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Growth-Oriented Adjustment Programs: A Conceptual Framework*

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Abstract

This paper suggests a conceptual framework that can serve as a basis for the design of growth-oriented adjustment programs. The two building blocks of the model are the well-known monetary approach to the balance of payments, and a variant of the open-economy neoclassical growth model. The integrated model combines growth, inflation, and the balance of payments, and links these objectives to government policies and the availability of foreign financing. The principal advantage of the proposed framework is its simplicity, which enables it to be applied relatively easily to a variety of developing countries.

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Contents

I. Introduction

There is a broad consensus in both academic and policymaking circles that a sustained rate of economic growth is central to an adjustment strategy aimed at achieving long-term viability in the balance of payments and a permanent reduction in the rate of inflation. Indeed, it can be argued that adjustment can only be termed successful if it brings about a rate of growth of output that allows for a steady improvement in per capita income and living standards. However, while there may be general agreement on the concept of "growth-oriented adjustment," designing a policy package that will simultaneously eliminate the macroeconomic imbalances in the economy and raise the growth rate turns out to be no easy task. The desire to develop a framework for growth-oriented adjustment has, thus, begun to preoccupy researchers and practitioners alike. Evidence of this interest is reflected in, *inter alia*, a growing number of academic papers, 1/ the recent joint Bank-Fund symposium on the subject of growth-oriented adjustment programs, 2/ and at a more policy-related level, the approach suggested in the report of the Group of Twenty Four. 3/

The need for a consistent framework in which policies can be linked to growth, inflation, and the balance of payments, becomes particularly pressing as one moves to operationalize the concept of growth-oriented adjustment. There are, of course, a number of empirical models available that attempt to capture the interrelationships between the three principal objectives of adjustment programs, but these models tend to be either too complicated or too country-specific to apply easily across countries. 4/ The development of a conceptual framework that incorporates the most important macroeconomic policy instruments and targets, and can be tailored to the circumstances and the structural characteristics of the individual country, is now clearly one of main priorities of research on developing countries.

The most widely used models at present are variants of the monetary approach to the balance of payments, used in designing short-term stabilization programs geared toward balance of payments and inflation targets, and simple versions of the open-economy neoclassical growth model, which

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1/ See the references in the survey paper by Khan (1987).
2/ See Corbo, Goldstein and Khan (1987).
3/ See G-24 (1987).
4/ See Khan and Knight (1985) for a survey of selected macroeconomic models for developing countries.

are applied to the analysis of growth issues. 1/ In a previous paper we described these two existing popular models and showed that they could be combined in a straightforward fashion, providing a simple framework that can be used as a starting point in the development of an appropriate model. 2/ Our purpose here is to examine the short-run comparative-static properties of the combined model. Since our intent is purely expositional, there is no pretense here at presenting a "new" macroeconomic model for developing countries. 3/

The model developed here has a number of features that deserve mention. First, it combines growth, inflation, and balance of payments within an integrated framework, but unlike the earlier model of Khan, Montiel, and Haque (1986), it does not utilize restrictive assumptions about the growth process, foreign debt and debt-servicing, and the endogeneity of exports. Second, the model is able to link these objectives of adjustment directly to a variety of government policies. Third, the model can be used to calculate the effects of changes in external financing on monetary and real variables in the economy. This last feature is of particular importance in present-day circumstances where developing countries are seriously constrained in the amount of foreign resources they can attract. Finally, as the model has a simple structure and requires a minimal amount of information, it can be applied in a fairly straightforward manner to a wide variety of countries. It thus has an operational advantage that more complex models would tend to lack.

In order to analyze the properties of this model we examine the short-run or impact effects on growth, inflation, and the balance of payments of a variety of exogenous and policy-induced shocks. The policy shocks include changes in domestic credit, the exchange rate, fiscal policies, and structural policies that alter the private savings rate and the efficiency of investment. Other shocks considered are changes in the income velocity of money and variations in foreign capital flows. The results we obtain from this analysis turn out to be broadly consistent with widely-held priors. The information on responses to shocks provided by such experiments would obviously have to be taken into account in the design of an appropriate policy package that combined growth with adjustment.

1/ The monetary approach to the balance of payments plays a key role in the formulation of Fund financial programs (IMF (1977) and (1987)), and the World Bank uses a two-gap growth model to establish external financing needs and consistent projections across countries (World Bank (1980)).

2/ See Khan, Montiel, and Haque (1986).

3/ See Corden (1987) for a discussion of the relevance of current macroeconomic theories to developing economies.

The remainder of the paper proceeds as follows: in Section II we briefly describe the structure of the model. Section III, which is the key component of the paper, undertakes comparative-static exercises to demonstrate the workings of the model. The concluding section summarizes the main points of the paper, and highlights some of the directions in which the proposed framework could be extended.

II. A Model of Adjustment and Growth

The model formulated in this section contains a growth block and a monetary block, which together determine the rate of growth of output, prices, and the balance of payments. This section begins by describing a simple macroeconomic framework for a representative developing economy. The growth and monetary components of the model are specified separately, and then combined to yield the complete model.

1. The macroeconomic framework

Consider a small open economy which maintains a fixed exchange rate. In this economy the private sector is assumed to own all factors of production. It receives income from production (Y), and uses it to pay taxes (T), consume (C), and save (S_p). The private sector's budget constraint is therefore: 1/

(1) $Y - T - C - S_p \equiv 0.$

Private sector savings are devoted to the accumulation of physical capital, to hoarding, and to reducing liabilities to the banking system: 2/

(2) $S_p \equiv P_D\, dk + dM^d - dD_p$

where P_D is the price of domestic output, dk is the change in the real private capital stock, 3/ dM^d is the change in the nominal demand for

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1/ For simplicity we assume that the private sector cannot borrow abroad, and that domestic interest rates are zero. While the introduction of private capital flows and domestic interest payments would complicate the analysis, it would be unlikely to alter the conclusions.

2/ Since the model described in this sector is formulated in discrete time, the symbol "d" will be used below to denote the change in a variable from the last period (0) to the present.

3/ We assume that there is no public investment so that all investment in the economy is undertaken by the private sector.

money (hoarding), and dD_p is the change in net domestic credit to the private sector extended by the banking system.

The government, in turn, consumes output (G), pays interest on its foreign borrowing (ieF), collects taxes from the private sector (T), receives the profits of the central bank (T_B), and finances its deficit by borrowing from the domestic banking system (dD_g) and from abroad (edF). We use e to denote the nominal exchange rate and F the foreign-currency value of the government's foreign debt. 1/ The government budget constraint is given by:

$$(3) \quad edF + dD_g \equiv G + ieF - T - T_B$$

Finally, the banking system, which is assumed to consist solely of the central bank, accumulates reserves with foreign-currency value R, extends credit to the government and the private sector, and issues liabilities in the form of money. With changes in the domestic currency value of foreign reserves arising out of exchange rate movements being sterilized, the change in the money supply would have the form:

$$(4) \quad dM^S \equiv e_0 dR + dD$$

where dM^S is the change in the nominal money supply, dR is the foreign-currency value of the change in foreign reserves (the balance of payments), e_0 is the exchange rate in the previous period, and dD is the change in total domestic credit, defined as:

$$(5) \quad dD = dD_g + dD_p$$

The portion of the central bank's profits that is transferred to the government is given by: 2/

$$(6) \quad T_B = ieR$$

1/ In this model it is assumed that only the government can borrow abroad.
2/ Capital gains from devaluation are assumed to be retained by the central bank.

Since this economy is open and both owns foreign assets (R) and owes liabilities to foreigners, GNP (which we denote $\tilde{Y}$) will differ from the value of domestic production Y by an amount equal to net interest payments abroad:

(7) $\tilde{Y} = Y - ie(F-R)$.

Given these budget constraints, balance sheet relationships, and definitions, we can proceed to describe the analytical model.

2. The growth component

Most of the modern literature on sources of growth in developing countries takes as its starting point the neoclassical production function. 1/ Thus, capacity growth depends on increases in total factor productivity, in the size of the labor force, and in the capital stock. Treating the first two of these as exogenous (though possibly responsive to efficiency-enhancing policies) we can formulate the expansion of capacity as a linear function of real investment:

(8) $dy = \alpha_0 + \alpha_1 dk$

where y is real output (GDP). The coefficient of investment, α_1, is the marginal product of capital, and the constant term α_0 captures the combined effects of increases in total factor productivity and the change in the size of the labor force. In empirical analyses of growth in developing countries an even simpler form of (8) is sometimes used, in which α_0 is set equal to zero. The result is the familiar "incremental capital output" relationship (ICOR) associated with, among others, Chenery and Strout (1966). The ICOR is also the key relationship in the Revised Minimum Standard Model (RMSM) utilized by the World Bank to calculate external financing needs for developing countries. 2/ Here we will work with the less restrictive growth specification, described by equation (8), which allows for productivity changes.

1/ See, for example, Robinson (1971), and more recently, Fischer (1987).

2/ See World Bank (1980). In practice Bank programs go well beyond what is implied by RMSM. For an extended discussion of the economics of Bank programs for adjustment and growth, see Michalopoulos (1987).

The counterpart to equation (8) for GNP is given by:

$$(9)\quad d\tilde{y} = dy - \frac{P_{D0}[ie(dF-dR) + i(F_0-R_0)de] - ie_0(F_0-R_0)dP_D}{P_{D0}P_D}$$

$$= \alpha_0 + \alpha_1 dk - \frac{P_{D0}[ie(dF-dR)+i(F_0-R_0)de] - ie_0(F_0-R_0)dP_D}{P_{D0}P_D}$$

Thus, the change in real national income depends both on the change in domestic production and on the change in the real value of net interest payments abroad. Holding the external interest rate constant, the latter depends on changes in net international indebtedness and in the real value of foreign interest payments brought about by changes in the real exchange rate.

The second element in the simple growth model is the identity that relates aggregate investment to aggregate savings. In our framework, this can be written as:

$$(10)\quad dk = s_p + [t - g - ie\frac{(F-R)}{P_D}] + e\frac{(dF - dR)}{P_D}$$

where s_p, t, g and $ie(F-R)/P_D$ are the real values of private saving, taxes, government spending, and net foreign interest payments respectively, measured in units of domestic goods. 1/ The first term in (10) is, therefore, real private saving, the second is real public saving, and the third is the real current account deficit--real foreign saving.

The third relationship in the model is that for private savings behavior. The simplest way of representing this relationship is to make real private saving proportional to real private disposable income:

$$(11)\quad s_p = s(y-t) \quad ; \quad 0 < s < 1$$

We assume that t and g are exogenous in real terms, and that dF is exogenous in foreign-currency terms. Using equation (11), equation (10) becomes:

1/ Lower-case letters will denote real variables throughout.

$$(10a)\quad dk = s(y-t) + [t-g-ie\ \frac{(F-R)}{P_D}] + e\frac{(dF-dR)}{P_D}$$

Finally, since $y = y_0 + dy$, and $P_D = P_{D0} + dP_D$, and using the growth equation (8), we can derive the following relationship between real output growth and changes in the price level in the simple growth model:

$$(12)\quad dy = (1-s\alpha_1)^{-1}\ \{\alpha_0 + \alpha_1\ [s(y_0-t) + (t-g) + \frac{e(dF - dR - i[F-R])}{P_{D0} + dP_D}]\}$$

Since $\alpha_1 < 1$ and $0 < s < 1$, the term $(1-s\alpha_1)^{-1}$ will be positive. This implies that, assuming that the trade balance is in deficit, i.e., $(dF-dR-i[F-R]) > 0$, an increase in dP_D will reduce dy, given dR. The economic reason for this inverse relationship is that, since the supply of foreign savings is given in foreign-currency terms, an increase in prices ($dP_D > 0$) will result in a real exchange rate appreciation which will reduce the real value of foreign savings measured in terms of domestic goods. With reduced real savings--the other components of aggregate savings are unchanged--real investment falls, and from equation (8), real output would decline.

It can be noticed, however, that even after treating t,g, and dF as exogenous, the simple growth model is underdetermined, as equation (12) contains three endogenous variables, namely dy, dR, and dP_D. 1/ Two additional restrictions on these three variables are necessary to close the model.

3. The monetary component

The simple open-economy monetary model has proven to be a very useful device for analyzing balance of payments questions, and variants this model are used to design financial programs to support the Fund's lending to its member countries. 2/ The very basic monetary model, as described for example by Robichek (1967), and in the papers contained in Frenkel and Johnson (1976), involves three relationships.

The first relationship is the flow supply of money, as given by equation (4):

$$(4)\quad dM^S = e_0 dR + dD$$

1/ Recall that $F = F_0 + dF$ and $R = R_0 + dR$.
2/ See IMF (1977) and (1987), as well as Robichek (1985).

The second relationship defines the flow demand for money. In general this would be derived from a stock demand for money function that included as explanatory variables, among others, real income, expected inflation, expected changes in the exchange rate, interest rates, etc. A restricted version of this model is the constant-velocity money demand specification, which in flow terms is given by: 1/

(13) $dM^d = \nu P dy + \nu y_0 dP$

where P is the aggregate price level, to be defined presently, and ν is the inverse of the income velocity of money.

The third key relationship in this model is the assumption of flow money-market equilibrium:

(14) $dM^d = dM^s$

Substituting the flow demand for money, given by equation (13), and the flow supply of money (4) into the equilibrium condition (14) and solving for the change in reserves we have:

(15) $edR = \nu P dy + \nu y_0 dP - dD$

Equation (15) is the fundamental equation of the monetary approach to the balance of payments, (Frenkel and Johnson (1976)). In this model, given the flow demand for money, increases in the rate of domestic credit expansion will be exactly matched by a deterioration in the balance of payments.

The aggregate price level that appears in equation (15) can be expressed as a weighted average of the price of importables (P_z) and the price of domestic output (P_D). If the weight of importables is given by θ, we can approximate the change in the aggregate price level as:

(16) $dP = \theta dP_z + (1-\theta) dP_D$,

1/ Using a more general formulation for the demand for money would not alter the analysis appreciably as long as the function was stable with respect to the explanatory variables.

assuming that θ is constant and $e_0 = P_{z0} = P_{D0} = 1$. Furthermore, if the law of one price holds and $P_z^* = 1$ is the (constant) foreign-currency price of importables, we also have:

$$(17) \quad dP_z = P_z^* de = de$$

Using equations (16) and (17) to substitute out dP from equation (15) we obtain:

$$(18) \quad dR = \nu dy + \nu y_0 \theta de + \nu y_0 (1-\theta) dP_D + \nu \theta de dy + \nu (1-\theta) dP_D dy - dD$$

Equation (18) summarizes the monetary model. However, as was the case in the growth model, this model is also underdetermined. Even if de and dD are taken as exogenous policy variables, equation (18) contains three unknowns--dR, dy, and dP_D. Again, two additional restrictions among these endogenous variables are required to close this system.

4. The merged model

With these two well-known models in hand, we can proceed to combine them into a merged model that will yield simultaneous solutions for growth, prices, and the balance of payments.

Since, as was pointed out, both the growth model and the monetary model are incomplete as they stand, they are supplemented by an additional relationship--common to both models--and an ancillary assumption specific to each of the models. The additional relationship is the balance-of-payments identity:

$$(19) \quad dR = X - Z - i(F-R) + dF$$

where X and Z are the foreign-currency values of exports and imports, respectively.

Defining the balance of trade deficit in foreign-currency terms (B) as B = Z - X, we assume:

$$(20) \quad B = B_0 - a\frac{(de-dP_D)}{P_D} + bdy,$$

$$= B_0 - a\,(e/P_D - 1) + bdy$$

i.e., the trade balance improves (B falls) in foreign currency terms when the real exchange rate depreciates ($e/P_D>1$) and deteriorates (B rises) when real output increases. Using equations (19) and (20) we can write the equation for dR as:

$$(21) \qquad dR = (dF-B_0) + a(e/P_D-1) - bdy - i(F-R)$$

Since $F = F_0 + dF$ and $R = R_0 + dR$, equation (21) can also be written as:

$$(21a) \qquad dR = (dF - B_0') + a'(e/P_D-1) - b'dy - i'(F_0-R_0),$$

where $a' = a/(1-i)$, $b'=b/(1-i)$, $i' = i/(1-i)$, and $B_0' = B_0/(1-i)$.

These equations can now be used to close the growth and monetary models. It should be noted that capital flows in equation (21) are assumed to be exogenous. In a more realistic setting one would expect that capital flows would also be affected by the exchange rate. However, if one assumes that capital flows have an autonomous component, corresponding say to dF, then the analysis will carry through even if part of capital flows are endogenous and respond to exchange rate changes.

Consider first the growth model. We can use equation (21) to eliminate dR from the growth equation (12). The result is:

$$(22) \quad dy = [1 - s\alpha_1 - \alpha_1 be/P_D]^{-1} \{\alpha_0 + \alpha_1 \{s(y_0-t) + (t-g) + \frac{e}{P_D} [B_0-a(e/P_D-1)]\}\}$$

By adding an ancillary assumption about dP_D, this model is able to explain dy. It can be seen that an increase in the private savings rate, government savings, or in the exogenous component of the current account *deficit would increase real output growth, in each case by increasing* aggregate saving and therefore investment. 1/ The effect of a devaluation is, however, ambiguous. Evaluated at $dy_0 = 0$, it is given by:

1/ This assumes that the factor $\alpha_1(s + b)$ is less than unity, a condition which is very unlikely to be violated empirically.

(22a) $\frac{\delta(dy)}{\delta(de)} = \alpha_1 \eta/\beta,$

where,

$\eta = B_0 - a = ?$

and

$\beta = 1 - \alpha_1 (s + b) > 0$

Devaluation simultaneously increases the real value of the initial level of foreign saving and, by discouraging imports and encouraging exports, reduces that level. The first effect increases real investment, while the second decreases it. If substitution effects dominate (i.e., if the parameter a is sufficiently large), the effect of devaluation on growth will be negative ($\eta < 0$) in this model. 1/ This result is a property of any open-economy Harrod-Domar model in which devaluation improves the trade balance. In essence, a real devaluation causes private agents to accumulate assets other than domestic capital, thereby reducing the growth rate of domestic output.

Equations (12) and (21) can be used, together with an assumption about prices, to apply the growth model in a "policy mode". Given a target value for the balance of payments, say dR*, equations (12) and (21) can be solved simultaneously to determine the output growth rate (dy) associated with each level of external financing (dF). The World Bank's RMSM model is normally applied in this way to calculate foreign exchange and financing gaps.

Combining the balance-of-payments equation (21a) with reserve change equation (18), and assuming that the change in real output is exogenous ($dy = d\bar{y}$) the monetary model can be solved for dR and dP_D. The result is a variant of the solution obtained in the well-known Polak (1957) model. 2/

1/ This is simply a slightly modified version of the familiar Marshall-Lerner condition.

2/ In the Polak model the endogenous variables are the balance of payments and nominal output. Assuming real output exogenous, the Polak model then determines the change in reserves and prices.

The model's implicit solution for the change in the price of domestic output can be determined from:

$$(23)\quad dP_D - \frac{[dF-B_0^{'}- i'(F_0-R_0)+dD] - (b'+\nu)\overline{dy}-\nu y_0\theta de - \nu\theta de\overline{dy} + a'(e/P_D-1)}{\nu(1-\theta)(y_0+\overline{dy})} = 0.$$

It can be shown that the domestic price level increases with an increase in the flow of bank credit, and decreases with an increase in output. The latter follows from flow money-market equilibrium. A one-unit increase in dy produces an incipient flow excess demand for money, since it both increases demand (by ν) and (through an increase in net imports of b') reduces the supply of money. Equilibrium requires a reduction in the price of domestic output, which creates a flow excess supply of money both by reducing money demand (by $\nu(1-\theta)y_0$) and by increasing money supply (by the amount a') through an improved trade balance. The effect of a devaluation on the price level is ambiguous. Assuming initial balance of payments equilibrium and setting dy equal to zero for simplicity, a devaluation will at the same time raise the flow supply of money by improving the trade balance and also the flow nominal demand for money by increasing the domestic-currency price of importables, and thus the aggregate price level. The net result on the flow excess supply and therefore on dP_D will depend on the sign of the expression $(a' - \nu y_0\theta)$.

The "policy mode" of the monetary model would be implemented using equations (18) and (21a), as well as the assumptions about the change in real output (dy) and a balance of payments target (dR*). This would enable one to solve for the domestic price level and the implied rate of domestic credit expansion.

Since the growth model assumes prices exogenous and the monetary model keeps real output exogenous, a natural alternative closure for the two models is to dispense with the ancillary assumptions made for each model (about the respective exogeneity of dP_D and dy) and combine the two models to solve for dP_D and dy simultaneously. This is readily done by combining equations (22) and (23), which already incorporate equations (12), (18), and (21). The resulting "merged" model can be described graphically through Figure 1. Equation (22), corresponding to the growth model, traces out a positively-sloped locus in dP_D-dy space (labeled GG in Figure 1), on the assumption that substitution effects are dominant. The slope of GG at the point dy = dP_D = 0 is:

$$\left.\frac{\delta(dP_D)}{\delta(dy)}\right|_{GG} = - \beta/\alpha_1\eta > 0$$

Increases in the domestic price level tend to be associated with increases in output in the growth model because higher domestic prices increase the trade deficit, and the associated increase in foreign saving results in increased investment.

Equation (23), which relates to the monetary model, traces out a negatively-sloped locus, labeled MM in Figure 1. The slope at dy=0 and $dP_D = 0$ of MM is given by:

$$\left.\frac{\delta(dP_D)}{\delta(dy)}\right|_{MM} = -(b'+\nu)/\gamma < 0,$$

where $\gamma = a' + \nu(1-\theta)y_0 > 0$. In the monetary model, increases in dP_D and dy are negatively associated because both tend to increase the flow excess demand for money. It follows that an increase in dP_D must be offset by a reduction in dy to maintain flow money market equilibrium.

The intersection of the GG and MM loci at point A in Figure 1 determines the equilibrium values of output changes dy* and domestic inflation dP_D^*. The model can be condensed into four equations--(22) and (23) as well as the GNP and balance of payments equations (9) and (21a). As summarized in Table 1, the model contains four endogenous variables--the growth of output and GNP, inflation, and the balance of payments. There are nine exogenous and predetermined variables. The five policy instruments include fiscal policy variables (t and g), monetary policy variables (dD and dD_p), and the exchange rate (de). Finally, the model contains seven parameters.

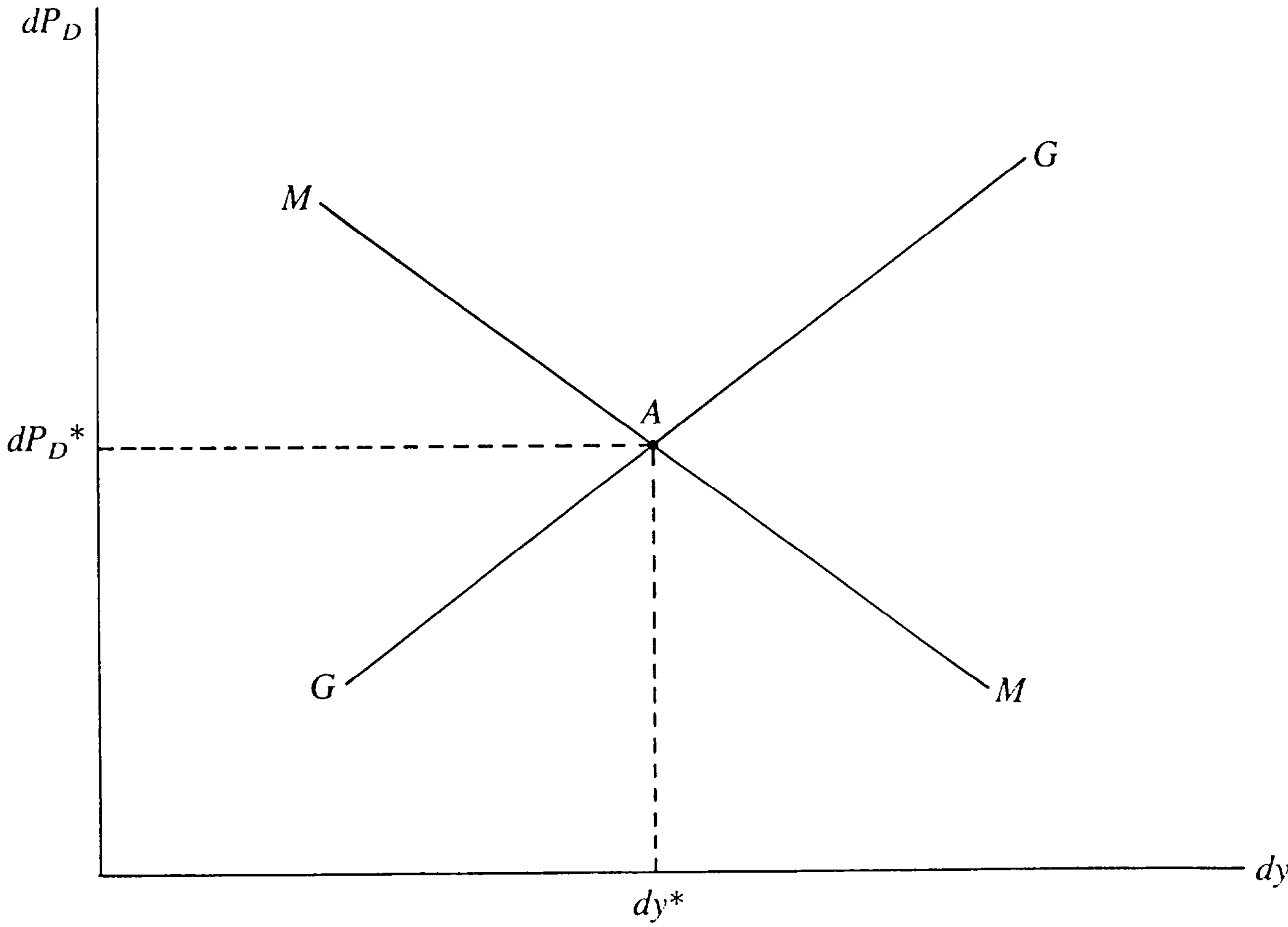
III. Properties of the Merged Model

Even though the merged model has a fairly rudimentary structure, particularly in terms of its behavioral content, it nevertheless has some interesting properties. These properties have a bearing on design of adjustment programs in which growth is an explicit objective. This section will examine the short-run effects of changes in policy instruments--domestic credit, the exchange rate, government spending--changes in key parameters--the private savings rate, total factor productivity, velocity--and finally, changes in capital inflows. These comparative-static exercises cover most of the effects one would typically be interested in, and yield useful insights into the interrelationships among growth, inflation, and the balance of payments in the model.

Table 1. Structure of the Merged Model

Endogenous Variables	Exogenous and Predetermined Variables	Policy Instruments	Parameters
dy	y_0	t	α_0
$d\tilde{y}$	F_0	de	α_1
dP_D	R_0	g	s
dR	$P_{D_0} = P_{z_0} = e_0 = 1$	dD	ν
	B_0	dD_p	θ
	dF		a
	i		b

FIGURE 1
MACROECONOMIC EQUILIBRIUM
IN THE "MERGED" MODEL



1. Changes in domestic credit

An increase in the rate of domestic credit expansion creates an excess flow supply of money. At a given level of output, this can only be absorbed by an increase in the price level, which induces an offsetting flow excess demand for money through two channels: first, there is an increase in demand for money through the constant velocity relationship; and second, as net imports rise there is a fall in reserves and a consequent reduction in the rate of monetary expansion. In the context of Figure 2 the MM schedule shifts upward to a position such as M'M'. Assuming that the increase in the supply of domestic credit leaves the government deficit unaffected, 1/ the GG schedule would remain stationary. However, the real exchange rate appreciation at point B, by creating a current account deficit, induces an increased use of foreign saving which increases investment. But the associated rise in output increases the demand for money, thereby reducing the increase in price level required to restore flow equilibrium in the money market. The end result is that both growth and inflation rise as a consequence of the increase in the rate of domestic credit expansion, i.e., we move from A to C in Figure 2.

Formally, the increase in the rate of inflation is given by:

$$(24) \qquad \frac{\delta(dP_D)}{\delta(dD)} = (\Omega\delta)^{-1} > 0$$

where,

$$\Omega = 1 - \frac{\alpha_1 \eta(b'+\nu)}{\beta\gamma} > 0$$

and, as previously defined:

$$\beta = 1 - \alpha_1 \ (s+b) > 0$$

$$\eta = B_0 - a$$

1/ This means that all the increase in domestic credit goes to the private sector.

The change in the growth rate is given by:

$$(25) \qquad \frac{\delta(dy)}{\delta(dD)} = -\frac{\alpha_1}{\beta} (\Omega\gamma)^{-1} > 0$$

To solve for the change in the balance of payments, notice from equation (21a) that:

$$(26) \qquad \frac{\delta(dR)}{\delta(dD)} = -a' \frac{\delta(dP_D)}{\delta(dD)} - b' \frac{\delta(dy)}{\delta(dD)}$$

$$= (b'\frac{\alpha_1}{\beta}\eta - a')(\Omega\gamma)^{-1} < 0.$$

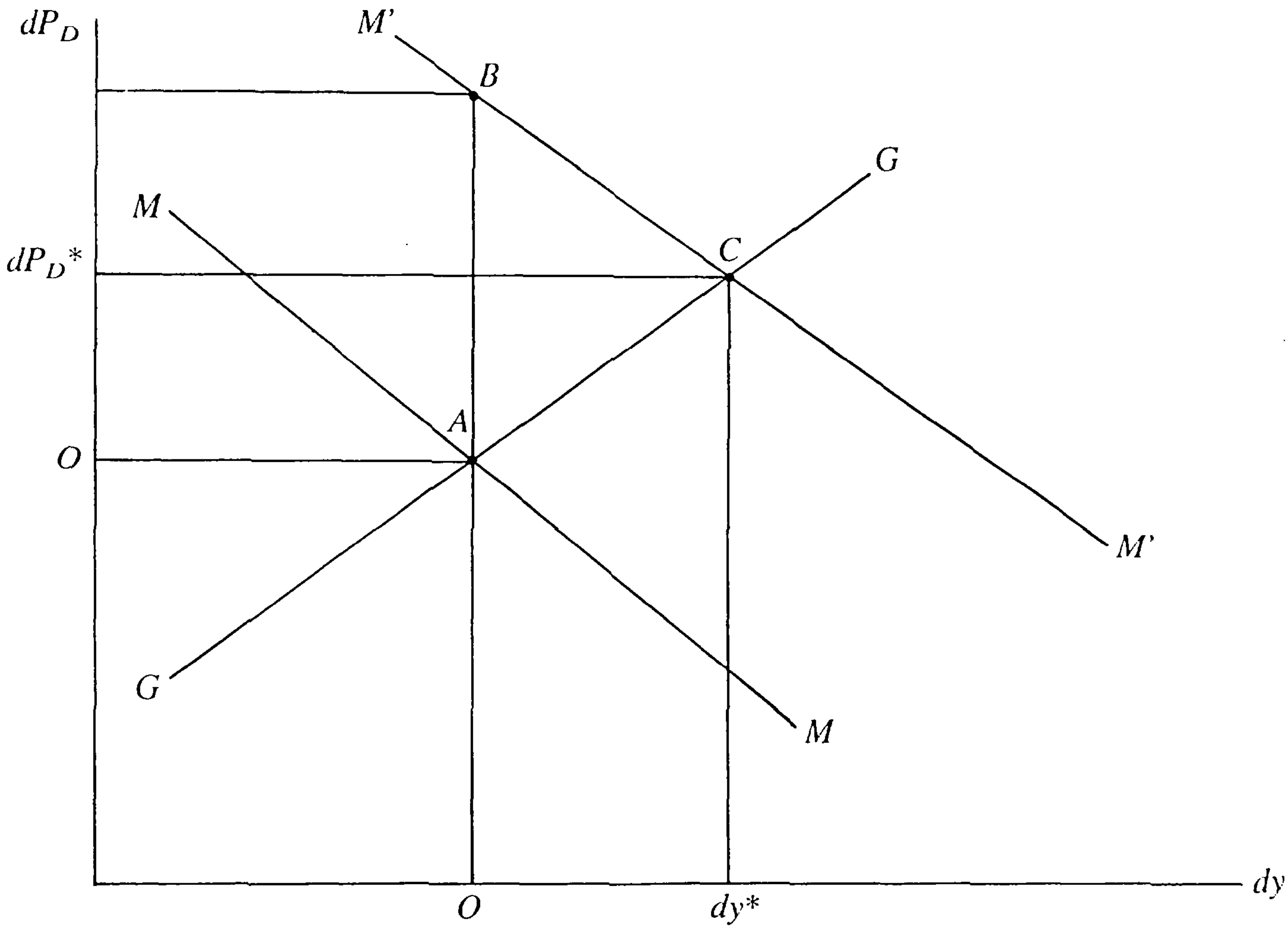
As is well known, in the monetary model of the balance of payments, a credit expansion must cause the balance of payments to deteriorate.

2. Devaluation

A devaluation has conflicting effects on the money market. Given the initial price of domestic goods, a devaluation will create a flow excess demand for money by increasing the aggregate price level as the price of imported goods rises, and a flow excess supply as the higher relative price of imports and exports discourages the former and encourages the production of the latter, thus leading to an improvement of the balance of payments. 1/ The net result will depend on the share of importables in the aggregate price index (θ), on the velocity of money (ν), and on the substitutability between home and traded goods (a). If the degree of substitutability is high, the reduction in net imports will dominate and an excess flow supply of money will result. On the other hand, if import prices have a large weight in the aggregate price index and the income velocity of money is low, there would be an excess flow demand for money. In Figure 3, which analyzes the effects of a devaluation, it is assumed that there is an excess flow supply of money, which is eliminated by an increase in dP_D, causing the MM schedule to shift upward to M'M'. It is important to notice that the upward shift in MM must be less than de. This can be verified from equation (23). If P_D rises by de, an excess demand for money will result. Only if $dP_D < de$--and substitution effects dominate--will the implied real exchange rate depreciation generate a sufficient flow supply of money (through the trade balance) so as to restore money market equilibrium.

1/ We assume that in the absence of the devaluation, the balance of payments would have been in equilibrium. If not, the change in the domestic currency value of the flow of foreign exchange reserves would also exert monetary effects.

FIGURE 2
EFFECTS OF AN INCREASE
IN DOMESTIC CREDIT



Inspection of equation (22) verifies that if the real exchange rate is unchanged by a nominal devaluation--i.e., if dP_D = de--output growth will be unchanged. Thus, at a given dy, a nominal devaluation will shift GG upward by dP_D = de, to a point such as B in Figure 3.

Under these circumstances a devaluation will unambiguously increase domestic prices while reducing real output. Intuitively, this is because growth can only increase if real savings increase. Since substitution effects are dominant in foreign trade, this requires that domestic prices increase <u>more</u> than in proportion to the devaluation. But if this were the case, there would be a flow excess demand for money. Thus, domestic prices must rise <u>less</u> than in proportion to the devaluation (the real exchange rate must depreciate), and with the improvement in the trade balance, real domestic saving and thus investment must decrease. In terms of the diagram, there must be a flow excess demand for money at point B, since the domestic price level has risen by dP_D = de and no other variables affecting the market have changed. Thus, the new M'M' curve must pass below B. At point C, for example, the money market clears both because the increase in the flow demand for money is less than at B and because the depreciation in the real exchange rate at this point causes a trade balance improvement which increases the flow supply of money. Since the upward shift in the MM curve is therefore smaller than that of the GG curve, the new eqilibrium must be to the left of AB, implying that $dy^*<0$.

The above assertions can be formally verified via inspection of the derivatives of dP_D and dy with respect to a change in the exchange rate. For the change in prices the derivative is:

(27) $$\frac{\delta(dP_D)}{\delta(de)} = (\Omega\gamma)^{-1} [a'-\nu y_0\theta - \alpha_1\eta(b'+\nu)/\beta] > 0$$

and for growth the derivative is:

(28) $$\frac{\delta(dy)}{\delta(de)} = \frac{\alpha_1\eta}{\beta}(\Omega\gamma)^{-1}\nu y_0 < 0.$$

Finally, the effect of devaluation on the balance of payments is given by:

(29) $$\frac{\delta(dR)}{\delta(de)} = a' - a' \frac{\delta(dP_D)}{\delta(de)} - b' \frac{\delta(dy)}{\delta(de)}$$

$$= (a' - b' \frac{\alpha_1}{\beta} \eta)(\Omega\gamma)^{-1} \nu\gamma_0 > 0.$$

The balance of payments improves both because the real exchange depreciates and because real output falls.

3. Changes in government spending

We now consider the effects of a reduction in real government spending, holding real tax revenue and total domestic credit expansion constant. This implies a reduction in the fiscal deficit, with the supply of credit freed up by the government being rechanneled to the private sector. Since domestic saving rises as a result of the increase in public sector saving, investment and output would rise. In Figure 4, therefore, the GG schedule would shift to the right to G'G'. As domestic credit expansion remains constant, the money market is unaffected and the MM schedule stays stationary. The increase in output puts downward pressure on domestic prices, and at the new equilibrium at point C growth is higher and inflation lower.

The precise impact effects of a change in real government spending on inflation and growth are:

(30) $$\frac{\delta(dP_D)}{\delta g} = \Omega^{-1}\alpha_1 \frac{(b'+\nu)}{\beta\gamma} > 0,$$

so that a reduction in g decreases dP_D, and

(31) $$\frac{\delta(dy)}{\delta g} = -\Omega^{-1}\alpha_1/\beta < 0$$

so dy increases when g falls. Since output increases and prices fall, the effect on the balance of payments is ambiguous:

(32) $$\frac{\delta(dR)}{\delta g} = \frac{\alpha_1}{\beta} \Omega^{-1} [b'-a'(b'+\nu)/\gamma] = ?$$

FIGURE 3
EFFECTS OF A DEVALUATION

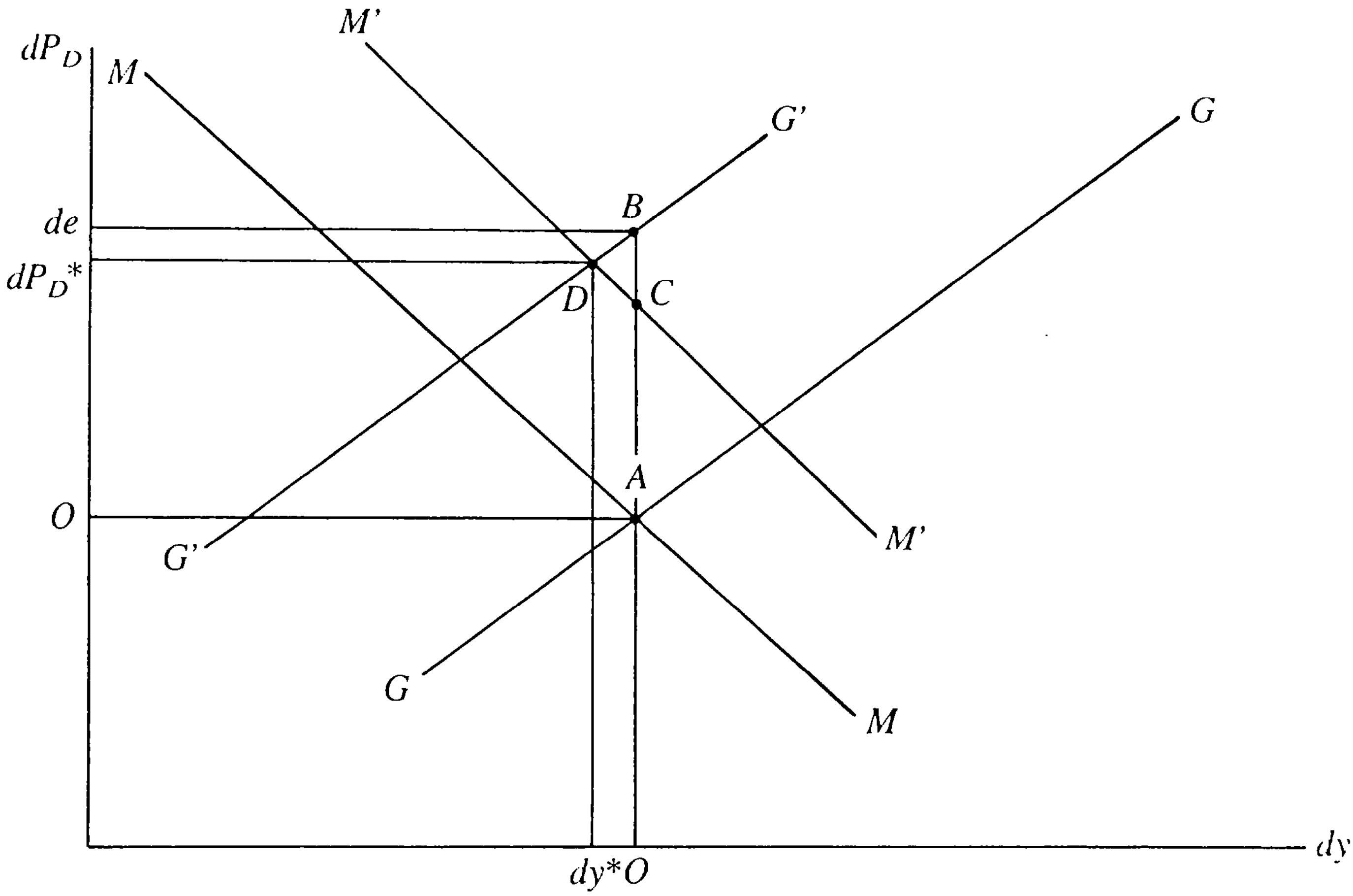
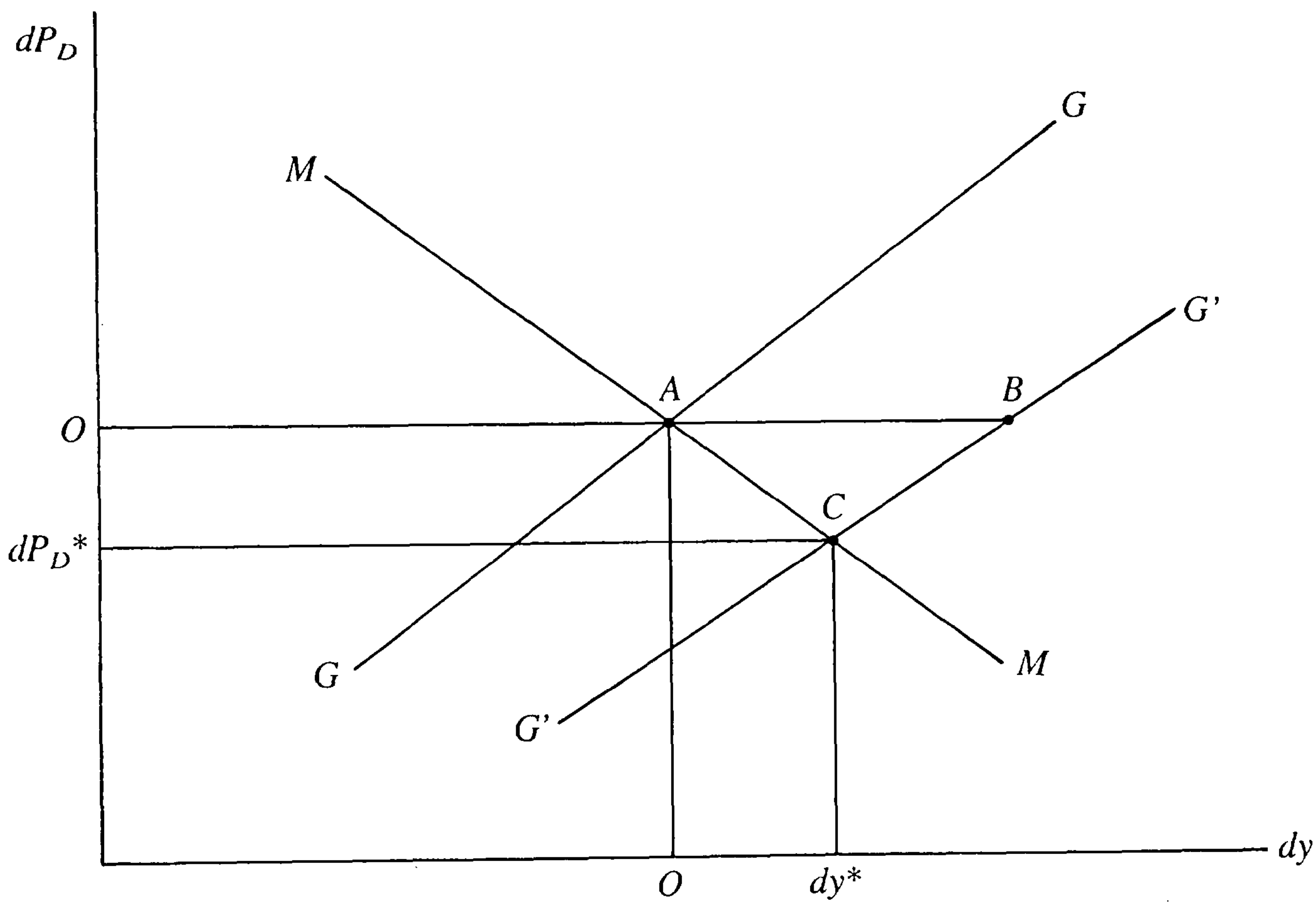


FIGURE 4
EFFECTS OF A REDUCTION IN
GOVERNMENT SPENDING



If substitution effects on the trade balance are strong relative to income effects (a' is large relative to b') and price effects are large (i.e., the value of $(b'+\nu)/\gamma$ is large), the balance of payments will improve.

A reduction of the fiscal deficit through an increase in taxes would operate in a like manner, except that the impact effect on domestic saving would be (1-s), rather than unity. The reason for this is the fact that there is a reduction in private saving as private disposable income declines.

4. Changes in the private saving rate

The effects of an increase in the private saving rate in this model are very similar to those resulting from an increase in public sector saving. A rise in the private saving rate increases domestic saving, *thereby creating an excess of saving over investment.* As investment rises output would be increased, shifting the GG curve in Figure 4 to the right. However, as the increased investment leads to higher output, a further increase in private saving is induced. This multiplier effect causes the shift in the GG schedule to be larger than would be the case when public saving was increased. Assuming that the increase in private saving is matched by investment and does not go into hoarding--leaving MM unaffected--there will be a higher rate of growth and a lower rate of inflation. 1/ The new equilibrium would be at a point like C in Figure 4, but as mentioned above, this point would lie further to the right than would be observed when government spending was reduced.

The effects of an increase in the private saving rate are given by:

$$(32) \qquad \frac{\delta\,(dP_D)}{\delta s} = -\ \Omega^{-1}\alpha_1(b'+\nu)(y_0-t)/\beta\gamma < 0$$

and

$$(33) \qquad \frac{\delta(dy)}{\delta s} = \Omega^{-1}\alpha_1(y_0-t)/\beta > 0$$

The balance of payments outcome is ambiguous, since prices and output move in opposite directions:

1/ This description ignores changes in the slope of GG, which are, however, captured in equations (30) and (31).

(34) $$\frac{\delta(dR)}{\delta s} = \Omega^{-1}\alpha_1 \frac{(y_0-t)}{\beta}\left[a'\frac{(b'+\nu)}{\gamma} - b'\right] = ?$$

5. Changes in total factor productivity

Consider the effects of the adoption of structural policies that enhance total factor productivity, i.e., policies that raise α_0. Since at the original level of investment a larger amount of output would be forthcoming, an incipient excess of saving over investment would ensue. This new saving would be channeled into investment, and output would rise still further. The GG schedule shifts rightward as in Figure 4, and once again the MM schedule is unaffected. Thus, a rise in factor productivity, like an increase in saving, is in effect a positive supply shock. Again, the increase in output exerts downward pressure on prices and the economy moves from A to C in Figure 4. 1/ The price and output effects are:

(35) $$\frac{\delta(dP_D)}{\delta\alpha_0} = -\Omega^{-1}(b'+\nu)/\beta\gamma < 0$$

and

(36) $$\frac{\delta(dy)}{\delta\alpha_0} = (\Omega\beta)^{-1} > 0$$

while the balance of payments effect is ambiguous:

(37) $$\frac{\delta(dR)}{\delta\alpha_0} = (\Omega\beta)^{-1}\left[a'\frac{(b'+\nu)}{\beta}-b'\right] = ?$$

6. Changes in velocity

Suppose there is an exogenous increase in the demand for money, in the form of a reduction in the income-velocity of money, given a positive initial output growth rate dy_0. This would give rise to flow excess demand in the money market so that, at a given dP_D, the MM curve must shift to

1/ We again ignore the changes in the slope of GG.

the left, say to M'M' in Figure 5. In other words, growth must fall to reduce the flow demand for money and restore flow equilibrium in the money market. The GG curve is unaffected, and the economy moves to a new equilibrium on this curve with lower growth and reduced inflation, as at point B in Figure 5. The formal effects of a change in velocity on prices, output, and the balance of payments are:

(37) $$\frac{\delta(dP_D)}{\delta\nu} = -\Omega^{-1}dy_0/\gamma < 0$$

(38) $$\frac{\delta(dy)}{\delta\nu} = \Omega^{-1}\alpha_1\eta dy_0/\beta\gamma < 0$$

(39) $$\frac{\delta(dR)}{\delta\nu} = -\Omega^{-1}dy_0(b'\frac{\alpha_1\eta}{\beta} - a')/\gamma > 0.$$

Since domestic prices and output both fall in this case, an increase in the demand for money causes the balance of payments to improve.

7. Changes in capital inflows

An increase in capital inflows, holding the exogenous components of the current account constant, must in the first instance be transformed into accumulation of reserves. Thus, such inflows will exert their impact on the domestic economy through the money supply, i.e., they give rise to a flow excess supply of money. As long as these capital inflows go into international reserves, the economy's use of foreign saving is unchanged. Thus, the MM curve would shift to the right and the GG curve would remain stationary. Both qualitatively and quantitatively this case is identical to that of an increase in domestic credit to the private sector (Figure 2). The reason for this equivalence is that both the increase in domestic credit and in capital inflows function as money supply shocks, with the former operating through an increase in the central bank's domestic assets and the latter through an increase in its foreign assets.

A more interesting exercise is one in which a new capital inflow is matched by an increase in imports, i.e., $d(dF)=dB_0'$. Since such an inflow has no immediate monetary consequences, the MM curve remains stationary. The GG curve, on the other hand, shifts to the right, as the increased supply of foreign saving increases investment and thus output. The results are increased output and lower prices. The equilibrium is similar to that illustrated in Figure 4. Quantitatively, the effects on domestic prices, output, and the balance of payments are identical to those of a reduction in government spending, since both represent an infusion of savings. In this case, it is also of interest to investigate the effects on real national income (GNP). Using (9), and assuming initial current account balance ($dF_0-dR_0=0$), we have:

$$(40)\quad \frac{\delta(d\tilde{y})}{\delta(dF)} = \frac{\delta(dy)}{\delta(dF)} - i\left[1-\frac{\delta(dR)}{\delta(dF)}\right] + i(F_0-R_0)\frac{\delta(dP_D)}{\delta(dF)}$$

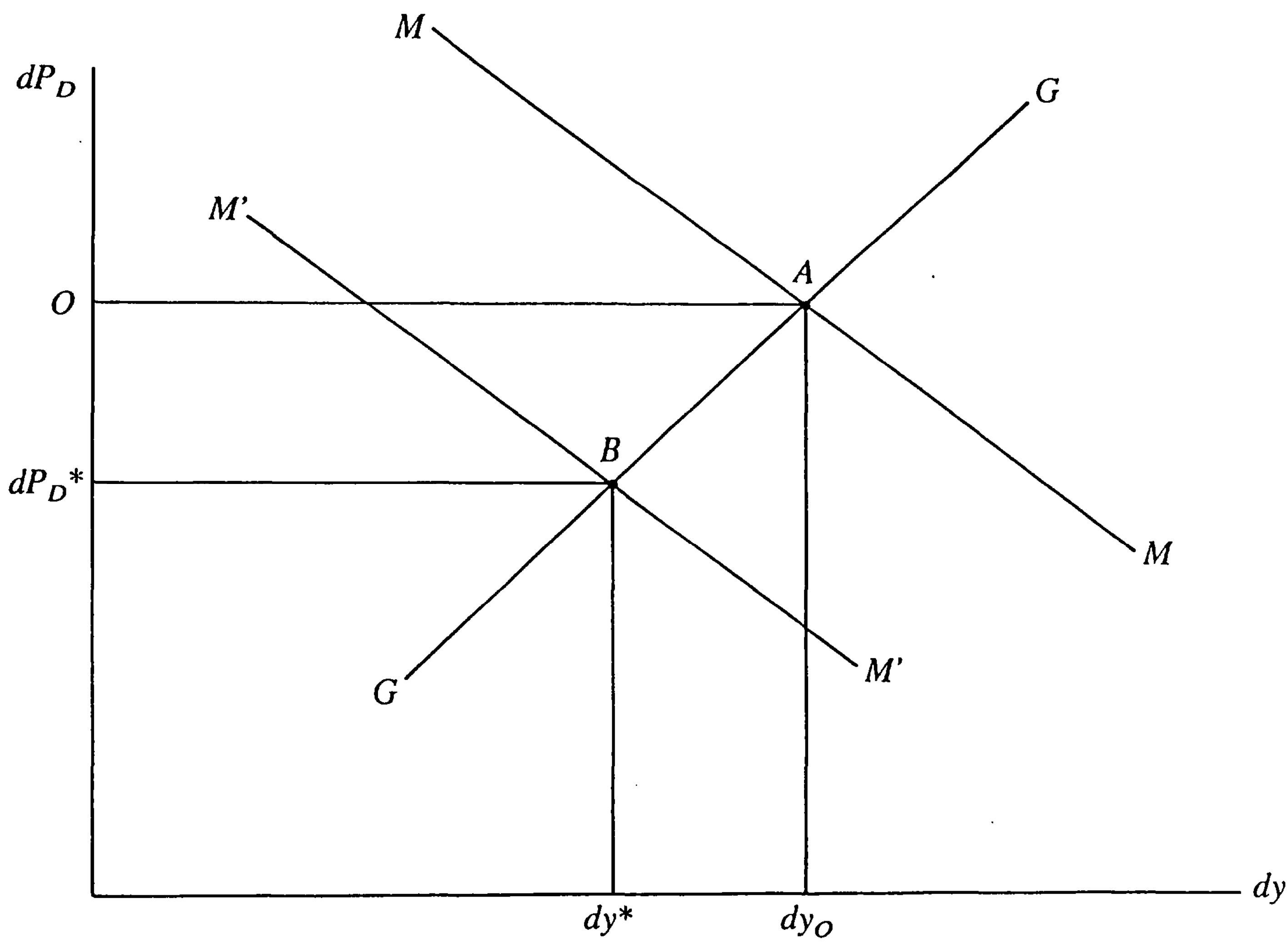
Using equations (30, (31), and (32):

$$(41)\quad \frac{\delta(d\tilde{y})}{\delta(dF)} = \alpha_1\frac{\Omega^{-1}}{\beta} - i\left\{1-\alpha_1\frac{\Omega^{-1}}{\beta}\left[a'\frac{(b'+\nu)}{\gamma}-b'\right]\right\} - i(F_0-R_0)\alpha_1\frac{\Omega^{-1}}{\beta}\frac{(b'+\nu)}{\gamma}$$

These results can readily be given an intuitive interpretation. A one-unit capital inflow used for investment increases output on impact by α_1 (the marginal product of capital). But, as equation (41) shows, the total effect on domestic output differs from α_1 in this model by a factor of $(\Omega\beta)^{-1}$, which consists of two parts, corresponding to induced effects on saving generated by the initial capital inflow. The term β^{-1} indicates that the original inflow of saving will be magnified by the effects of positive marginal propensities to save and import (recall that $\beta = 1-\alpha_1(s+b) < 1$), so that a one-unit increase in saving increases total saving by β^{-1}, at a given dP_D. Second, since domestic prices fall, this will also affect real saving (this corresponds to the movement from B to C in Figure 4). This effect is captured by the factor Ω^{-1}, which is less than one in absolute value. Thus the increase in domestic output may exceed or fall short of the marginal product of capital α_1.

According to equation (41), the change in national income is derived by subtracting from the change in output the change in real factor payments abroad, which is the product of the interest rate and the change in real net international indebtedness. The latter, in turn, consists of the difference between the additional capital inflow and any induced changes in foreign exchange reserves, plus the change in the real value of interest payments. The induced balance of payments effect of the capital inflow may be positive or negative. To clear the flow money market, the increase in output must be accompanied by a decrease in prices. However, these changes have conflicting effects on the balance

FIGURE 5
EFFECTS OF REDUCED VELOCITY



of payments, the former reducing the overall surplus and the latter increasing it. The balance of payments surplus is likely to increase the larger are substitution effects (a') relative to income effects (b'). To the extent that the balance of payments goes into deficit, net international indebtedness will increase by more than the one-unit capital inflow. On the other hand, if a surplus results, net indebtedness will increase by less than one unit. Finally, since domestic prices fall, the real value of the original level of interest payments must rise. This increases the real burden of servicing the debt and thus reduces real national income, accounting for the final term in equation (41).

Equation (41) thus represents a generalization of the familiar result that a capital inflow devoted to investment will only increase national income if the marginal product of capital (α_1) exceeds the interest rate charged on the loan (i). The generalization involves taking into account induced effects on saving and on real net international indebtedness implied by the model.

8. Summary of results

To obtain an overall perspective on the properties of the merged model, the results obtained from the comparative-static experiments are summarized in Table 2. This table shows the signs of the short-run effects on prices, real output and the balance of payments, of changes in the various policy instruments, behavioral parameters, and exogenous variables.

IV. Conclusions

The objective of this paper was to outline a simple analytical framework--combining two well-established models--that could prove useful in designing growth-oriented adjustment programs. This framework allows for the treatment of economic growth as an explicit policy objective, along with the objectives of balance of payments improvement and price stability that are generally part of an adjustment strategy. The integrated model is thus able to address many of the issues that would arise in formulating a growth-oriented adjustment program. For example, given targets for growth, the balance of payments, and inflation, the model can be used to determine a set of demand-management policies (domestic credit ceilings and reductions in the fiscal deficit), exchange rate policies, structural policies (policies to increase savings and the level and efficiency of investment), and external financing policies, that would achieve these targets. The model outlined in this paper can also be used to evaluate the short-run effects of certain domestic and foreign shocks on the economy.

Table 2. Impact Effects on Changes in Prices, Real Output and the Balance Payments

	Changes in:		
	Domestic Prices	Real Output	Balance of Payments
	dP_D	dy	dR
Effects of increases in:			
Domestic credit dD	> 0	> 0	< 0
Exchange rate de	> 0	< 0	> 0
Government spending dg	> 0	< 0	?
Private saving rate ds	< 0	> 0	?
Factor productivity $d\alpha_0$	< 0	> 0	?
Velocity of money $d\nu$	> 0	> 0	> 0
Capital inflows 1/ dF	< 0	> 0	?

1/ Matched by an offsetting change in imports.

The type of framework developed here should, however, not be interpreted as a comprehensive model of growth and adjustment, or a completely realistic representation of the behavioral and structural characteristics of a developing economy. While the model is internally consistent and includes many of the principal policy targets and policy instruments, there are several areas where further work is both necessary and desirable in order to introduce more realism into the analysis.

First, the behavioral equations in this model are rudimentary, amounting in some cases (e.g., private savings, the demand for money) to simple rules of thumb. Furthermore, the institutional framework is extremely simplified. The monetary sector of the model, for example, does not handle demand for and supplies of different types of domestic and foreign financial assets, and more importantly, domestic interest rate determination. By excluding the latter the model leaves out a potentially important channel through which monetary policy could affect the economy. Also there is no attempt made to formalize the interaction between the central bank, the fiscal sector, and the banking system. This is an area where further work would yield significant payoffs. Though it would obviously be desirable to incorporate behavioral and institutional relationships that are more realistic and analytically defensible, each such innovation would involve sacrifices in terms of transparency and ease of application. The model described here in fact provides a first step in the direction of increased realism by integrating capacity growth--albeit in a very simple way--into a standard monetary framework, and it is evident that even this is done at some cost in terms of complexity.

Second, the model is assumed to be in continuous equilibrium and thus all adjustments occur instantaneously. This feature is particularly striking in the case of prices, which continuously adjust to clear the flow money market. The addition of short-run dynamic behavior, say through lags in adjustment of prices to monetary disequilibrium or through slow revision of expectations of future inflation, while perhaps not changing the overall conclusions, would nonetheless yield useful information on the time path of prices. A satisfactory treatment of dynamics is necessary, since policymakers are often as concerned with the time paths of the target variables as they are with the final outcomes. The model as presently formulated does not enable one to trace out the transition of the economy from one short-run equilibrium to another. Moreover, the model has an implicit long-run dynamic structure (through the acculation of capital as well as financial assets) which implies that present actions have future consequences. Thus a desirable extension of the present analysis would be to exploit the longer-term dynamics arising from asset accumulation.

Third, growth in this model is entirely determined by supply factors, and the economy is assumed to always be operating at full capacity. As such, changes in aggregate demand have no effect, even in the short run, on the rate of capacity utilization. In a properly specified macroeconomic model one would presumably wish to make distinctions between growth in productive capacity, growth of output resulting from more efficient use of productive capacity, and growth that results from increases in aggregate demand (when there is excess capacity in the economy). In the present full-capacity framework one cannot treat important issues of employment and wage determination.

Fourth, capital flows would in general respond to expectations of interest rates and exchange rates, which in turn would likely be affected by policy actions. Assuming foreign financing to be exogenous, as is done in the model here, is quite restrictive and may well lead to incorrect policy recommendations. While there can be no argument about the appropriateness of treating capital flows as endogenous to domestic policies, it must, however, be recognized that modelling such relationships is quite difficult. As yet there have been very few successful attempts to do this, reflecting both a lack of theory on what drives capital movements, as well as an inability to properly model unobservable variables such as expectations.

In conclusion, the present model can be viewed as a first step in the development of a conceptual framework within which to design growth-oriented adjustment programs. The simplicity of the model is certainly a virtue, as it is easily understood and can be readily applied with a minimal amount of information. From an operational perspective, particularly in countries where data are limited and of uneven quality, this latter feature takes on considerable importance. It would seem pointless to design complex models that cannot be applied because they have more demanding information requirements. A logical second step would be to test the empirical validity of the simple model. If the model passes the test, it could serve as a foundation on which more elaborate and realistic structures, possibly along the lines mentioned above, can be built.

References

Chenery, Hollis B., and Alan M. Strout, "Foreign Assistance and Economic Development," American Economic Review (September 1966), pp. 679-733.

Corbo, Vittorio, Morris Goldstein, and Mohsin Khan (eds.), Growth-Oriented Adjustment Programs (Washington, D.C.: IMF and the World Bank, 1987).

Corden, W. Max, "The Relevance for Developing Countries of Recent Developments in Macroeconomic Theory," World Bank Research Observer (July 1987), pp. 171-188.

G-24--International Group of Twenty-Four on International Monetary Affairs, "The Role of the IMF in Adjustment with Growth," (March 1987).

Fischer, Stanley, "Economic Growth and Economic Policy," in V. Corbo, M. Goldstein, and M. Khan (eds.), Growth-Oriented Adjustment Programs (Washington, D.C.: IMF and the World Bank, 1987), pp. 151-178.

Frenkel, Jacob A., and Harry G. Johnson (eds.), The Monetary Approach to the Balance of Payments (London: A. Unwin, 1976).

International Monetary Fund, The Monetary Approach to the Balance of Payments (Washington, D.C.: IMF 1977).

_____, Theoretical Aspects of the Design of Fund-Supported Adjustment Programs, IMF Occasional Paper No. 55 (September 1987).

Khan, Mohsin, S., "Macroeconomic Adjustment in Developing Countries: A Policy Perspective," World Bank Research Observer (January 1987), pp. 23-42.

_____, and Malcolm D. Knight, Fund-Supported Adjustment Programs and Economic Growth, IMF Occasional Paper No. 41 (Washington, D.C., International Monetary Fund, November 1985).

_____, Peter Montiel, and Nadeem Haque, "Adjustment with Growth: Relating the Analytical Approaches of the World Bank and the IMF," World Bank, Development Policy Issues Series Discussion Paper (October 1986).

Michalopoulos, Constantine, "World Bank Programs for Adjustment and Growth," in V. Corbo, M. Goldstein, and M. Khan (eds.), Growth-Oriented Adjustment Programs (Washington, D.C.: IMF and The World Bank, 1987), pp. 15-62.

Polak, Jacques J., "Monetary Analysis of Income Formation and Payments Problems," IMF Staff Papers (November 1957), pp. 1-50.

Robichek, E. Walter, "Financial Programming Exercises of the International Monetary Fund in Latin America," address to a seminar of Brazilian Professors of Economics, Rio de Janerio (September 1967).

_____, "Financial Programming as Practiced by the IMF," World Bank, unpublished (January 1985).

Robinson, Sherman, "Sources of Growth in Less Developed Countries: A Cross-Section Study," Quarterly Journal of Economics (August 1971), pp. 391-406.

World Bank, "The Revised Minimum Standard Model," Comparative Analysis and Projections Division, unpublished (May 1980).