/ The interest rate was not included due to lack of consistent and sufficiently long time series. In any case, at least in the past, for many developing countries interest rate was fixed for relatively lengthy periods of time.

2/ Lower values of the error-correction coefficient, by reducing the speed of adjustment of prices to money, caused convergence problems and gave implausible simulation results, in particular, in the case of high inflation countries.

Table 5. Average Estimated Coefficients for Broad Money 1/

	Government Balance	Change in Reserves	Lagged Money
Net debtor countries	-0.58	0.08	0.26
By region			
Africa	-0.50	0.07	0.28
Asia	-0.64	0.10	0.24
Europe and non-oil Middle East	-0.63	0.08	0.29
Western Hemisphere	-0.50	0.05	0.29
By predominant export			
Primary products	-0.52	0.09	0.29
Manufactures	-0.64	0.09	0.25
Services and remittances	-0.56	0.08	0.20
Diversified	-0.50	0.06	0.29
Net creditor countries	-0.55	0.09	0.30

1/ Estimation is undertaken for individual countries using annual data for the period 1973-91. The coefficients are averaged using as weights the share of each country's purchasing power parity (PPP) valuation of GDP in the regional or group GDP.

Table 6. Average Estimated Coefficients for GDP Deflator 1/

	Real GDP	Broad Money
Net debtor Countries	-0.08	0.21
By region		
Africa	-0.16	0.20
Asia	-0.01	0.19
Europe and non-oil		
Middle East	-0.11	0.20
Western Hemisphere	-0.18	0.28
By predominant export		
Primary products	-0.14	0.20
Manufactures	-0.05	0.23
Services and remittances	-0.03	0.20
Diversified	-0.15	0.19
Net creditor countries	-0.13	0.17

1/ Estimation is undertaken for individual countries using annual data for the period 1973-91. The coefficients are averaged using as weights the share of each country's purchasing power parity (PPP) valuation of GDP in the regional or group GDP.

Hemisphere where it is larger, reflecting in part the higher variability of inflation.

With regard to the determination of the exchange rate, the modeling difficulties are well-known. In the case of many developing countries, the modeling problem is compounded by the fact that the nominal rate is often kept fixed for long periods of time at a level that may not be justified by the fundamentals. ^{1/} In view of this, one option would have been to assume that for the duration of any simulation exercise, the exchange rate is exogenous. This would have been inappropriate, however, when a simulation entailed a significantly different inflationary path compared to the baseline. To overcome this problem, it is assumed that purchasing power parity holds in the long run, although in the short run significant deviations from it may occur. ^{2/} Ideally it would be appropriate to take account of the exchange rate regime in modeling the exchange rate. But quite apart from the modeling difficulties, it is not clear that for simulation purposes such an approach would have any additional benefits over what is attempted here. This is because over the medium term, large deviations from purchasing power parity are not expected, in general, to be sustainable, regardless of exchange rate regime. Thus, the following error-correction formulation for the nominal exchange rate is adopted :

$$\Delta \log(e) = \alpha \Delta \log(\text{PGDP}/\text{PGDP}^*) - \delta_4 [\log(e_{-1}) - \log(\text{PGDP}_{-1}/\text{PGDP}^*_{-1})] \quad (7)$$

where e is the nominal exchange rate and PGDP^* is foreign prices (defined as the GDP deflator for industrial countries in U.S. dollars). ^{3/} Estimating this equation for high-inflation countries, or for countries where the exchange rate is fixed with occasional realignments, was particularly problematic, and the parameter estimates varied considerably across countries. This resulted from the high variability in the response of the exchange rate to prices in different time periods across different countries. To avoid convergence problems, and to ensure that model properties conform to prior expectations, we set the short-run coefficient, α , equal to 0.50, and the error-correction coefficient, δ_4 equal to 0.20 for all countries. These values imply that the nominal exchange rate adjusts to a price shock by 50 percent after one year and by nearly 80 percent after five years.

^{1/} See, for instance, Kumar and Sephton (1993).

^{2/} Note that when the exchange rate is adjusted only discretely an error-correction formulation would only be an approximation to a more appropriate limited-dependent specification of the equation. See, for example, Samiei (1989).

^{3/} The exchange rate in equation (7) is the dollar exchange rate. It would have been more appropriate to model the effective rate, but this was not feasible due to data problems. Moreover, the dollar rather than the effective rate is required for calculations for the simulation period.

IV. External Sector

The current and the capital accounts of the balance of payments are modeled separately. The current account balance is disaggregated into exports and imports of goods and nonfactor services, net transfer receipts, and net investment income flows. For the capital account, separate equations are specified for non-debt-creating capital flows, net external borrowing, and the accumulation of international reserves.

1. Exports of goods and nonfactor services

Exports are disaggregated into non-oil, oil, and nonfactor services. The specification for net debtors assumes that non-oil exports are determined by both supply and demand factors. Demand is assumed to depend on export prices relative to world prices and world income, while supply depends on export prices relative to the domestic price of nontradables and the capital stock in the tradable sector:

$$TXQN^d = F(TXP/TXP^*, Y^*) \quad (8)$$

$$TXQN^s = F(TXP/PGDP, K) \quad (9)$$

where $TXQN$ is non-oil exports, d and s denote demand and supply respectively, TXP is export price, K is the domestic capital stock, and $*$ denotes world. From these structural equations, the reduced form equations for non-oil export volume and prices are derived. In the case of net creditor oil exporters, which have only negligible non-oil exports, both non-oil exports and their prices are treated as exogenous.

The estimation results are reported in Tables 7 and 8. These indicate that for net debtors, the elasticity of non-oil export volume with respect to world income is, on average, above unity, underlining the high sensitivity of non-oil exports to external demand. The elasticity has the lowest value in the case of Africa, and the highest for Europe and the non-oil Middle East. When China and India, where the adoption of export oriented policies is relatively recent, are excluded, the average income elasticity in Asia increases to 2.47 and for exporters of manufactures, to 2.21. Thus, in general, exporters of manufactures have a much higher foreign income elasticity than primary product exporters. The elasticity of export volumes with respect to relative prices is also broadly as expected with the elasticity for the exporters of manufactures markedly higher than that for primary product exporters. Capital stocks influences non-oil export volumes for most groups, with the highest impact for exporters of manufacturers.

The estimation results for the price equation are similar to those in Adams and Adams (1989). They indicate a very small impact of capital stock and foreign demand on export prices in all regions. The elasticity with

Table 7. Average Estimated Coefficients for Non-Oil Export Volumes 1/

	Real Capital Stock	Relative Price	World Income
Net debtor countries	0.38	-0.34	1.24
By region			
Africa	0.06	-0.31	0.83
Asia	0.48	-0.43	1.28
Europe and non-oil	0.08	-0.32	2.36
Middle East			
Western Hemisphere	0.40	-0.17	1.10
By predominant export			
Primary products	0.31	-0.17	1.28
Manufactures	0.46	-0.42	1.17
Services and remittances	0.32	-0.27	0.95
Diversified	0.18	-0.21	1.31

1/ Estimation is undertaken for individual countries using annual data for the period 1973-91. The coefficients are averaged using as weights the share of each country's purchasing power parity (PPP) valuation of GDP in the regional or group GDP.

Table 8. Average Estimated Coefficients for Non-Oil Export Price 1/

	World Income	Relative Price	Real Capital Stock
Net debtor countries	0.05	0.84	-0.03
By region			
Africa	0.01	0.66	-0.02
Asia	0.06	0.80	-0.03
Europe and non-oil	0.03	0.91	-0.02
Middle East			
Western Hemisphere	0.04	0.97	-0.05
By commodity			
Primary products	0.03	0.90	-0.04
Manufactures	0.05	0.88	-0.03
Services and remittances	0.04	0.81	-0.02
Diversified	0.04	0.66	-0.05

1/ Estimation is undertaken for individual countries using annual data for the period 1973-91. The coefficients are averaged using as weights the share of each country's purchasing power parity (PPP) valuation of GDP in the regional or group GDP.

respect to world prices, however, is not significantly different from unit in most regions, indicating that changes in world prices are largely transmitted into export prices.

The volume of oil exports by net debtors as a whole is assumed to be exogenous and is allocated across individual countries according to historical shares:

$$\text{Net debtors: } TXQO = F(\text{Total oil exports of net debtor countries}) \quad (10)$$

where TXQO is oil exports by individual net debtor countries.

Oil exports by net creditor oil exporters on the other hand, are assumed to be determined by oil prices relative to world prices, (industrial countries) world GDP, and a time trend (which captures the long-run tendency for both a decline in energy intensity of production, and a substitution away from oil). To allow for dynamic adjustment over time, the lagged value of oil exports is also included:

$$\text{Net creditor oil exporters: } TXQO = F(TXQO_{-1}, TXPO/P^*, Y^*, t) \quad (11)$$

where TXPO is the price of oil, P^* is industrial country GDP deflator, Y^* is industrial country GDP, and t is a time trend. Oil export equations for the oil exporting countries are estimated by imposing cross-country equality restrictions on the parameters (except for the intercepts). This should give more reliable estimates than using data on individual countries, given the homogeneity of oil and similarity between net creditor oil exporters. The parameter estimates, presented in Table 9, all have the expected signs and magnitudes, and suggest that holding world income and prices constant, exports of oil exporters fall, on average, by 2 percent a year. ^{1/}

^{1/} This trend decline counters the otherwise high long-run elasticity of oil export volume with respect to world income.

Table 9. Panel Data Parameter Estimates for Oil
Export Volumes: Oil Exporting Net Creditors 1/

Lagged oil exports	0.82
Relative price	-0.18
Real GDP in industrial countries	0.63
Trend	-0.02

1/ Estimation is undertaken using a panel of
cross-section time series data (for the seven
oil exporting countries for the period 1973-91).

World oil prices are assumed to be determined exogenously and the
dollar export price of oil in each individual net debtor or net creditor
country, TXPO, is assumed to follow the world oil price:

$$TXPO = F(\text{World oil price}) \quad (12)$$

Exports of nonfactor services, XNFS, comprise receipts from tourism,
banking, and other services. For net debtor countries, these exports, in
current dollar terms, are assumed to depend on the level of dollar GDP in
industrial countries:

$$XNFS = F(\text{Industrial country current dollar GDP}) \quad (13)$$

In the case of oil exporting net creditors, these exports are relatively
small and thus are treated exogenously.

2. Imports of goods and nonfactor services

A key feature of the existing model system is the assumption that
imports are determined residually by the foreign exchange available in each
country. Foreign exchange, in turn, is a function of export earnings,
transfer receipts, and net capital flows. The assumption reflects the
constraint on a majority of developing countries in the 1980s that resulted
primarily from the external debt crisis, and the virtual cessation of new
commercial bank lending. This feature of the model is modified in the new

version to allow flexibility in financing imports which lets domestic factors play a role.

It is assumed that for each of the net debtor countries, total imports switch between being fully constrained by external financing and being determined by a mixture of domestic and external factors, depending on the size of a country's foreign exchange reserves. ^{1/} Chart 2 illustrates the regime switch and the various factors affecting the determination of imports. When reserves are sufficiently high, the left panel is the relevant one and actual imports are determined by desired imports. When reserves are low, the right panel is the relevant one and imports are constrained. Imports may be further limited in this case when external borrowing is also constrained. These different regimes and constraints are amplified in the equations below.

If the reserves-to-import ratio is low, then imports are constrained by the amount of foreign exchange available: ^{2/}

$$\text{Net debtors: } M^C = (X*TXP + T - \Delta R) / TMP \quad (14)$$

where M^C denotes total constrained imports in real terms, $X*TXP$ is total export revenue, T is the sum of net transfer receipts, net investment income receipts and net capital inflows (which will be discussed later), ΔR denotes change in international reserves, and TMP is the price of imports.

When imports are equal to constrained imports, foreign reserves are exogenously determined. One of the key items in net capital inflows is new borrowing, which, as discussed later, could be constrained depending on the debt/GDP ratio. Therefore, two types of potential constraints, in effect, operate on imports; one results from the availability of reserves and the other from the access to new borrowing from the international capital markets.

In contrast, when the reserves-to-import ratio is sufficiently high, imports are determined by the following behavioral equation:

$$\text{Net debtors: } M^U = F(TMP/PGDP, RAN, (R/M)_{-1}, X) \quad (15)$$

^{1/} See Samiei (1988) for a discussion of external constraints in the determination of imports in different developing country regions in the context of a switching-regression framework.

^{2/} Reserves are considered low when the average reserves-to-import ratio for the previous three years is below 0.25, or if the current stock of reserves would become negative if the desired imports, given by equation (15) below, were to be realized.

where M^u is unconstrained imports and RAN is expenditure on home goods. Exports are included so that external factors are to some extent taken into account, even when the country is not considered to be externally constrained. The presence of the lagged reserves-to-import ratio also generates a response of imports to the change in external environment in the medium term. 1/ The results of estimating this unconstrained equation over the historical period are reported in Table 10, and indicate an average elasticity of expenditure on home goods of 0.74 and an average relative price elasticity of -0.37. Both real export earnings and external reserves also have positive effect on imports.

Given total imports, division of imports between oil and non-oil imports for the simulation period is determined by their relative shares computed from historical data.

Non-oil and oil import prices, TMPN and TMPO, are determined as follows:

$$TMPN = F(\text{World prices of manufactured goods, and of non-oil primary commodities}) \quad (16)$$

$$TMPO = F(\text{World oil price}) \quad (17)$$

When total imports are unconstrained, international reserves are residually determined: 2/

$$\Delta R = X \cdot TXP - M \cdot TMP + T, \quad \text{when } M = M^u \quad (18)$$

Imports of net creditors in the short run are assumed not to be externally constrained and are determined primarily by domestic factors, while foreign reserves adjust residually. Foreign reserves, however, continue to play a role in the determination of imports in the medium term. These assumptions are reflected in the following specification:

$$\text{Net creditors: } TMQN = F(TMP/PNTD, Y, (R/M)_{-1}, M_{-1}) \quad (19)$$

1/ For a comparable specification see Khan and Knight (1988).

2/ Note that this is also the equation for reserves in the case of net creditors, for whom imports are assumed never to be externally constrained.

Chart 2. Determination of Imports

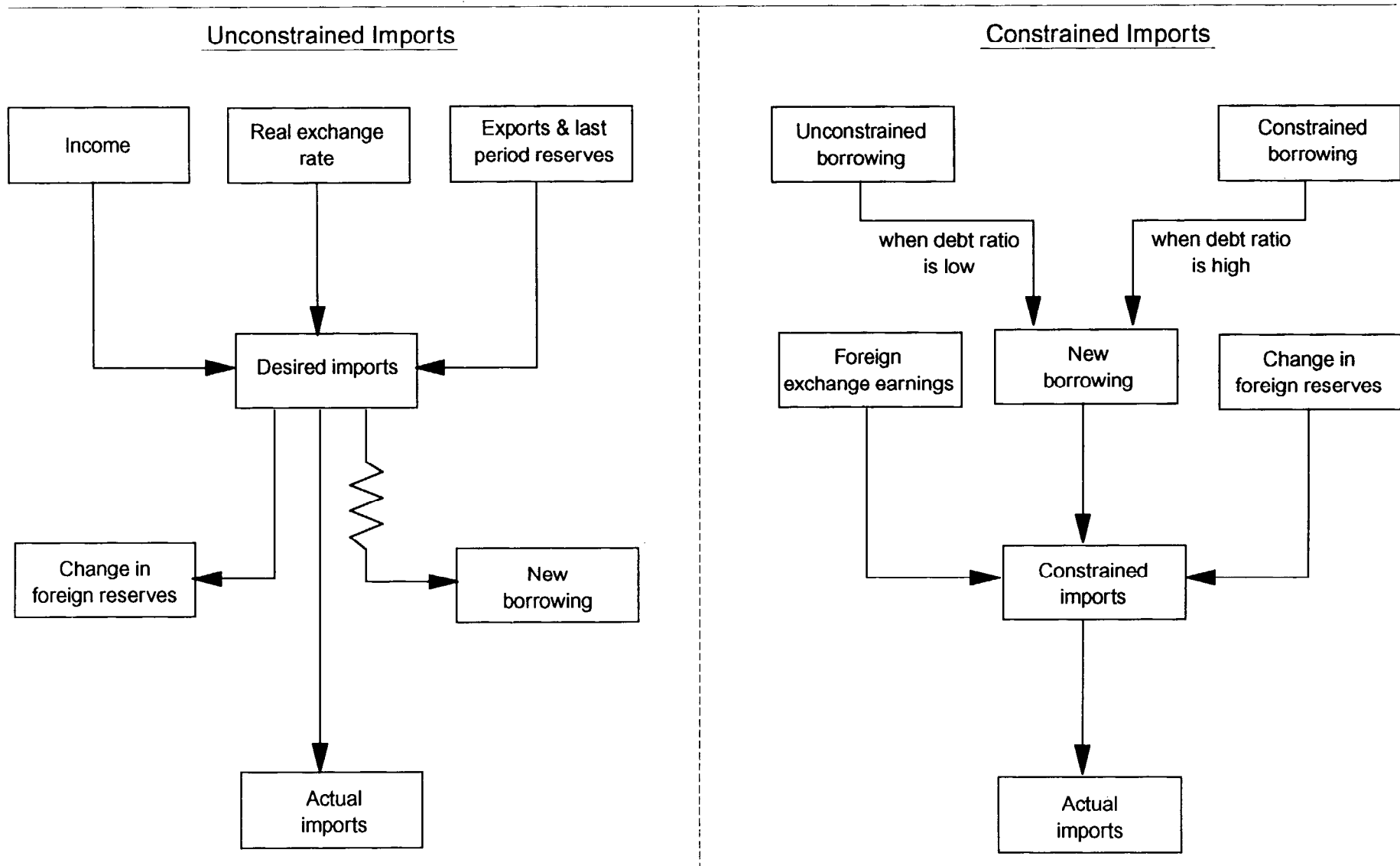


Table 10. Average Estimated Coefficients for Unconstrained Merchandise Imports 1/

	Expenditure on Home Goods	Real Export Earnings	Relative Prices	Reserve to Import Ratio
Net debtor countries	0.74	0.36	-0.37	0.28
By region				
Africa	0.55	0.25	-0.38	0.47
Asia	0.77	0.41	-0.30	0.27
Europe and non-oil				
Middle East	0.74	0.34	-0.31	0.18
Western Hemisphere	0.77	0.32	-0.50	0.26
By predominant export				
Primary products	0.69	0.32	-0.32	0.36
Manufactures	0.78	0.37	-0.32	0.28
Services and remittances	0.67	0.36	-0.33	0.18
Diversified	0.54	0.36	-0.28	0.45

1/ Estimation is undertaken for individual countries using annual data for the period 1973-91. The coefficients are averaged using as weights the share of each country's purchasing power parity (PPP) valuation of GDP in the regional or group GDP.

where TMQN denotes non-oil imports, TMP is import price, PNTD is the price of nontradables, and Y is income. 1/ As in the case of oil exports, slope coefficients were restricted to be equal across all net creditor oil exporting countries. Moreover, the effect of private and government income is separated to allow different absorption elasticities which could result from the fact that the government is a major importer, and oil revenue is largely taxed (and spent) by it. 2/ The estimation results indicate a small price elasticity, a small but positive response to foreign exchange reserves, and a significantly larger absorption elasticity for the government than for the private sector (Table 11).

Table 11. Panel Data Parameter Estimates for
Non-Oil Import Volumes: Oil Exporting Net
Creditors 1/

Lagged non-oil imports	0.37
Relative price	-0.06
Real private absorption	0.07
Real government spending	0.33
Reserve-to-import ratio	0.06

1/ Estimation is undertaken using a panel of cross-section time series data (for the seven oil exporting countries for the period 1973-91).

3. Transfers and net investment income

The equations for private and official transfers, BTRP and BTRG, are as follows:

1/ The price of nontraded goods is constructed according to the following definition: (nominal GDP - nominal value of exports)/volume of nontradables. This measure was only used in the case of net creditors where GDP deflator (which incorporates movements in oil prices) was deemed inappropriate as a measure of domestic prices.

2/ See, for example, Aghevli and Sassanpour (1991) for a discussion of this issue in the case of the Islamic Republic of Iran.

$$\text{BTRP} = \text{F}(\text{Export earnings of Middle East oil exporters,} \\ \text{European GDP}) \cdot \frac{1}{} \quad (20)$$

$$\text{BTRG} = \text{F}(\text{Official development assistance}). \quad (21)$$

Equation (20) reflects the fact that a bulk of private transfers in the Asian and African countries have been remittances mainly from the industrial countries in Europe and the high income oil exporters in the Middle East.

Investment income credits, BXSI, are specified to depend on a country's stock of foreign assets and their rate of return, which is proxied by the London interbank offered rate (LIBOR) on six-month dollar deposits. Two categories of investment income debits are considered: direct investment debits, BMSDI, which are modeled as a function of GDP, and other debits, BMSNDI, which comprise interest payments on external debt and are modeled as a function of debt-service payments:

$$\text{BXSI} = \text{F}(\text{LIBOR} \cdot \text{R}) \quad (22)$$

$$\text{BMSDI} = \text{F}(\text{GDP}) \quad (23)$$

$$\text{BMSNDI} = \text{F}(\text{Debt-service payments}) \quad (24)$$

4. Capital account

The capital account is disaggregated into three components: non-debt-creating capital flows, net external borrowing (defined as new borrowing less amortization), and the accumulation of international reserves. The determination of reserves was noted above, and the other equations, discussed below, are essentially unchanged from the existing version of LDCMOD.

Non-debt-creating capital flows, NDKFD, comprise mainly direct foreign investment and portfolio equity flows, but also include new allocation of SDRs, valuation adjustments, and a balancing item necessary to reconcile the discrepancies between the current and capital account of the balance of payments. While in theory there are a large number of factors that affect these flows, in practice, domestic economic performance proxied by the change in domestic GDP appears to be a key determining variable. Thus, the following specification is used:

$$\text{NDKFD} = \text{F}(\Delta \text{GDP}) \quad (25)$$

¹/ Note that export earnings of the Middle East oil exporters are not included in the case of net creditor oil exporters.

New external borrowing is assumed to depend on whether or not a country has access to the international financial markets. If the debt-to-GDP ratio is high (the average over 1989-92 is above 2), then borrowing is assumed to be constrained and is determined by

$$B^C = \text{Average amount of dollar financing received over the period 1988-92 } \underline{1/} \quad (26)$$

where B^C denotes constrained borrowing. If, on the other hand, external debt is not too large (debt-to-GDP ratio is below 2), B is determined by real LIBOR, terms of trade changes (ΔTOT), domestic GDP, and lagged new borrowing:

$$B^U = F(\text{Real LIBOR}, \Delta TOT, \text{GDP}, B_{-1}) \quad (27)$$

where B^U is unconstrained borrowing.

Amortization payments, AP , are assumed to be related to external debt, lagged one year:

$$DSPT = F(D_{-1}) \quad (28)$$

Total stock of external debt, D , is then determined by net external borrowing, B , and last period's stock of debt adjusted for valuation effects:

$$D = (1 + u) * (1 - v) * D_{-1} + B + \text{debt-reduction operations} \quad (29)$$

where u is the proportional change in the dollar multilateral exchange rate (MERM) between $t-1$ and t , and v is the share of debt in non-dollar currencies. Debt-reduction operations are exogenous.

Finally, interest payments on outstanding external debt are modeled as a function of current and past LIBOR in order to allow differential interest rates on borrowings of different vintages:

1/ In Adams and Adams (1989), the period is 1982-88.

$$\text{Interest payments due} = \sum a_i \text{LIBOR}_{t-i} D_{-1} \quad (30)$$

where a_i 's are weights that sum to unity.

V. Simulation Experiments

The results of four simulation exercises are reported here to illustrate how the new model system may be used to assess the effects of changes in domestic policies and in the external environment. Two of the simulations examine the implications of an increase in government expenditure and excessive monetary expansion. Two other simulations consider the impact on developing countries of a fall in world oil prices and higher growth in industrial countries. Before discussing the simulation results reported below, some long-run properties of the model are worth emphasizing.

In the long run, nominal variables, including money, prices, and the exchange rate move proportionally for any given level of output. Nominal shocks, however, may have long-run real effects to the extent that the capital stock (and thus productive capacity) or the composition of output (between the private and public sector) are affected by short-run dynamics. For instance, the private absorption equation allows for an increase in government expenditure to crowd out private absorption to such an extent that output is not neutral to the composition of final demand. In addition, government nominal expenditure and revenue are homogeneous of degree one in prices in the long run. Although in the long run a balanced budget is not imposed, the inclusion of revenue in the expenditure functions ensures that these two variables do not deviate from each other significantly.

1. Increase in government expenditure

In this scenario, government capital expenditure in nominal terms is assumed to rise 20 percent above the baseline for the period 1993 to 1998. ^{1/} In the initial year, reflecting this stimulus, real output rises by 3/4 of 1 percent above the baseline in the net debtor countries, and by 2 percent in the net creditor countries (Table 12). The increase in capital expenditure also raises potential output and augments the capital stock, which in turn increases export capacity. This short-run beneficial impact on output is smallest in the Western Hemisphere and largest in Africa, reflecting, in part, the differing share of government expenditure in GDP. By 1995, the gain in output is virtually eliminated in all regions, reflecting the adverse effects both on private absorption and exports of

^{1/} This is equivalent to an increase in the range of 5 to 10 percent in total government expenditure in most developing countries.

Table 12. Medium-Term Implications of Simulations: 20 Percent Increase in Government Capital Expenditure, 1993-98

(Difference from the reference scenario in percent)

	1993	1995	1998		1993	1995	1998
Net debtor countries				By predominant export			
Real GDP	0.7	-0.2	-0.4	Primary products exporters			
GDP deflator	0.2	2.0	6.3	Real GDP	0.6	-0.4	-0.4
Broad money	1.1	3.8	8.0	GDP deflator	0.3	3.8	12.9
Fiscal balance 1/	-0.8	-0.8	-0.7	Broad money	1.7	6.4	15.8
Export volume	0.1	--	-0.3	Fiscal balance 1/	-0.7	-0.7	-0.5
Import volume	0.5	0.1	--	Export volume	0.1	--	-0.2
Current account balance 2/	-0.6	-0.1	-0.1	Import volume	0.3	0.1	0.2
Reserve import ratio	-0.8	-0.3	-0.5	Current account balance 2/	-0.3	-0.2	-0.8
Debt ratio 2/	-0.1	-0.2	-0.4	Reserve import ratio	-0.4	-0.2	-1.8
Debt-service ratio 2/	--	--	--	Debt ratio 2/	-0.2	-0.3	--
				Debt-service ratio 2/	--	--	--
By region				Exporters of manufactures			
Africa				Real GDP	0.6	-0.3	-0.5
Real GDP	1.4	0.2	-0.1	GDP deflator	0.1	1.2	4.0
GDP deflator	0.1	2.9	8.6	Broad money	0.8	2.5	5.3
Broad money	1.9	6.1	11.2	Fiscal balance 1/	-0.7	-0.7	-0.6
Fiscal balance 1/	-1.0	-1.0	-0.8	Export volume	0.1	--	-0.4
Export volume	--	-0.1	-0.3	Import volume	0.4	-0.1	-0.2
Import volume	0.2	0.1	0.3	Current account balance 2/	-0.4	0.1	0.2
Current account balance 2/	-0.2	--	-0.1	Reserve import ratio	-0.8	-0.1	0.1
Reserve import ratio	-0.4	-0.5	-1.2	Debt ratio 2/	-0.1	-0.2	-0.2
Debt ratio 2/	--	-0.3	-0.9	Debt-service ratio 2/	--	--	--
Debt-service ratio 2/	--	--	-0.1				
Asia				Service and remittance countries			
Real GDP	0.8	-0.3	-0.5	Real GDP	1.1	-0.2	0.2
GDP deflator	0.2	1.8	5.4	GDP deflator	0.4	3.8	9.9
Broad money	1.0	3.1	5.7	Broad money	2.1	6.5	14.2
Fiscal balance 1/	-0.9	-0.9	-0.7	Fiscal balance 1/	-1.5	-1.4	-1.3
Export volume	0.1	-0.1	-0.4	Export volume	0.1	--	-0.2
Import volume	0.7	--	-0.2	Import volume	1.1	0.3	0.1
Current account balance 2/	-0.7	0.1	0.3	Current account balance 2/	-0.7	-0.3	-0.4
Reserve import ratio	-0.9	-0.1	0.5	Reserve import ratio	-0.9	-0.8	-1.2
Debt ratio 2/	-0.1	-0.2	-0.5	Debt ratio 2/	-0.3	-0.3	-0.3
Debt-service ratio 2/	--	--	-0.1	Debt-service ratio 2/	--	--	--
Europe and non-oil Middle East				Diversified exporters			
Real GDP	1.1	0.3	0.2	Real GDP	1.2	--	-0.3
GDP deflator	0.1	1.5	4.6	GDP deflator	0.1	2.2	7.2
Broad money	1.4	3.7	6.9	Broad money	1.3	4.1	8.1
Fiscal balance 1/	-1.0	-1.0	-0.9	Fiscal balance 1/	-1.2	-1.2	-1.1
Export volume	0.1	--	-0.1	Export volume	--	-0.1	-0.3
Import volume	0.8	0.4	0.2	Import volume	0.9	0.2	-0.2
Current account balance 2/	-0.6	-0.7	-0.4	Current account balance 2/	-1.2	-0.6	0.1
Reserve import ratio	-0.9	-1.3	-2.8	Reserve import ratio	-0.9	-0.8	-0.6
Debt ratio 2/	-0.1	-0.1	--	Debt ratio 2/	--	--	-0.5
Debt-service ratio 2/	--	--	--	Debt-service ratio 2/	--	--	--
Western Hemisphere				By miscellaneous criteria			
Real GDP	0.3	-0.3	-0.2	Fifteen heavily indebted countries			
GDP deflator	0.1	2.1	7.9	Real GDP	0.4	-0.2	-0.2
Broad money	1.1	4.5	12.8	GDP deflator	0.1	2.1	7.8
Fiscal balance 1/	-0.5	-0.5	-0.5	Broad money	1.1	4.6	12.3
Export volume	--	--	-0.1	Fiscal balance 1/	-0.5	-0.5	-0.6
Import volume	0.3	0.1	0.4	Export volume	--	--	-0.1
Current account balance 2/	-0.3	-0.3	-0.9	Import volume	0.3	0.2	0.3
Reserve import ratio	-0.6	-0.5	-2.2	Current account balance 2/	-0.3	-0.3	-0.9
Debt ratio 2/	-0.1	--	0.2	Reserve import ratio	-0.6	-0.6	-2.3
Debt-service ratio 2/	--	--	--	Debt ratio 2/	-0.1	--	0.2
				Debt-service ratio 2/	--	--	--
By financial criteria				Small low-income countries			
Countries with recent debt-servicing difficulties				Real GDP	1.6	-0.5	-0.4
Real GDP	0.5	-0.1	-0.2	GDP deflator	0.4	5.5	14.1
GDP deflator	0.1	2.3	7.9	Broad money	3.0	9.2	17.4
Broad money	1.2	4.8	12.1	Fiscal balance 1/	-1.6	-1.4	-1.1
Fiscal balance 1/	-0.6	-0.6	-0.6	Export volume	0.2	-0.1	-0.3
Export volume	--	--	-0.1	Import volume	0.6	0.2	0.1
Import volume	0.4	0.2	0.3	Current account balance 2/	-0.7	--	0.4
Current account balance 2/	-0.4	-0.3	-0.7	Reserve import ratio	-0.7	--	0.2
Reserve import ratio	-0.6	-0.6	-2.1	Debt ratio 2/	-0.8	-1.6	-1.5
Debt ratio 2/	-0.1	-0.1	--	Debt-service ratio 2/	-0.1	-0.1	-0.1
Debt-service ratio 2/	--	--	--				
Countries without recent debt-servicing difficulties				Net creditor countries			
Real GDP	0.8	-0.3	-0.5	Real GDP	2.1	1.3	1.0
GDP deflator	0.2	1.9	5.5	GDP deflator	0.1	1.9	7.9
Broad money	1.1	3.3	6.0	Broad money	1.9	6.4	14.1
Fiscal balance 1/	-1.0	-0.9	-0.7	Fiscal balance 1/	-2.0	-2.1	-1.7
Export volume	0.1	-0.1	-0.4	Export volume	0.1	0.3	0.5
Import volume	0.6	--	-0.1	Import volume	1.4	1.6	0.6
Current account balance 2/	-0.7	--	0.2	Current account balance 2/	-1.7	-1.8	-1.0
Reserve import ratio	-0.8	-0.1	0.3	Reserve import ratio	-2.6	-7.6	-12.1
Debt ratio 2/	-0.1	-0.2	-0.4	Debt ratio 2/	-0.1	-0.1	-0.2
Debt-service ratio 2/	--	--	-0.1	Debt-service ratio 2/	--	--	--

1/ Ratio to nominal GDP

2/ Ratios to exports of goods and services.

higher inflation stemming from faster money growth and the increased burden of government deficit as expenditure adjusts faster than revenue to higher prices. Across regions, this is most notable in the Western Hemisphere and in Africa, where there are a number of large high inflation countries; the Asian and the Middle Eastern and European regions experience a lower increase in prices, reflecting the high weight of countries with low inflation. By 1998, net debtor countries' real GDP falls by 1/2 of 1 percent below the baseline, as domestic prices and the exchange rate adjust further to higher fiscal deficits.

For net creditors, the output increase, as in the case of the net debtors, has a declining trend. However, the short-run positive impact is larger owing to the higher stimulus reflecting the higher share of government expenditure in GDP. The positive effect, furthermore, lasts longer since exports do not decline (oil prices are exogenously determined) and since imports are not constrained.

2. Monetary expansion

A rise in the money supply has a short-run positive effect on the private sector's real wealth before it is transmitted into higher prices. This positive effect increases private absorption temporarily, leading to higher activity and GDP. In the medium term, however, through the rise in prices, there are negative effects on aggregate demand, similar to those described in the case of fiscal expansion. The effects are manifested in a loss of competitiveness which leads to a fall in exports, and a decline in private absorption due to the fall in the terms of trade, real income, and wealth. Over time, the effect on GDP diminishes as prices and the exchange rate adjust to the increase in money supply.

The simulated effects of an increase of 10 percent in the stock of money are reported in Table 13. It can be seen that for net debtors as a whole there is a short-run positive effect on GDP of 1 3/4 percent above the baseline after the first year, but by 1998, the effect is reversed to 1/2 of 1 percent below the baseline. The GDP deflator rises by about the same amount as monetary expansion by the end of the period. In some regions, depending on the speed of adjustment of prices to money and the nominal exchange rate to prices, small cyclical movements are also observed. In the case of net creditors, the effect on prices is similar to that for net debtors; however, the effect on output is relatively muted in the initial year and is virtually negligible subsequently.

3. A fall in the nominal price of crude oil

This scenario considers the effect of a fall in the nominal price of oil, below the baseline, sustained over the period 1993-98. Interest in such a scenario stems from the possibility of excess supply developing in

Table 13. Medium-Term Implications of Simulations: 10 Percent Increase in Broad Money, 1993-98

(Difference from the reference scenario in percent)

	1993	1995	1998		1993	1995	1998
Net debtor countries				By predominant export			
Real GDP	1.7	0.3	-0.4	Primary products exporters			
GDP deflator	1.5	7.6	9.9	Real GDP	1.3	-0.1	-0.6
Broad money	10.0	10.0	10.0	GDP deflator	1.6	8.9	10.6
Fiscal balance 1/	--	-0.2	--	Broad money	10.0	10.0	10.0
Export volume	-0.1	-0.7	-0.7	Fiscal balance 1/	--	-0.2	-0.3
Import volume	1.2	-0.1	-0.4	Export volume	-0.1	-0.4	-0.3
Current account balance 2/	-1.3	-0.2	0.2	Import volume	1.0	0.3	-0.3
Reserve import ratio	-2.1	-2.2	-1.6	Current account balance 2/	-1.2	-0.8	-0.1
Debt ratio 2/	-0.1	-0.4	-0.3	Reserve import ratio	-1.3	-2.2	-2.2
Debt-service ratio 2/	--	--	-0.1	Debt ratio 2/	--	0.1	0.1
				Debt-service ratio 2/	--	--	--
By region				Exporters of manufactures			
Africa				Real GDP	1.9	0.7	-0.4
Real GDP	2.2	-0.2	-1.3	GDP deflator	1.6	6.8	9.6
GDP deflator	1.4	8.0	10.4	Broad money	10.0	10.0	10.0
Broad money	10.0	10.0	10.0	Fiscal balance 1/	--	--	0.2
Fiscal balance 1/	0.1	-0.3	-0.1	Export volume	-0.2	-1.0	-1.0
Export volume	-0.1	-0.4	-0.3	Import volume	1.6	-0.5	-0.9
Import volume	--	0.7	0.8	Current account balance 2/	-1.9	-0.2	0.3
Current account balance 2/	--	--	--	Reserve import ratio	-2.9	-2.5	-1.4
Reserve import ratio	-0.6	-1.3	-1.5	Debt ratio 2/	--	--	--
Debt ratio 2/	-0.3	-1.9	-1.8	Debt-service ratio 2/	--	--	--
Debt-service ratio 2/	--	-0.2	-0.2				
Asia				Service and remittance countries			
Real GDP	2.3	0.7	-0.5	Real GDP	0.6	0.2	0.2
GDP deflator	1.7	7.9	10.8	GDP deflator	1.7	8.8	8.8
Broad money	10.0	10.0	10.0	Broad money	10.0	10.0	10.0
Fiscal balance 1/	--	-0.1	0.1	Fiscal balance 1/	-0.1	-0.5	-0.5
Export volume	-0.2	-0.4	-0.6	Export volume	-0.1	-0.6	-0.3
Import volume	-1.9	0.2	0.5	Import volume	0.3	-0.1	--
Current account balance 2/	-3.0	-2.4	-1.0	Current account balance 2/	-0.5	-0.2	-0.3
Reserve import ratio	-0.1	-0.6	-0.4	Reserve import ratio	-0.4	-0.5	-0.8
Debt ratio 2/	--	-0.1	-0.1	Debt ratio 2/	0.1	0.5	0.3
Debt-service ratio 2/	--	--	-0.1	Debt-service ratio 2/	--	--	--
Europe and non-oil Middle East				Diversified exporters			
Real GDP	0.3	-0.4	0.1	Real GDP	3.5	-0.4	-1.9
GDP deflator	1.5	7.7	8.2	GDP deflator	1.1	8.3	12.3
Broad money	10.0	10.0	10.0	Broad money	10.0	10.0	10.0
Fiscal balance 1/	-0.1	-0.4	-0.2	Fiscal balance 1/	--	-0.4	-0.3
Export volume	-0.1	-0.7	-0.5	Export volume	-0.1	-0.7	-0.6
Import volume	0.2	-0.2	-0.6	Import volume	0.2	-0.2	0.5
Current account balance 2/	-0.3	-0.5	-0.1	Current account balance 2/	-0.3	1.2	0.7
Reserve import ratio	-0.3	-0.9	-2.1	Reserve import ratio	-1.2	-1.0	0.2
Debt ratio 2/	0.2	0.9	0.6	Debt ratio 2/	-0.2	-1.8	-1.3
Debt-service ratio 2/	--	0.1	0.1	Debt-service ratio 2/	--	-0.2	-0.2
Western Hemisphere				By miscellaneous criteria			
Real GDP	0.6	-0.2	--	Fifteen heavily indebted countries			
GDP deflator	1.3	6.5	7.9	Real GDP	0.9	-0.2	-0.1
Broad money	10.0	10.0	10.0	GDP deflator	1.3	6.6	8.1
Fiscal balance 1/	--	-0.2	-0.2	Broad money	10.0	10.0	10.0
Export volume	--	-0.2	-0.2	Fiscal balance 1/	--	-0.2	-0.3
Import volume	1.0	0.4	-0.4	Export volume	--	-0.2	-0.2
Current account balance 2/	-1.2	-1.0	-0.2	Import volume	0.8	0.4	-0.4
Reserve import ratio	-1.2	-2.3	-2.9	Current account balance 2/	-1.1	-1.0	-0.1
Debt ratio 2/	0.1	0.3	0.2	Reserve import ratio	-1.2	-2.5	-3.0
Debt-service ratio 2/	--	0.1	--	Debt ratio 2/	0.1	0.3	0.2
				Debt-service ratio 2/	--	--	--
By financial criteria				Small low-income countries			
Countries with recent debt-servicing difficulties				Real GDP	1.9	0.7	-0.4
Real GDP	1.3	-0.2	-0.5	GDP deflator	1.5	8.1	9.4
GDP deflator	1.3	6.9	8.8	Broad money	10.0	10.0	10.0
Broad money	10.0	10.0	10.0	Fiscal balance 1/	--	-0.4	-0.5
Fiscal balance 1/	--	-0.3	-0.3	Export volume	-0.1	-0.7	-0.3
Export volume	-0.1	-0.3	-0.2	Import volume	0.8	--	-0.3
Import volume	0.6	0.5	--	Current account balance 2/	-1.1	-0.2	0.3
Current account balance 2/	-0.8	-0.7	-0.1	Reserve import ratio	-1.5	-1.6	-0.9
Reserve import ratio	-1.0	-2.1	-2.6	Debt ratio 2/	--	0.2	-0.1
Debt ratio 2/	--	-0.3	-0.4	Debt-service ratio 2/	--	--	--
Debt-service ratio 2/	--	--	--				
Countries without recent debt-servicing difficulties				Net creditor countries			
Real GDP	2.0	0.6	-0.4	Real GDP	0.6	--	0.1
GDP deflator	1.7	7.9	10.5	GDP deflator	1.4	7.2	9.2
Broad money	10.0	10.0	10.0	Broad money	10.0	10.0	10.0
Fiscal balance 1/	--	-0.1	0.1	Fiscal balance 1/	-0.1	-0.4	-0.3
Export volume	-0.2	-1.0	-0.9	Export volume	--	-0.1	-0.1
Import volume	1.4	-0.4	-0.6	Import volume	0.1	-0.1	--
Current account balance 2/	-1.6	0.1	0.4	Current account balance 2/	-0.2	-0.3	-0.3
Reserve import ratio	-2.8	-2.3	-1.1	Reserve import ratio	-0.3	-1.2	-2.0
Debt ratio 2/	-0.1	-0.5	-0.3	Debt ratio 2/	--	--	-0.1
Debt-service ratio 2/	--	-0.1	-0.1	Debt-service ratio 2/	--	--	--

1/ Ratio to nominal GDP

2/ Ratios to exports of goods and services.

the world oil market over the medium term. ^{1/} Countries that are dependent on oil imports and are finance-constrained would benefit from a fall in oil prices as this allows a rise in non-oil imports and a higher level of activity; even countries that are not finance-constrained would benefit from a terms of trade gain. Oil exporting countries, on the other hand, will have lower oil revenue (as long as the price elasticity of world demand for oil is less than unity), lower income and lower imports. However, since the volume of oil exports will rise, the effect on GDP (which by definition does not take account of movements in the terms of trade) would depend on the relative size of the fall in domestic activity and the rise in export volumes. Among oil exporters, the effect of a fall in oil prices is likely to be most noticeable in the case of net creditor oil exporters where oil constitutes a large proportion of GDP.

The simulation results indicate that a 10 percent fall in oil prices has a rather small effect on net debtor countries as a whole (Table 14). Some variation, however, is observed across different regions depending on the presence of major oil exporters. In Africa, for example, primarily because of Nigeria, there is a small negative effect on GDP. In the Western Hemisphere, on the other hand, by 1998, the combined positive effects on large oil importers, such as Brazil, offset the negative effects on countries like Venezuela and Mexico. As expected, the effects of an oil price fall is most significant in the case of net creditor oil exporters. ^{2/} To highlight the differential impact on income and GDP in this case, the simulated effects on both of these variables are reported. Real GDP falls below the baseline initially as the positive effect on export volume is dominated by the negative effect on domestic absorption, but rises above the baseline as export volumes increase. Income, on the other hand, has a more substantial initial fall and remains below the baseline throughout the period. The current account worsens, and the reserves-to-import ratio falls significantly.

4. Faster industrial country growth

In this simulation, GDP growth in the industrial world is assumed to increase by 1 percentage point a year over the period 1993-98. ^{3/} As in Adams and Adams (1989), this leads to higher real exports, imports, and growth in the developing countries (Table 15). Exports rise by 10 percent above the baseline by 1998, contributing to an increase of GDP of 2 percent

^{1/} See, for example, Box 5 in the *World Economic Outlook*, May 1993, for an examination of the likely developments in the world oil market in the medium term.

^{2/} Table 14 presents the results only for oil exporting net creditors rather than all net creditors.

^{3/} In order to take account of the feedback effects within developing countries, for each individual country it was assumed, on the basis of an iterative procedure, that growth elsewhere in the developing world would be higher by $\frac{1}{2}$ a percentage point above the baseline.

Table 14. Medium-Term Implications of Simulations: 10 Percent Fall in Oil Prices, 1993-98

(Difference from the reference scenario in percent)

	1993	1995	1998		1993	1995	1998
Net debtor countries				By predominant export			
Real GDP	-0.1	-0.1	--	Primary products exporters			
GDP deflator	--	0.1	0.2	Real GDP	--	0.1	--
Broad money	--	0.1	0.5	GDP deflator	--	--	0.3
Fiscal balance 1/	--	--	-0.1	Broad money	--	0.1	0.5
Export volume	0.5	0.4	0.3	Fiscal balance 1/	--	--	--
Import volume	0.2	0.2	--	Export volume	0.2	0.2	0.2
Current account balance 2/	-0.2	-0.2	0.2	Import volume	0.3	0.4	0.3
Reserve import ratio	-0.2	-0.9	-0.7	Current account balance 2/	--	--	-0.1
Debt ratio 2/	1.1	0.5	-0.1	Reserve import ratio	0.1	-0.1	-0.4
Debt-service ratio 2/	0.2	0.1	0.1	Debt ratio 2/	0.8	0.6	0.5
				Debt-service ratio 2/	0.1	0.1	0.1
By region				Exporters of manufactures			
Africa				Real GDP	0.1	0.1	--
Real GDP	-0.2	-0.3	-0.1	GDP deflator	--	-0.1	--
GDP deflator	0.1	0.2	0.9	Broad money	--	--	0.1
Broad money	--	0.2	1.1	Fiscal balance 1/	--	--	--
Fiscal balance 1/	-0.1	-0.1	-0.1	Export volume	0.1	0.1	--
Export volume	0.7	0.7	0.7	Import volume	0.5	0.6	0.8
Import volume	-0.7	-0.6	-1.1	Current account balance 2/	0.4	0.4	0.2
Current account balance 2/	-0.8	-0.7	-0.3	Reserve import ratio	0.2	0.2	0.4
Reserve import ratio	-0.9	-1.5	-2.1	Debt ratio 2/	-0.1	-0.3	-0.3
Debt ratio 2/	3.7	4.1	4.8	Debt-service ratio 2/	--	-0.1	-0.1
Debt-service ratio 2/	0.6	0.4	1.1				
Asia				Service and remittance countries			
Real GDP	0.1	0.1	--	Real GDP	-0.3	-0.2	-0.1
GDP deflator	--	-0.1	--	GDP deflator	--	0.3	0.3
Broad money	--	--	--	Broad money	--	0.1	0.2
Fiscal balance 1/	--	--	--	Fiscal balance 1/	--	-0.1	-0.1
Export volume	0.3	0.2	0.1	Export volume	0.5	0.5	0.4
Import volume	0.4	0.5	0.6	Import volume	0.6	0.4	0.2
Current account balance 2/	0.2	0.2	0.2	Current account balance 2/	-0.2	-0.2	-0.1
Reserve import ratio	-0.1	-0.3	-0.3	Reserve import ratio	-0.1	-0.4	-0.6
Debt ratio 2/	--	-0.2	-0.2	Debt ratio 2/	0.8	0.8	0.6
Debt-service ratio 2/	--	--	-0.1	Debt-service ratio 2/	0.1	0.1	--
Europe and Middle East				Diversified exporters			
Real GDP	-0.4	-0.2	-0.3	Real GDP	--	--	-0.1
GDP deflator	--	0.3	0.5	GDP deflator	--	--	0.2
Broad money	-0.1	0.1	0.4	Broad money	--	0.1	0.2
Fiscal balance 1/	--	-0.1	-0.1	Fiscal balance 1/	--	--	--
Export volume	0.2	0.2	0.2	Export volume	0.2	0.1	0.1
Import volume	0.6	0.3	0.5	Import volume	0.1	0.2	0.3
Current account balance 2/	0.1	0.4	0.4	Current account balance 2/	0.5	0.4	0.4
Reserve import ratio	-0.1	0.4	1.2	Reserve import ratio	0.3	0.8	1.2
Debt ratio 2/	0.4	0.4	0.3	Debt ratio 2/	--	-0.1	-0.2
Debt-service ratio 2/	--	--	--	Debt-service ratio 2/	--	--	--
Western Hemisphere				By miscellaneous criteria			
Real GDP	-0.5	-0.4	0.2	Fifteen heavily indebted countries			
GDP deflator	0.1	0.5	0.6	Real GDP	-0.5	-0.4	0.1
Broad money	--	0.2	1.3	GDP deflator	0.1	0.5	0.7
Fiscal balance 1/	--	-0.1	-0.1	Broad money	--	0.2	1.3
Export volume	0.9	0.7	0.6	Fiscal balance 1/	-0.1	-0.1	-0.1
Import volume	--	-0.4	-1.6	Export volume	1.0	0.8	0.7
Current account balance 2/	-1.1	-1.2	0.4	Import volume	-0.2	-0.9	-1.5
Reserve import ratio	0.1	-2.4	-1.8	Current account balance 2/	-1.4	-1.1	--
Debt ratio 2/	3.7	1.9	-1.0	Reserve import ratio	-0.3	-2.7	-2.6
Debt-service ratio 2/	0.5	0.5	0.1	Debt ratio 2/	4.5	2.8	-0.1
				Debt-service ratio 2/	0.6	0.6	0.2
By financial criteria				Small low-income countries			
Countries with recent debt-servicing difficulties				Real GDP	0.1	0.1	--
Real GDP	-0.5	-0.4	--	GDP deflator	--	--	0.1
GDP deflator	0.1	0.4	0.7	Broad money	--	0.1	0.2
Broad money	--	0.2	1.2	Fiscal balance 1/	--	--	--
Fiscal balance 1/	-0.1	-0.1	-0.1	Export volume	0.1	0.1	0.1
Export volume	0.8	0.7	0.6	Import volume	0.6	0.7	0.7
Import volume	--	-0.5	-1.1	Current account balance 2/	0.2	0.1	0.1
Current account balance 2/	-1.0	-0.8	0.1	Reserve import ratio	0.2	0.4	0.6
Reserve import ratio	-0.3	-2.2	-2.1	Debt ratio 2/	0.3	0.3	0.2
Debt ratio 2/	3.3	2.1	-0.2	Debt-service ratio 2/	--	--	--
Debt-service ratio 2/	0.4	0.4	0.1				
Countries without recent debt-servicing difficulties				Oil exporting net creditor countries			
Real GDP	0.1	0.1	--	Real GDP	-0.6	1.0	2.2
GDP deflator	--	-0.1	--	Real income	-3.7	-2.6	-1.7
Broad money	--	--	0.1	GDP deflator	0.1	0.9	1.4
Fiscal balance 1/	--	--	--	Broad money	0.5	1.9	4.3
Export volume	0.3	0.3	0.2	Fiscal balance 1/	-0.8	-0.6	-0.4
Import volume	0.3	0.5	0.4	Export volume	1.7	4.0	5.8
Current account balance 2/	0.2	0.1	0.2	Import volume	-0.7	-1.5	-2.4
Reserve import ratio	-0.1	-0.2	-0.1	Current account balance 2/	-7.0	-4.8	-3.7
Debt ratio 2/	0.3	0.1	0.2	Reserve import ratio	-4.6	-13.3	-21.5
Debt-service ratio 2/	0.1	--	0.1	Debt ratio 2/	5.6	3.9	2.6
				Debt-service ratio 2/	0.6	0.7	0.4

1/ Ratio to nominal GDP

2/ Ratios to exports of goods and services.

Table 15. Medium-Term Implications of Simulations: 1 Percentage Point Per Annum Increase in Foreign Demand Growth, 1993-98

(Difference from the reference scenario in percent)

	1993	1995	1998		1993	1995	1998
Net debtor countries				By predominant export			
Real GDP	0.3	0.9	1.9	Primary products exporters			
GDP deflator	--	-0.4	-1.6	Real GDP	0.3	0.7	1.3
Broad money	--	-0.1	-0.8	GDP deflator	--	-0.6	-1.9
Fiscal balance 1/	--	0.1	0.3	Broad money	--	-0.2	-1.3
Export volume	1.3	4.2	10.1	Fiscal balance 1/	0.1	0.1	0.3
Import volume	0.8	2.7	6.9	Export volume	1.2	3.5	7.6
Current account balance 2/	0.8	2.3	4.5	Import volume	0.8	1.8	3.9
Reserve import ratio	0.4	2.1	7.1	Current account balance 2/	0.9	2.4	4.7
Debt ratio 2/	-2.4	-6.0	-10.8	Reserve import ratio	0.5	2.2	6.7
Debt-service ratio 2/	-0.3	-0.8	-1.6	Debt ratio 2/	-3.4	-7.9	-14.8
				Debt-service ratio 2/	-0.4	-0.9	-1.7
By region				Exporters of manufactures			
Africa				Real GDP	0.3	0.7	1.2
Real GDP	0.2	0.5	0.9	GDP deflator	--	-0.3	-1.1
GDP deflator	--	-0.4	-1.6	Broad money	--	-0.1	-0.7
Broad money	--	-0.4	-1.4	Fiscal balance 1/	--	0.1	0.2
Fiscal balance 1/	--	0.1	0.3	Export volume	1.6	5.1	11.9
Export volume	0.6	1.9	4.2	Import volume	1.1	3.2	8.4
Import volume	0.6	2.0	3.8	Current account balance 2/	0.8	2.3	4.4
Current account balance 2/	0.2	0.7	1.7	Reserve import ratio	0.4	1.6	4.8
Reserve import ratio	0.2	0.5	1.2	Debt ratio 2/	-2.2	-5.2	-9.1
Debt ratio 2/	-1.5	-4.5	-8.9	Debt-service ratio 2/	-0.3	-0.8	-1.3
Debt-service ratio 2/	-0.3	-0.6	-1.1				
Asia				Service and remittance countries			
Real GDP	0.3	1.0	2.3	Real GDP	0.1	0.3	0.4
GDP deflator	--	-0.5	-1.9	GDP deflator	--	-0.2	-0.9
Broad money	--	--	-0.5	Broad money	--	-0.1	-1.1
Fiscal balance 1/	--	0.1	0.4	Fiscal balance 1/	--	0.1	0.3
Export volume	1.5	5.1	12.4	Export volume	1.2	4.0	8.9
Import volume	0.9	3.2	8.2	Import volume	0.8	3.1	7.8
Current account balance 2/	0.9	2.3	4.7	Current account balance 2/	0.6	1.9	3.4
Reserve import ratio	0.4	2.1	7.3	Reserve import ratio	0.2	1.2	3.9
Debt ratio 2/	-1.8	-4.7	-8.3	Debt ratio 2/	-2.8	-8.6	-15.3
Debt-service ratio 2/	-0.2	-0.6	-1.1	Debt-service ratio 2/	-0.2	-0.7	-1.3
Europe and non-oil Middle East				Diversified exporters			
Real GDP	0.2	2.1	4.4	Real GDP	0.2	1.2	2.6
GDP deflator	--	-0.5	-2.0	GDP deflator	--	-0.6	-2.4
Broad money	--	0.3	1.0	Broad money	--	-0.1	-0.8
Fiscal balance 1/	0.1	0.2	0.6	Fiscal balance 1/	--	0.2	0.5
Export volume	2.4	7.0	16.7	Export volume	0.8	3.1	6.7
Import volume	1.7	3.0	9.4	Import volume	0.6	2.4	5.4
Current account balance 2/	0.7	4.5	9.0	Current account balance 2/	0.2	1.2	2.1
Reserve import ratio	-0.1	3.8	19.0	Reserve import ratio	0.1	1.1	3.7
Debt ratio 2/	-4.7	-11.5	-21.5	Debt ratio 2/	-0.8	-3.3	-5.9
Debt-service ratio 2/	-0.5	-1.3	-2.6	Debt-service ratio 2/	-0.1	-0.4	-0.6
Western Hemisphere				By miscellaneous criteria			
Real GDP	0.3	0.5	0.8	Fifteen heavily indebted countries			
GDP deflator	--	-0.2	-1.1	Real GDP	0.3	0.5	0.9
Broad money	0.1	-0.1	-1.7	GDP deflator	--	-0.3	-1.1
Fiscal balance 1/	--	0.1	0.2	Broad money	0.1	-0.1	-1.5
Export volume	0.8	2.5	5.4	Fiscal balance 1/	--	0.1	0.2
Import volume	0.4	1.4	3.0	Export volume	0.7	2.2	4.9
Current account balance 2/	1.0	1.8	2.9	Import volume	0.3	1.1	2.5
Reserve import ratio	0.8	2.6	6.3	Current account balance 2/	0.9	1.9	3.1
Debt ratio 2/	-2.8	-5.4	-8.7	Reserve import ratio	0.7	2.4	6.1
Debt-service ratio 2/	-0.4	-0.8	-1.4	Debt ratio 2/	-2.5	-5.5	-9.2
				Debt-service ratio 2/	-0.4	-0.8	-1.5
By financial criteria				Small low-income countries			
Countries with recent debt-servicing difficulties				Real GDP	0.2	0.1	0.1
Real GDP	0.3	0.5	0.9	GDP deflator	--	-0.4	-1.4
GDP deflator	--	-0.3	-1.3	Broad money	-0.1	-0.6	-2.1
Broad money	--	-0.2	-1.6	Fiscal balance 1/	0.1	0.1	0.3
Fiscal balance 1/	--	0.1	0.3	Export volume	1.0	3.1	6.7
Export volume	0.8	2.4	5.3	Import volume	0.9	2.4	4.7
Import volume	0.5	1.6	3.6	Current account balance 2/	0.7	0.8	1.6
Current account balance 2/	0.7	1.8	3.1	Reserve import ratio	0.2	0.5	0.8
Reserve import ratio	0.6	2.1	5.8	Debt ratio 2/	-4.1	-7.7	-13.9
Debt ratio 2/	-2.3	-5.7	-9.9	Debt-service ratio 2/	-0.3	-0.6	-1.0
Debt-service ratio 2/	-0.3	-0.8	-1.5				
Countries without recent debt-servicing difficulties				Net creditor countries			
Real GDP	0.3	1.0	2.3	Real GDP	0.9	3.5	8.8
GDP deflator	--	-0.5	-1.8	GDP deflator	-0.1	-1.4	-5.9
Broad money	--	--	-0.4	Broad money	0.1	0.2	-0.7
Fiscal balance 1/	--	0.1	0.4	Fiscal balance 1/	0.1	0.5	1.3
Export volume	1.5	5.1	12.4	Export volume	1.5	5.8	14.6
Import volume	1.0	3.2	8.3	Import volume	0.6	2.8	8.1
Current account balance 2/	0.9	2.5	5.0	Current account balance 2/	1.0	3.4	8.1
Reserve import ratio	0.4	2.2	7.8	Reserve import ratio	0.2	2.8	14.2
Debt ratio 2/	-2.1	-5.2	-9.2	Debt ratio 2/	-0.6	-1.7	-3.7
Debt-service ratio 2/	-0.3	-0.7	-1.3	Debt-service ratio 2/	-0.1	-0.4	-0.5

1/ Ratio to nominal GDP

2/ Ratios to exports of goods and services.

for the net debtor countries. All regions show a significant increase in real GDP by 1998. Asia, and the Middle East and Europe, post the most noticeable increases in export volume, reflecting the relatively high elasticities of their exports to increases in economic activity. These economies also enjoy a higher increase in real output, reflecting the relatively large share of exports in GDP. Africa shows a more modest increase in output reflecting the importance of fuel and primary product exports, which as noted earlier, are in general relatively less sensitive to changes in economic activity than exports of manufactures. For net creditors, the rise in GDP is higher than that of net debtor countries and reaches 8 3/4 percent above the baseline by 1988. This is primarily due to the impact of higher foreign demand on exports from Taiwan Province of China.

Countries and Regions in the Developing Country Model

1. Net debtor countries (87 countries)

a. By region

(1) Africa (38 countries)

Algeria, Benin, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, Côte d'Ivoire, Ethiopia, Gabon, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Madagascar, Malawi, Mauritania, Mauritius, Morocco, Mozambique, Niger, Nigeria, Senegal, Sierra Leone, Somalia, South Africa, Sudan, Tanzania, Togo, Tunisia, Uganda, Zaïre, Zambia, Zimbabwe.

(2) Asia (19 countries)

Afghanistan, Bangladesh, Bhutan, China, Fiji, India, Indonesia, Korea, Lao People's Democratic Republic, Malaysia, Nepal, Pakistan, Papua New Guinea, Philippines, Singapore, Solomon Islands, Sri Lanka, Thailand, Western Samoa.

(3) Europe and Middle East (8 countries)

Cyprus, Egypt, Israel, Jordan, Malta, Syrian Arab Republic, Turkey, Republic of Yemen.

(4) Western Hemisphere (22 countries)

Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominica, Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Paraguay, Peru, Suriname, Uruguay, Venezuela.

b. By financial criteria

(1) Countries with debt-servicing difficulties (57 countries)

Defined as those countries that incurred external payments arrears or entered into official or commercial bank debt-rescheduling agreements during 1986-90. Information on these developments is taken from relevant issues of the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions.

(2) Countries without debt-servicing difficulties (30 countries)

All other net-debtor countries not classified as "Countries with debt-servicing difficulties."

c. By predominant export

(1) Exporters of primary products (41 countries)

Afghanistan, Argentina, Bhutan, Bolivia, Burundi, Central African Republic, Chad, Chile, Colombia, Comoros, Costa Rica, Côte d'Ivoire, Dominica, El Salvador, Ghana, Guatemala, Guinea, Guinea-Bissau, Guyana, Honduras, Kenya, Lao People's Democratic Republic, Liberia, Madagascar, Malawi, Mauritania, Mauritius, Niger, Papua New Guinea, Paraguay, Peru, Solomon Islands, Somalia, Sri Lanka, Sudan, Suriname, Togo, Uganda, Uruguay, Zaïre, Zambia.

(2) Exporters of manufactures (9 countries)

Brazil, China, India, Israel, Korea, Singapore, Thailand, Tunisia, Turkey.

(3) Services and private transfers (17 countries)

Burkina Faso, Cape Verde, Cyprus, Dominican Republic, Egypt, Ethiopia, Fiji, Grenada, Jamaica, Jordan, Malta, Mozambique, Nepal, Pakistan, Tanzania, Western Samoa, Republic of Yemen.

(4) Diversified export base (11 countries)

Bangladesh, Benin, Haiti, Malaysia, Morocco, Philippines, Senegal, Sierra Leone, South Africa, Syrian Arab Republic, Zimbabwe.

d. By miscellaneous criteria

(1) Fifteen heavily indebted countries (excluding the former Soviet Federal Republic of Yugoslavia)

Argentina, Bolivia, Brazil, Chile, Colombia, Côte d'Ivoire, Ecuador, Mexico, Morocco, Nigeria, Peru, Philippines, Uruguay, Venezuela.

(2) Small low-income economies (34 countries)

Afghanistan, Bangladesh, Benin, Bhutan, Burkina Faso, Burundi, Central African Republic, Chad, Comoros, Ethiopia, Ghana, Guinea, Guinea-Bissau, Guyana, Haiti, Kenya, Lao People's Democratic Republic, Madagascar, Malawi, Mauritania, Mozambique, Nepal, Niger, Pakistan, Senegal, Sierra Leone, Somalia, Sri Lanka, Sudan, Tanzania, Togo, Uganda, Zaïre, Zambia.

(3) Net Creditors (8 countries)

Islamic Republic of Iran, Kuwait, Libya, Oman, Qatar, Saudi Arabia, Taiwan Province of China, United Arab Emirates.

Developing Country Model: Detailed Specification

This appendix presents the structure of the developing country model grouped in the following manner: aggregate demand, the government sector, money, prices and exchange rates, exports of goods and services, imports of goods and services, transfers and net investment income, the capital account, and alternative specifications for net creditors. Regression coefficients are referred to by the letter "B" followed by a number. Mnemonics in lowercase refer to model variables, while those in upper case refer to fixed values such as historical shares or values of a variable in a particular year. Model equations are reported using AREMOS software notation: "log" is the natural logarithm, "dlog" is the change in the natural logarithm from the previous year, "pch" denotes the percentage change from the previous year, "diff" denotes the difference from the previous period, "*" denotes multiplication, "**" denotes exponentiation. Lags are indicated by the suffix ".1," where the number "1" indicates that the period for which the variable is lagged. The Boolean operator (x==a) takes the value one if x = a and zero otherwise. (x>a) and (x<a) are similarly defined. Following the list of equations is a list of the endogenous and exogenous variables, as well as the fixed values and shares.

1. Aggregate demand

Real private absorption

$$\begin{aligned} \log(\text{nap_r}) = & B1 * \log((\text{ngdpd} + \text{bxsi} - \text{bmsdi} - \text{bmsndi} + \text{btrp}) \\ & / [(1 - \text{SM}) * (\text{pgdpd}/\text{PGDPD85}) + \text{SM} * \text{tmpd}]) \\ & + B2 * \log(\text{txpd}/\text{pgdpd}) \\ & + B3 * \log(\text{fmb}/\text{pgdp}) \\ & + B4 * [0.5 * \log(\text{gcnl}/\text{pgdp}) \\ & + 0.5 * \log(\text{gcnl.1}/\text{pgdp.1})] \\ & + B5 * [\text{con_lend}/d - \text{dlog}(\text{pgdpd})] \\ & + B6 \end{aligned} \tag{A1}$$

Real consumption spending

$$\text{rc} = Q_WT * \text{nap_r} + \text{gcec}/\text{pgdp} \tag{A2}$$

Real investment spending

$$\text{ri} = (1 - Q_WT) * \text{nap_r} + \text{gcek}/\text{pgdp} \tag{A3}$$

Total real absorption

$$\text{ra} = \text{ri} + \text{rc} \tag{A4}$$

Total real GDP

$$\text{ngdp_r} = \text{ra} + \text{rxgnfs} - \text{rmgnfs} \tag{A5}$$

Total capital stock

$$rk = ri + .95 * rk.1 \quad (A6)$$

Capital stock in tradables

$$rkt = KT_W * rk \quad (A7)$$

Capital stock in nontradables

$$rkn = (1 - KT_W) * rk \quad (A8)$$

Nominal GDP in local currency

$$ngdp = ngdp_r * pgdp \quad (A9)$$

Nominal GDP in U.S. dollars

$$ngdpd = ngdp/ed \quad (A10)$$

Real GDP in tradables

$$rgdpt = rxgnfs \quad (A11)$$

Real GDP in nontradables

$$rgdpn = ra - rmgnfs \quad (A12)$$

Total real GNP

$$rgnp = (ngdpd + bxsi - bmsdi - bmsndi) * ed/pgdp \quad (A13)$$

2. Government sector

Current expenditure

$$\begin{aligned} dlog(gcec) = & B1 * dlog(ngdp_r) \\ & + B2 * dlog(pgdp) \\ & + B3 * dlog(gcrg/pgdp) \\ & + B4 * [\log(gcec.1) - 0.5 * \log(ngdp_r.1) \\ & - \log(pgdp.1) - 0.5 * \log(gcrg.1/pgdp.1)] \\ & + B5 \end{aligned} \quad (A14)$$

Current revenue

$$\begin{aligned} \text{dlog}(\text{gcrg}) = & B1 * \text{dlog}(\text{ngdp_r}) \\ & + B2 * \text{dlog}(\text{pgdp}) \\ & + B3 * \text{dlog}(\text{bxt}/\text{pgdpd}) \\ & + B4 * \text{dlog}(\text{bmt}/\text{pgdpd}) \\ & + B5 * [\log(\text{gcrg}.1) - \log(\text{pgdp}.1) \\ & - 0.5 * \log(\text{ngdp_r}.1) \\ & - 0.25 * \log(\text{bxt}.1/\text{pgdpd}.1) \\ & - 0.25 * \log(\text{bmt}.1/\text{pgdpd}.1)] \\ & + B6 \end{aligned} \quad (\text{A15})$$

Capital expenditure

$$\text{gcek} = \text{gcek_r} * \text{pgdp} \quad (\text{A16})$$

Total expenditure

$$\text{gcnl} = \text{gcec} + \text{gcek} \quad (\text{A17})$$

Government balance

$$\text{gcb} = \text{gcrg} - \text{gcnl} \quad (\text{A18})$$

3. Money, prices, and the exchange rate

Broad money

$$\begin{aligned} \text{diff}(\text{fmb})/\text{ngdp} = & B1 * \text{gcb}/\text{ngdp} \\ & + B2 * \text{diff}(\text{ifxrd} * \text{ed})/\text{ngdp} \\ & + B3 * \text{diff}(\text{fmb}.1)/\text{ngdp}.1 \\ & + B4 \end{aligned} \quad (\text{A19})$$

GDP deflator

$$\begin{aligned} \text{dlog}(\text{pgdp}) = & B1 * \text{dlog}(\text{ngdp_r}) \\ & + B2 * \text{dlog}(\text{fmb}) \\ & + B3 * [\log(\text{pgdp}.1) - \log(\text{fmb}.1) + \log(\text{ngdp_r}.1)] \\ & + B4 \end{aligned} \quad (\text{A20})$$

Nominal exchange rate

$$\begin{aligned} \text{dlog}(\text{ed}) = & 0.5 * \text{dlog}(\text{pgdp}/\text{pgdpd110}) \\ & - 0.2 * \log(\text{ed}.1/\text{pgdp}.1 * \text{pgdpd110}.1) \\ & + B1 \end{aligned} \quad (\text{A21})$$

GDP deflator in U.S. dollars

$$\text{pgdpd} = \text{pgdp}/\text{ed} \quad (\text{A22})$$

4. Exports of goods and nonfactor services

Non-oil export volumes

$$\begin{aligned} \log(\text{txqnoil}) = & B1 * \log(\text{rkt}) \\ & + B2 * \log[(\text{pgdpd}/\text{PGDPD85})/\text{txpcpnoild}] \\ & + B3 * \log(\text{txrgnp}) \\ & + B4 \end{aligned} \quad (\text{A23})$$

Exports of nonfactor services

$$\log(\text{xs_nfd}) = B1 * \log(\text{ngdpd110}) + B2 \quad (\text{A24})$$

Oil export volumes

$$\text{dlog}(\text{txqoil}) = B1 * \text{dlog}(\text{txqoil606}) + B2 \quad (\text{A25})$$

Non-oil export price

$$\begin{aligned} \log(\text{txpnoild}) - \log(\text{pgdpd}/\text{PGDPD85}) = & B1 * \log(\text{txrgnp}) \\ & + B2 * [\log(\text{txpcpnoild}) \\ & - \log(\text{pgdpd}/\text{PGDPD85})] \\ & + B3 * \log(\text{rkt}) \\ & + B4 \end{aligned} \quad (\text{A26})$$

Oil export price

$$\log(\text{txpoild}/\text{txpoild999.1}) = B1 * \text{dlog}(\text{txpoild999}) + B2 \quad (\text{A27})$$

Total export price

$$\begin{aligned} \log(\text{txpd}) = & (1 - \text{OILX_W}) * \log(\text{txpnoild}/\text{TXPNOILD85}) \\ & + (\text{OILX_W}) * \log(\text{txpoild}/\text{TXPOILD85}) \end{aligned} \quad (\text{A28})$$

World income (foreign demand)

$$\begin{aligned} \log(\text{txrgnp}) = & \text{GEE_XWT1} * \log(\text{txrgnp111}) \\ & + \text{GEE_XWT2} * \log(\text{txrgnp112}) \\ & + \text{GEE_XWT3} * \log(\text{txrgnp132}) \\ & + \text{GEE_XWT4} * \log(\text{txrgnp134}) \\ & + \text{GEE_XWT5} * \log(\text{txrgnp136}) \\ & + \text{GEE_XWT6} * \log(\text{txrgnp156}) \\ & + \text{GEE_XWT7} * \log(\text{txrgnp158}) \\ & + \text{GEE_XWT8} * \log(\text{txrgnp123}) \\ & + \text{GEE_XWT9} * \log(\text{txrgnp209}) \\ & + \text{GEE_XWT10} * \log(\text{txrgnp606}) \end{aligned} \quad (\text{A29})$$

Total value of non-oil exports

$$\text{txn_oild} = \text{txpnoild} * \text{txqnoil} \quad (\text{A30})$$

Total value of oil exports

$$tx33 = txpoild * txqoil \quad (A31)$$

Total value of exports

$$bxt = txn_oild + tx33 \quad (A32)$$

Real exports of nonfactor services

$$rxs_nfd = xs_nfd/pgdpd110 \quad (A33)$$

Real exports of goods and services

$$rxgnfs = [(txqoil * RXPOILD85) + (txqnoil + rxs_nfd) * RXPNOILD85] * xmfactor \quad (A34)$$

Manufactures and commodity price

$$\log(txpcpnoild) = COMX1 * \log(txpnopc) + COMX2 * \log(txpmf) \quad (A35)$$

Non-oil primary commodity price

$$\begin{aligned} \log(txpnopc) = & NOPC1 * \log(txpf606) \\ & + NOPC2 * \log(txpb606) \\ & + NOPC3 * \log(txprm606) \\ & + NOPC4 * \log(txpmm606) \end{aligned} \quad (A36)$$

Terms of trade

$$tot = txpd/tmpd \quad (A37)$$

5. Imports of goods and nonfactor services

Desired value of merchandise imports

$$\begin{aligned} \log(bmt_des/tmpd) = & B1 * \log(ra - rmgnfs) \\ & + B2 * \log(xcad/txpd) \\ & + B3 * \log(tmpd/pgdpd) \\ & + B4 * ifxrd.1/bmt.1 \\ & + B5 \end{aligned} \quad (A38)$$

Desired imports of nonfactor services

$$ms_nfd_des = (1 - BMT_W)/BMT_W * bmt_des \quad (A39)$$

Control switch for import regime determination

$$\begin{aligned} \text{bmt_cntl} = & [(\text{ifxrd_bmt3} * 12) < 3] \\ & + [(\text{ifxrd}.1 - (\text{bmt_des} + \text{ms_nfd_des} + \text{bmsi} \\ & - \text{xcad} - \text{ndkfd} + \text{dsp_t} - \text{con_lend})) < 0] \end{aligned} \quad (\text{A40})$$

Merchandise imports

$$\begin{aligned} \text{bmt} = & (\text{bmt_cntl}=0) * \text{bmt_des} \\ & + (\text{bmt_cntl}>0) * (\text{ndkfd} + \text{con_lend} - \text{dsp_t} \\ & + \text{bra} + \text{xcad} - \text{bmsi}) * \text{BMT_W} \end{aligned} \quad (\text{A41})$$

Imports of nonfactor services

$$\begin{aligned} \text{ms_nfd} = & (\text{bmt_cntl}=0) * \text{ms_nfd_des} \\ & + (\text{bmt_cntl}>0) * (\text{ndkfd} + \text{con_lend} \\ & - \text{dsp_t} + \text{bra} + \text{xcad} - \text{bmsi}) * (1 - \text{BMT_W}) \end{aligned} \quad (\text{A42})$$

Non-oil import prices

$$\log(\text{tmpn_oild}) = \text{COMM1} * \log(\text{TXPNOPC606}) + \text{COMM2} * \log(\text{txpmf}) \quad (\text{A43})$$

Total volume of non-oil imports

$$\text{dlog}(\text{tmqn_oil}) = \text{dlog}(\text{bmt}/\text{tmpd}) \quad (\text{A44})$$

Total volume of oil imports

$$\text{dlog}(\text{tmqoil}) = \text{dlog}(\text{bmt}/\text{tmpd}) \quad (\text{A45})$$

Oil import price

$$\log(\text{tmpoild}) - \log(\text{txpoild999}.1) = \text{B1} * \text{dlog}(\text{txpoild999}) + \text{B2} \quad (\text{A46})$$

Total import price

$$\begin{aligned} \log(\text{tmpd}) = & (1 - \text{OILM_W}) * \log(\text{tmpn_oild}/\text{TMPNOILD85}) \\ & + \text{OILM_W} * \log(\text{tmpoild}/\text{TMPOILD85}) \end{aligned} \quad (\text{A47})$$

Total value of non-oil imports

$$\text{tmn_oild} = \text{tmqn_oil} * \text{tmpn_oild} \quad (\text{A48})$$

Total value of oil imports

$$\text{tm33} = \text{tmqoil} * \text{tmpoild} \quad (\text{A49})$$

Real imports of nonfactor services

$$\text{rms_nfd} = \text{ms_nfd}/\text{pgdpd110} \quad (\text{A50})$$

Real imports of goods and services

$$\begin{aligned} \text{rmgnfs} = & ((\text{tmqoil} * \text{RMP OILD85}) + (\text{tmqn_oil} + \text{rms_nfd}) * \text{RMPN_OILD85}) \\ & - (\text{rxgnfs}/\text{xmfactor} - \text{rxgnfs}) \end{aligned} \quad (\text{A51})$$

6. Transfers and net investment income

Private transfers, net

$$\text{btrp} = \text{B1} * \text{ngdpd120} + \text{B2} * \text{xd209} + \text{B3} \quad (\text{A52})$$

Official transfers, net

$$\text{btrg} = \text{B1} * (\text{odad}) + \text{B2} \quad (\text{A53})$$

Official development assistance

$$\text{odad} = \text{B1} * \text{ngdpd110} + \text{B2} \quad (\text{A54})$$

Investment income credits

$$\text{bxsi} = \text{B1} * (\text{ilibor} * \text{ifxrd}) + \text{B2} \quad (\text{A55})$$

Investment income debits

$$\text{bmsdi} = \text{B1} * \text{ngdpd} + \text{B2} \quad (\text{A56})$$

Other investment income debits

$$\text{bmsndi} = \text{B1} * \text{dsi_t} + \text{B2} \quad (\text{A57})$$

7. Capital account and reserves

Non-debt-creating capital flows

$$\text{ndkfd} = \text{B1} * (\text{ngdpd} - \text{ngdpd.1}) + \text{B2} \quad (\text{A58})$$

New borrowing

$$\begin{aligned} \text{nlend} = & \text{B1} * [\text{ilibor} - (\text{pch}(\text{txpd})/100)] \\ & + \text{B2} * [\text{base_tmd} * \text{dlog}(\text{tot})] \\ & + \text{B3} * \text{ngdpd} \\ & + \text{B4} * \text{nlend.1} \\ & + \text{B5} \end{aligned} \quad (\text{A59})$$

Debt/export ratio

$$\text{debtr} = \text{d}/(\text{bxt} + \text{xs_nfd} + \text{bxsi}) \quad (\text{A60})$$

Debt/export ratio--smoothed

$$\text{drhist} = (\text{debtr.1} + \text{debtr.2} + \text{debtr.3})/3 \quad (\text{A61})$$

Constrained borrowing equation

$$\begin{aligned} \text{con_lend} = & \text{MLN85} * (\text{drhist} \geq 2) \\ & + \text{nlend} * (\text{drhist} < 2) * (\text{drhist.1} < 2) * (\text{drhist.2} < 2) \\ & + (2/3 * \text{nlend} + 1/3 * \text{MLN85}) \\ & * (\text{drhist} < 2) * (\text{drhist.1} < 2) * (\text{drhist.2} \geq 2) \\ & + (1/3 * \text{nlend} + 2/3 * \text{MLN85}) \\ & * (\text{drhist} < 2) * (\text{drhist.1} \geq 2) \end{aligned} \quad (\text{A62})$$

Amortization

$$\text{dsp_t} = \text{B1} * \text{d.1} + \text{B2} \quad (\text{A63})$$

Debt

$$\begin{aligned} \text{d} = & [1 + (\log(\text{mermus}) - \log(\text{mermus.1})) * (1 - \text{D_CUR_W})] \\ & * \text{d.1} + \text{con_lend} + \text{ddr} - \text{dsp_t} \end{aligned} \quad (\text{A64})$$

Debt interest payments

$$\text{dsi_t} = \text{D_VR_W} * \text{ilibor} * \text{d.1} + (1 - \text{D_VR_W}) * \text{iliborf} * \text{d.1} \quad (\text{A65})$$

Current account receipts

$$\text{xcad} = \text{bxt} + \text{xs_nfd} + \text{bxsi} + \text{btrp} + \text{btrg} \quad (\text{A66})$$

Current account debits

$$\text{mcad} = \text{bmt} + \text{ms_nfd} + \text{bmsi} \quad (\text{A67})$$

Reserves

$$\text{ifxrd} = \text{ifxrd.1} - \text{bra} \quad (\text{A68})$$

Reserve-to-import ratio

$$\text{ifxrd_bmt} = \text{ifxrd}/(\text{bmt} + \text{ms_nfd}) \quad (\text{A69})$$

Three-period average reserve-to-import ratio

$$\text{ifxrd_bmt3} = (\text{ifxrd_bmt.1} + \text{ifxrd_bmt.2} + \text{ifxrd_bmt.3})/3 \quad (\text{A70})$$

Change in reserves

$$\begin{aligned} \text{bra} = & [(\text{ifxrd_bmt3} * 12) \geq 3] * \\ & [(\text{ifxrd}.1 - (\text{bmt_des} + \text{ms_nfd_des} + \text{bmsi} - \text{xcad} \\ & - \text{ndkfd} + \text{dsp_t} - \text{con_lend})) \geq 0] * (\text{bmt_des} + \text{ms_nfd_des} \\ & + \text{bmsi} - \text{xcad} - \text{ndkfd} + \text{dsp_t} - \text{con_lend}) \\ & + [(\text{ifxrd_bmt3} * 12) < 3] * \text{bra_base} \\ & + [(\text{ifxrd_bmt3} * 12) \geq 3] \\ & * [(\text{ifxrd}.1 - (\text{bmt_des} + \text{ms_nfd_des} + \text{bmsi} - \text{xcad} \\ & - \text{ndkfd} + \text{dsp_t} - \text{con_lend})) < 0] * \text{bra_base} \end{aligned} \quad (\text{A71})$$

Aggregate financing

$$\text{befd} = \text{ndkfd} + (\text{con_lend} - \text{dsp_t}) + \text{bra} \quad (\text{A72})$$

Current account balance

$$\text{bca} = - \text{befd} \quad (\text{A73})$$

8. Alternative equations for net creditors

Real private absorption

$$\begin{aligned} \log(\text{nap_r}) = & B1 * \log\{(\text{ngdpd} + \text{bxsi} - \text{bmsdi} - \text{bmsndi} + \text{btrp}) \\ & / [(1 - \text{SM}) * (\text{pgdpd}/\text{pGdpD85}) + \text{SM} * \text{tmpd}]\} \\ & + B2 * \log(\text{txpd}/\text{pgdpd}) \\ & + B3 * \log(\text{fmb}/\text{pgdp}) \\ & + B4 * (0.5 * \log(\text{gcenl}/\text{pgdp}) \\ & + 0.5 * \log(\text{gcenl}.1/\text{pgdp}.1)) \\ & + B5 \end{aligned} \quad (\text{A74})$$

Real imports of goods and services taking account of the terms of trade effect

$$\text{rmgnfstt} = \text{tmqoil} * (\text{tmpoild} * \text{ed})/\text{pgdp} + (\text{tmqn_oil} + \text{rms_nfd}) * (\text{tmpn_oild} * \text{ed})/\text{pgdp} \quad (\text{A75})$$

Real exports of goods and services taking account of the terms of trade effect

$$\text{rxgnfstt} = \text{txqoil} * (\text{txpoild} * \text{ed})/\text{pgdp} + (\text{txqn_oil} + \text{rxs_nfd}) * (\text{txpnoild} * \text{ed})/\text{pgdp} \quad (\text{A76})$$

Price of nontraded goods in dollars

$$\text{pntd} = (\text{ngdp_r} - \text{rxgnfstt}) * \text{pgdpd}/\text{ran} \quad (\text{A77})$$

Real income

$$\text{ninc_r} = \text{ra} + (\text{rxgnfstt} - \text{rmgnfstt}) + (\text{bxsi} - \text{bmsi})/\text{pgdpd} \quad (\text{A78})$$

Oil export volume

$$\begin{aligned} \log(\text{txqoil}) = & B1 * \log(\text{txqoil}.1) \\ & + B2 * \log(\text{txpoild}/\text{pgdpdl10}) \\ & + B3 * \log(\text{rgdp110}) \\ & + B4 * \text{TREND} \\ & + B5 \end{aligned} \quad (\text{A79})$$

Total volume of non-oil imports

$$\begin{aligned} \log(\text{tmqn_oil}) = & B1 * \log(\text{tmqn_oil}.1) \\ & + B2 * \log(\text{tmp_oild}/\text{pntd}) \\ & + B3 * \log(\text{nap_r}) \\ & + B4 * \log(\text{gcenl_r}) \\ & + B5 * \text{ifxrd}.1/\text{bmt}.1 \\ & + B6 \end{aligned} \quad (\text{A80})$$

Imports of nonfactor services

$$\log(\text{ms_nfd}) = B1 * \log(\text{bmt}) + B2 \quad (\text{A81})$$

Private transfers, net

$$\text{btrp} = B1 * \text{ngdpdl20} + B2 * \text{ngdpd} + B3 \quad (\text{A82})$$

Total value of imports

$$\text{bmt} = \text{tmn_oild} + \text{tm33} \quad (\text{A83})$$

Aggregate financing

$$\text{befd} = \text{mcad} - \text{xcad} \quad (\text{A84})$$

Change in reserves

$$\text{bra} = \text{befd} - \text{ndkfd} - (\text{con_lend} - \text{dsp_t}) \quad (\text{A85})$$

9. Endogenous variables

BCA	=	Current account balance
BEFD	=	Aggregate financing (negative of the current account balance), in billion dollars
BMS	=	Current account, services and income debits
BMSDI	=	Current account, direct investment income
BMSI	=	Current account, factor income debit
BMSNDI	=	Current account, interest income debit
BMSO	=	Current account, other debits
BMT	=	Current account, merchandise imports
BMT_CNTL	=	Control variable for import regime switch
BMT_DES	=	Desired level of merchandise imports

BRA	=	Change (increase = -) in reserves
BT	=	Current account, merchandise balance
BTR	=	Unrequited transfers
BTRG	=	Current account, official unrequited transfers
BTRP	=	Current account, private unrequited transfers
BXS	=	Current account, services and income credits
BXSI	=	Current account, factor income credit
BXSO	=	Current account, other credits
BXT	=	Current account, merchandise exports
CON_LEND	=	Constrained external borrowing, in billion dollars
D	=	Total debt outstanding at end of current year
DEBTR	=	Debt/export ratio
DRHIST	=	Debt/export ratio (three-year moving average)
DSI_T	=	Total debt interest paid
DSP_T	=	Total amortization paid
ED	=	Exchange rate, national currency per dollar
FMB	=	Broad money
GCB	=	Central government fiscal balance
GCEC	=	Central government current expenditure
GCEK	=	Central government capital expenditure
GCENL	=	Central government expenditure
GCRG	=	Central government revenue
IFXRD	=	Stock of reserves, in billion dollars
IFXRD_BMT	=	Reserve-to-import ratio
IFXRD_BMT3	=	Reserve-to-import ratio, three-year average
MCAD	=	Current account debits, total, in billion dollars
MS_NFD	=	Imports of nonfactor services, in billion dollars
MS_NFD_DES	=	Desired value of imports of nonfactor services
NAP_R	=	Real private absorption
NDKFD	=	Non-debt-creating capital flows in billion dollars
NGDP	=	Nominal GDP, in billion of national currency
NGDPD	=	Nominal GDP, in billion dollars
NGDP_R	=	Gross domestic product, constant prices
NINC_R	=	Real income
NLEND	=	New external borrowing, in billion dollars
ODAD	=	Overseas development assistance
PGDP	=	GDP deflator
PGDPD	=	GDP deflator in dollar terms
PNTD	=	Price of nontraded goods in dollars
RA	=	Real absorption in billions of national currency, at constant prices
RC	=	Real consumption (residually defined) in billions of national currency at constant prices
RGDPN	=	Real GDP in nontradables, in billions of national currency at constant prices
RGDPT	=	Real GDP in tradables, in billions of national currency at constant prices
RGNP	=	Real GNP, in billions of national currency at constant prices

RI	=	Real investment, in billions of national currency at constant prices
RK	=	Real capital stock, in billions of national currency at constant prices
RKN	=	Real capital stock in nontradables, in billions of national currency at constant prices
RKT	=	Real capital stock in tradables, in billions of national currency at constant prices
RMGNFS	=	Real imports of goods and nonfactor services
RMGNFSTT	=	Real imports of goods and nonfactor services taking account of the terms of trade effect
RMS_NFD	=	Real imports of nonfactor services, in billion of national currency at constant prices
RXGNFS	=	Real exports of goods and nonfactor services
RXGNFSTT	=	Real exports of goods and nonfactor services taking account of the terms of trade effect
RXS_NFD	=	Real exports of nonfactor services, in billions of national currency at constant prices
TM33	=	Value of oil imports, current prices
TMN_OILD	=	Value of non-oil merchandise imports, in billion dollars
TMPD	=	Import unit value index, 1985 = 1
TMPN_OILD	=	Price index of non-oil imports, 1985 = 1
TMPOILD	=	Price index of oil imports, 1985 = 1
TMQN_OIL	=	Non-oil import volumes, in billion dollars at 1985 prices
TMQOIL	=	Oil import volumes, in billion dollars at 1985 prices
TOT	=	Terms of trade index, 1985 = 1
TX33	=	Value of oil exports, current prices
TXN_OILD	=	Value of non-oil merchandise exports, in billion dollars
TXPCPNOILD	=	Weighted world price of manufactures and non-oil primary commodities, 1985 = 1
TXPD	=	Export unit value index, 1985 = 1
TXPNOILD	=	Price index of non-oil exports, 1985 = 1
TXPNOPC	=	Weighted world price of non-oil primary commodities, 1985 = 1
TXPOILD	=	Price index of oil exports, 1985 = 1
TXQNOIL	=	Non-oil export volumes, in billion dollars at 1985 prices
TXQOIL	=	Oil export volumes, in billion dollars at 1985 prices
TXRCNP	=	Weighted index of world output (demand), 1985 = 1
XCAD	=	Current account credits, total in billion dollars
XS_NFD	=	Export of nonfactor services, in billion dollars

10. Exogenous variables

BASE_TMD	=	Baseline value of imports, in billion dollars
BRA_BASE	=	Baseline value of the change in reserves
DDR	=	Impact of debt-reduction operation, in billion dollars
GCEK_R	=	Real government capital expenditure
ILIBOR	=	London interbank offered rate on six-month U.S. dollar deposits
ILIBORF	=	Moving average of LIBOR interest rate

MERMUS	=	U.S. effective exchange rate, nominal
NGDPD110	=	GDP in industrial countries, billion dollars
NGDPD120	=	GDP in Europe, billion dollars
PGDPD110	=	GDP deflator for industrial countries, dollars
RGDP110	=	Real GDP in industrial countries
TREND	=	Trend (time) line
TXPMF	=	World export price of manufactures
TXPNOPC606	=	Price of non-oil primary commodities from developing countries
TXPOILD999	=	World oil price
TXQOIL606	=	Volume of oil exports in net debtor developing countries
TXPB606	=	World commodity price, beverages
TXPF606	=	World commodity price, food
TXPMM606	=	World commodity price for metals and minerals
TXPRM606	=	World commodity price for raw materials
TXRGNP111	=	Real GDP (United States)
TXRGNP112	=	Real GDP (United Kingdom)
TXRGNP123	=	Real GDP (smaller industrial countries)
TXRGNP132	=	Real GDP (France)
TXRGNP134	=	Real GDP (Germany)
TXRGNP136	=	Real GDP (Italy)
TXRGNP156	=	Real GDP (Canada)
TXRGNP158	=	Real GDP (Japan)
TXRGNP209	=	Real GDP (net creditor developing countries)
TXRGNP606	=	Real GDP (net debtor developing countries)
XD209	=	Total value of exports from the oil exporting net creditor countries
XMFACTOR	=	Adjustment for re-export trade

11. Fixed values and shares

BMT_W	=	Share of merchandise imports in imports of goods and nonfactor services
COMM1	=	Share of non-oil primary commodities in non-oil import prices
COMM2	=	Share of manufactures in non-oil import prices
COMX1	=	Share of non-oil primary commodities in non-oil export prices
COMX2	=	Share of manufactures in non-oil export prices
D_CUR_W	=	Share of non-dollar debt
D_VR_W	=	Share of debt held at variable interest rates
GEE_XWT1	=	Share of exports to United States
GEE_XWT2	=	Share of exports to United Kingdom
GEE_XWT3	=	Share of exports to France
GEE_XWT4	=	Share of exports to Germany
GEE_XWT5	=	Share of exports to Italy
GEE_XWT6	=	Share of exports to Canada
GEE_XWT7	=	Share of exports to Japan
GEE_XWT8	=	Share of exports to other industrial countries
GEE_XWT9	=	Share of exports to net creditor countries

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