IMF WORKING PAPER

WP/89/1

INTERNATIONAL MONETARY FUND

Research Department

Dynamics of Devaluation and "Equivalent" Fiscal Policies for a Small Open Economy*

Prepared by J. Saul Lizondo and Peter J. Montiel

Authorized for Distribution by Mohsin S. Khan

January 3, 1989

Abstract

In pursuing a steady-state reserve target, policymakers in small open economies can resort to devaluation or to temporary increases in public saving. This paper contrasts the dynamic implications of these alternative policies in a model with optimizing agents who possess perfect foresight. In general, the private sector cannot be insulated from the effects of the government's reserve-accumulation policies. The dynamic effects of devaluation depend on the fiscal policy rule in effect. In contrast to devaluation, the "equivalent" fiscal policies imply discontinuities in private consumption and temporary tax increases may cause key macroeconomic variables to overshoot their steady-state values.

JEL Classification Number:
4310

*This paper has been prepared for the Interamerican Seminar on Economics. We are grateful to Mohsin Khan for his comments on an earlier draft.

I. Introduction

Although fixed exchange rates among the major industrial-country trading blocs have been abandoned for some time, the vast majority of developing countries have continued to defend fixed official parities for their currencies. 1/ Since these countries have experienced severe macroeconomic shocks--of both external and domestic origin--in the recent past that have led to imbalances in their external accounts, devaluation has remained an important component of their macroeconomic adjustment programs, and exchange-rate changes figure prominently in the macroeconomic policy advice offered to them by international organizations, and particularly the IMF. 2/

In view of the continued importance of devaluation as a policy tool in much of the world, it is somewhat surprising that, in the absence of a general consensus on the macroeconomic effects of devaluation, this question has ceased to command the attention of the economics profession. 3/ For example, although a setting in which economic agents possess perfect foresight and optimize over infinite horizons is now the standard benchmark for the analysis of the effects of macroeconomic policies, we know of only one previous study of the effects of devaluation in this framework (Obstfeld (1981)). Since this familiar approach has yielded important new insights in other areas, it seems a promising avenue of research for understanding the macroeconomic consequences--and especially the macroeconomic dynamics--of devaluation.

Our purpose in this paper is to extend the analysis of devaluation in this direction. We construct a simple model of a small "dependent economy" operating with a fixed exchange rate, in which agents produce and consume both traded and nontraded goods and hold assets in the form of both money and bonds. 4/ Their consumption and asset accumulation decisions are derived by solving an intertemporal optimization problem over an infinite horizon under the assumption of perfect foresight. Our analysis examines the dynamic responses of the overall balance of payments, real exchange rate, the current account, private consumption, the domestic real interest rate, and real output, to a nominal devaluation. Since in this model the purpose of an official devaluation is to alter the public sector's steady-state net international indebtedness, we compare the

---

1/ According to the IMF (1988), as of June 30, 1988, a total of 90 developing countries maintained an official parity for their currencies.

2/ See IMF (1987).

3/ The absence of consensus can be documented, for example, in the "contractionary devaluation" debate (see the recent survey by Lizondo and Montiel (1989)).

4/ Both Khan and Lizondo (1987) and Khan and Montiel (1987) examine the macroeconomic effects of devaluation in a model of this type, but without explicit optimization.

effects of devaluation to those obtained from alternative ways of securing the same steady-state stock of net foreign assets for the public sector. Since the public sector can increase its steady-state asset stock by temporarily increasing its own saving, these "equivalent" policies include temporary reductions in government spending on traded and nontraded goods and temporary tax increases. Our aim is to examine the extent to which the steady-state equivalence of such policies carries over to the dynamics of adjustment.

The remainder of the paper consists of four sections. The model is presented and solved in the next section, while the dynamic responses of the economy to an unanticipated devaluation are explored in Section III. Section IV examines the effects of a temporary reduction in government spending on nontraded goods and of a temporary tax increase. Finally, the paper's conclusions are briefly summarized in the last section, which also contains a discussion of some possible extensions.

II. The Model

1. Specification

Consider a small open economy producing both traded and nontraded goods. Agents in this economy derive utility from the consumption of both kinds of goods and from the holding of real cash balances. We denote these respectively as c_T, c_N, and m, where m is the nominal money stock (M) divided by a price index (P) with the latter defined as:

$$P = P_T^{1-\alpha} P_N^{\alpha} \ ; \ 0 < \alpha < 1 \tag{1}$$

where α is a parameter whose economic interpretation will be given below, and P_T and P_N are, in turn, the domestic-currency prices of traded and nontraded goods. The instantaneous utility function u is therefore given by:

$$u(t) = u(c_T(t), c_N(t), m(t)) \ . \tag{2}$$

The representative agent is assumed to choose paths for c_T, c_N, and m by maximizing a functional of the form:

$$U = \int_0^{\infty} u(t)\exp(-\Delta(t))dt \ ,$$

where $\Delta(t)$ is the discount factor which applies to utility received at instant t. Following Obstfeld (1981) and Uzawa (1968), the rate of time preference is endogenous in our model. The discount factor $\Delta(t)$ is given by:

$$\Delta(t) = \int_0^{t} \delta[u(s)]ds \ , \tag{3}$$

where the rate of time preference δ at time s depends on the instantaneous rate of utility received by the household at that moment. 1/ δ is assumed to have the properties $\delta' > 0$, $\delta'' > 0$, and $\delta - u\delta' > 0$--i.e., the rate of time preference is an increasing function of the flow of utility (see Obstfeld 1981)).

In maximizing the functional U, the household has to respect a number of constraints. Let a denote the household's financial wealth measured in units of traded goods. Financial wealth is the sum of the household's stocks of money and bonds, so a is given by:

$$a = me^{-\alpha} + b_p \ , \tag{4}$$

where e is the real exchange rate, defined as $e = P_T/P_N$, and b_p denotes the households' bond holdings, measured in units of traded goods. Bonds are assumed to be internationally traded, and to yield the interest rate r. The rate r is both a nominal and real rate, since we shall assume that there is no ongoing traded goods inflation. The evolution of financial wealth over time is governed by:

1/ The endogeneity of the rate of time preference is introduced to ensure the existence of a steady-state solution in the presence of perfect capital mobility. As Obstfeld (1981) points out, unless either the rate of time preference or the market interest rate is endogenous, the economy will not converge to a steady state.

$$\dot{a} = (y-\tau-rm)e^{-\alpha} + ra - c_T - c_N e^{-1} , \tag{5}$$

when y denotes the value of real output in the economy and τ is the real value of the household's tax liabilities. Taxes are taken to be lump-sum and measured in units of the consumption bundle. Equation (5) is the household's instantaneous budget constraint. Its intertemporal budget constraint is given by:

$$\lim_{t\to\infty} \exp(-rt)a_t \geq 0 \tag{6}$$

This condition, together with the flow budget constraint (5), ensures that the present value of the household's consumption (including liquidity services of money) does not exceed the present value of its resources. A final constraint that operates on the household is that its solution paths for both types of consumption as well as for money must be non-negative:

$$0 \leq c_T,\ c_N,\ m\ . \tag{7}$$

In solving the household's problem, it is convenient to once again follow Obstfeld and Uzawa in using the change of variables $\Delta = \Delta(t)$ to express the problem in terms of Δ, rather than t. 1/ After making this transformation, the household's maximization problem becomes:

$$\max_{\{c_T, c_N, m\}} \int_0^\infty \frac{u(c_T, c_N, m)}{\delta[u(c_T, c_N, m)]} \exp(-\Delta)\, d\Delta$$

subject to:

1/ The application of the maximum principle is greatly simplified by expressing the problem in terms of Δ, rather than t.

$$a = me^{-\alpha} + b_p$$

$$\frac{da}{d\Delta} = \frac{(y-\tau-rm)e^{-\alpha}+ra-c_T-c_N e^{-1}}{\delta[u(c_T,c_N,m)]}$$

$$\lim_{t\to\infty} \exp(-rt)a_t \geq 0$$

$$0 \leq c_T, c_N, m$$

By applying the Maximum Principle and reversing the change of variables, we derive the first-order conditions for an interior maximum:

$$u_1(\delta-u\delta') - \lambda\delta - \lambda u_1\delta'\dot{a} = 0 \qquad (8)$$

$$u_2(\delta-u\delta') - \lambda\delta e^{-1} - \lambda u_2\delta'\dot{a} = 0 \qquad (9)$$

$$u_3(\delta-u\delta') - \lambda\delta re^{-\alpha} - \lambda u_3\delta'\dot{a} = 0 \qquad (10)$$

$$\dot{\lambda} = \lambda(\delta-r) \qquad (11)$$

$$\dot{a} = (y-\tau-rm)e^{-\alpha} + ra - c_T - c_N e^{-1} , \qquad (12)$$

where λ is a costate variable and numerical subscripts denote partial derivatives. These equations characterize the solution to the household's optimization problem for the general utility function given by equation (2).

It is much more convenient, however, to work with a specific utility function, and for this purpose we adopt the logarithmic version:

$$u(c_T,c_N,m) = \beta[(1-\alpha)\ell n(c_T)+\alpha\ell n(c_N)] + (1-\beta)\ell n(m) , \qquad (13)$$

where β is a parameter with $0 < \beta < 1$. Since this function has the familiar property that consumption of each good is proportional to total consumption expenditure, it simplifies matters to conduct the analysis below in terms of the latter variable. Let Z denote total consumption expenditure measured in terms of traded goods, defined as:

$$Z = c_T + e^{-1}c_N \tag{14}$$

By using the specific utility function (13) in equations (8)-(10) and making use of the definition (14), we can now rewrite the necessary conditions for the solution to the household's problem as:

$$c_T = (1-\alpha)Z \tag{15}$$

$$c_N = \alpha e Z \tag{16}$$

$$m = \frac{(1-\beta)}{\beta} e^{\alpha} r^{-1} Z \tag{17}$$

$$\frac{\beta Z^{-1}(\delta[V(Z,e)]-V(Z,e)\delta'[V(Z,e)])}{\delta + \beta Z^{-1}\delta'[V(Z,e)]\dot{a}} = \lambda \tag{18}$$

$$\dot{\lambda} = \lambda(\delta[V(Z,e)] - r) \tag{19}$$

$$\dot{a} = (y-\tau)e^{-\alpha} + ra - \beta^{-1}Z \tag{20}$$

Equation (20) is derived by substituting equations (14) and (17) in (12). We have also defined the function $V(Z,e)$, given by:

$$\begin{aligned} V(Z,e) &= u[c_T(Z,e), c_N(Z,e), m(Z,e)] \\ &= H + \ell n Z + \alpha \ell n e \end{aligned} \tag{21}$$

where $H = \beta[\alpha\ell n\alpha+(1-\alpha)\ell n(1-\alpha)] + (1-\beta)\ell n[(1-\beta)/r\beta]$, and $V(\ )$ is obtained by substituting equations (15)-(17) in (13) and simplifying.

In addition to the household sector, the economy also contains a government and a central bank. The government purchases both traded (g_T) and nontraded (g_N) goods, collects taxes, and receives interest from both its own stock of bonds (b_G) and that of the central bank (b_c). Any excess of receipts over expenditures is devoted to bond accumulation. Thus the government's budget constraint is given by:

$$\dot{b}_G = r(b_c+b_G) + \tau e^{-\alpha} - g_T - e^{-1}g_N \tag{22}$$

We will suppose that initially the composition of the government's expenditures mirrors that of the private sector. That is,

$$g_T = (1-\alpha)g \tag{23a}$$

$$g_N = \alpha eg \tag{23b}$$

where:

$$g = g_T + e^{-1}g_N \tag{24}$$

In addition, we will assume that b_c, which represents the central bank's stock of foreign exchange reserves, is positive, but that b_G is zero, so the government is neither a net creditor nor debtor.

Turning to the central bank, its only role is to maintain the exchange rate. It does so by exchanging domestic currency for foreign-exchange denominated bonds at an announced par value. Its balance sheet is given by:

$$b_c(t) = m(t)e(t)^{-\alpha} + n \ , \tag{25}$$

where P_T^* is the foreign-currency price of traded goods. The second term, n, represents the cumulative value of the devaluation profits of the central bank and constitutes the bank's net worth, since all operating profits (interest receipts on bonds) are, as indicated previously, transferred to the government. For simplicity, we assume that there was no previous devaluation; therefore n is zero initially.

Our model is closed by the specification of the conditions of production. We assume that the economy is continually at full employment and possesses a concave transformation frontier between traded and non-traded goods. It operates at the point of tangency between that frontier and a straight line with slope $-e^{-1}$. This implies that output of traded and nontraded goods is given by:

$$y_T = y_T(e) \ , \ y_T' > 0 \tag{26a}$$

$$y_N = y_N(e) \ , \ y_N' < 0 \tag{26b}$$

with $y_T' + e^{-1}y_N' = 0$. Since all income from production is received by the private sector, we also have:

$$\begin{aligned} y &= y_T e^{\alpha} + y_N e^{\alpha-1} \\ &= y(e) \ , \end{aligned} \tag{27}$$

with $y' = e^{\alpha-1}(\alpha y_T - (1-\alpha)y_N e^{-1}) \gtrless 0$. Output of nontraded goods must clear the market for such goods:

$$y_N(e) = c_N + g_N \tag{28}$$

In the case of traded goods, however, any excess of production over domestic consumption can be sold abroad, implying a trade balance of $y_T - c_T - g_T$ and a current account balance (ca), measured in terms of traded goods, of:

$$ca = y_T + rb - c_T - g_T \ , \tag{29}$$

where:

$$b = b_p + b_G + b_c \tag{30}$$

is the economy's net international creditor position.

2. Solution

To solve this model, it is necessary to specify the nature of fiscal policy. We assume initially that τ is set exogenously, and that g is set such that, given the initial value of $b_c + b_G$, the budget is in balance--i.e., $\dot{b}_G = 0$. The composition of g is determined by equations (23) in the initial steady state. In response to shocks, however, we assume--unless otherwise stated--that g_N remains fixed at its initial value while g_T is adjusted to maintain budget balance. As we show below, this is an important assumption.

Proceeding to the solution of the model, we first find the value of e that clears the market for nontraded goods, given Z and g_N:

$$e = e(Z, g_N) \tag{31}$$

$$e_1 = \alpha e/(y_N' - \alpha Z) < 0$$

$$e_2 = 1/(y_N' - \alpha Z) < 0$$

Substituting equation (27) in the household's saving equation (20) and then using (31), we can express private asset accumulation as a function of private expenditure, real private financial wealth, and the exogenous fiscal policy variables:

$$\dot{a} = a(Z, a, \tau, g_N) \tag{32}$$

$$a_1 = -\beta^{-1}(1+\alpha e^{-1} Z e_1) < 0$$

$$a_2 = r > 0$$

$$a_3 = -e^{-\alpha} < 0$$

$$a_4 = -\beta^{-1}\alpha e^{-1} Z e_2 > 0$$

Next we use equation (18) to express λ as a function of private expenditure Z, real private financial wealth a and the fiscal variables τ and g_N:

$$\lambda = \lambda(Z, a, \tau, g_N) \tag{33}$$

$$\lambda_1 = -[\lambda Z^{-1} + \beta V\delta''\delta^{-1}Z^{-2}(1+\alpha e^{-1}Ze_1)] < 0$$

$$\lambda_2 = -\lambda\delta'\beta Z^{-1} < 0$$

$$\lambda_3 = \frac{\lambda}{\delta}\beta Z^{-1}\delta' e^{-\alpha} > 0$$

$$\lambda_4 = -\beta Z^{-1}V\delta''\alpha e^{-1}e_2/\delta > 0$$

By differentiating equation (33) with respect to time and solving for $\dot{Z}$ we have:

$$\begin{aligned}\dot{Z} &= (\lambda/\lambda_1)\dot{\lambda} - (\lambda_2/\lambda_1)\dot{a} \\ &= (\lambda/\lambda_1)(\delta[V(Z,e)]-r) - (\lambda_2/\lambda_1)\dot{a} \\ &= Z\ (Z,a,\tau,g_N)\ ,\end{aligned} \tag{34}$$

with:

$$Z_1 = 0$$

$$Z_2 = -(\lambda_2/\lambda_1)r < 0$$

$$Z_3 = (\lambda_2/\lambda_1)e^{-\alpha} > 0$$

$$Z_4 = 0$$

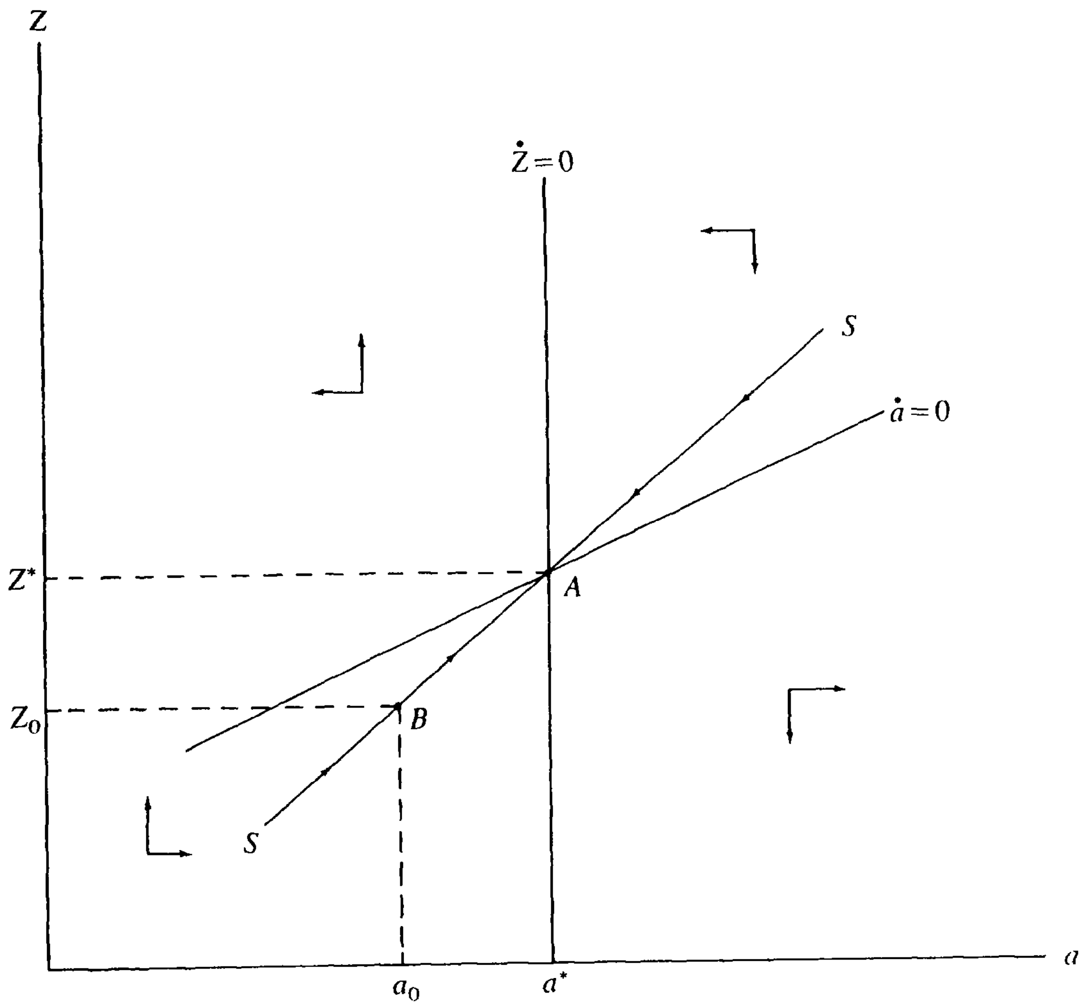
Equations (32) and (34) represent a two-equation system of differential equations with a single predetermined variable (a). The system has a determinant Ω given by:

$$\Omega = -Z_2 a_1 < 0 \tag{35}$$

Thus the steady-state equilibrium defined by $\dot{a} = \dot{Z} = 0$ is saddlepoint stable. The system is depicted graphically in Figure 1. The condition $\dot{a} = 0$ traces out a locus in a-Z space with slope:

$$\left.\frac{dZ}{da}\right|_{\dot{a}=0} = -\ a_2/a_1 > 0$$

Figure 1
Steady-State Equilibrium and Devaluation Dynamics



Since $\textit{Ƶ}_1 = 0$, however, the condition $\dot{Ƶ} = 0$ is only satisfied at a unique value of a--i.e., the locus $\dot{Ƶ} = 0$ is vertical. The stable arm of this system, depicted as SS in Figure 1, has slope given by:

$$\left.\frac{dƵ}{da}\right|_{SS} = Ƶ_2/q > 0 ,$$

where q is the stable (negative) root of the system. As can be verified from the direction of the arrows in Figure 1, the slope of SS must exceed that of the $\dot{a} = 0$ locus. It can readily be seen that for any given value of private wealth, say a_0, the solution to the household's maximization problem must place private consumption on the stable path SS (say at point B, where consumption is $Ƶ_0$). This is because values of Ƶ above SS would place the household on a divergent path that eventually moves into the second quadrant, where a_t is negative and constraint (6) is violated. 1/ Such paths are obviously not feasible. Paths that begin below SS, on the other hand, cannot be optimal, since such paths must always remain below SS, implying permanently lower consumption than is attainable along SS.

With the solution to the model in hand, we can now proceed to study the effects of devaluation as well as of fiscal policy in this model.

III. Devaluation

To motivate a nominal devaluation in our model, suppose that policy-makers desire to increase the stock of bonds (foreign exchange reserves) in the hands of the public sector--i.e., $b_c + b_G$. 2/ Since for the purpose of this exercise we will continue to assume that g_T is adjusted to maintain balance in the government's budget, b_G is unchanged (at zero) and the full increase occurs in b_c. Consider the central bank's balance sheet, given by equation (25). Since a nominal devaluation is neutral in our model, the post-devaluation steady-state values of m and e will be unchanged. Thus the effect of a devaluation at time t on the steady-state value of b_c is given by:

1/ Notice that (6) is satisfied for paths that begin on SS, since for such paths a_t converges to a constant steady-state value a*.

2/ By having the government turn over any bonds it accumulates to the central bank in exchange for claims on the bank, b_G can also be regarded as part of the bank's stock of foreign exchange reserves.

$$db_c^* = dn$$

$$= m^* e_*^{-\alpha} \; (ds/s) \; ,$$

where s denotes the nominal exchange rate. When solved for ds, this expression yields the size of the nominal devaluation required to achieve a given change in the steady-state value of b_c. We begin by considering the "standard" case, in which the fiscal policy rule is as specified above. We then turn to the consideration of alternative fiscal policy rules.

1. The standard case

Devaluation operates through familiar monetary channels in this model. Using equation (4) and the definition of the real exchange rate, private financial wealth can be expressed as:

$$a = M/P_T + b_p \; .$$

Since a devaluation raises P_T in the same proportion as the change in the exchange rate, we have:

$$\frac{da}{ds} = - \; (M/P_T^2) P_T^* < 0$$

Devaluation lowers the real value of the pre-devaluation money stock and thus reduces private wealth. In terms of Figure 1, private wealth falls from a^* to a^o. This reduction in private wealth reduces household expenditure from Z^* to Z_o, located on the saddle path SS. The dynamics of adjustment to the higher price of foreign exchange are straightforward. The reduction of household spending means that households begin to save. As they do so, household wealth and spending both rise over time along SS, until they regain their original values (a^*, Z^*) at A. At point A, all real variables in the system have returned to their original values, except for certain items in the central bank's balance sheet and the government's budget. In terms of equation (25), the central bank's balance sheet now shows a higher value of b_c, offset on the right-hand side by a larger value of net worth in the form of devaluation profits. In the government's budget, transfers from the central bank earned in the form of interest receipts on the higher value of b_c finance a permanently higher value of g_T.

We now examine the dynamics of adjustment in more detail by investigating the responses of other macroeconomic variables.

By substituting equation (17) into (25) and differentiating with respect to time, the evolution of foreign exchange reserves over time can be shown to be given by:

$$\dot{b}_c = r^{-1} \left(\frac{1-\beta}{\beta}\right)\dot{z} \tag{36}$$

Since $\dot{z}$ is positive during the period following devaluation, devaluation therefore induces a balance of payments surplus during the transition to the new steady state. By summing the budget constraints of the private sector (20) and the government (22), using the definition of the current account given by (29) and imposing the market-clearing condition for non-traded goods (28), we have:

$$\begin{aligned} ca &= \dot{a} + \dot{b}_G \\ &= \dot{a}\ , \end{aligned} \tag{37}$$

since $\dot{b}_G = 0$ by assumption. Since a is rising over the segment BA in Figure 1, this means that devaluation induces a current account as well as a balance of payments surplus. Whether the capital account behaves similarly is more problematic. Using (36) and (37) the capital account surplus can be expressed as:

$$\begin{aligned} \dot{b}_c - \dot{a} &= \left[r^{-1} \frac{(1-\beta)}{\beta} \frac{\dot{z}}{\dot{a}} - 1\right] \dot{a} \\ &= \left(\frac{dz}{da} \bigg|_{SS} - r\frac{\beta}{1-\beta} \right) r^{-1} \frac{1-\beta}{\beta} \dot{a} \end{aligned} \tag{38}$$

Since $\dot{a} > 0$, the capital account will be in surplus ($\dot{b}_p < 0$) if the saddle path SS is sufficiently steep. While it is possible to derive a set of sufficient conditions on the parameters of the model that ensure this result, devaluation need not in general induce a capital account surplus in this model.

From equation (31), we know that the nominal devaluation will result in a <u>real</u> exchange rate depreciation on impact. Since this depreciation must be reversed over time, the path BA must be characterized by continuous inflation. However, because $\dot{z}$ decreases as A is approached, the rate of inflation is highest immediately following the devaluation, and then decreases over time. With the nominal interest rate fixed by the assumed perfect mobility of capital, the domestic real interest rate must initially <u>fall</u> following the devaluation, then gradually recover its original level as inflation subsides during the return to the steady state.

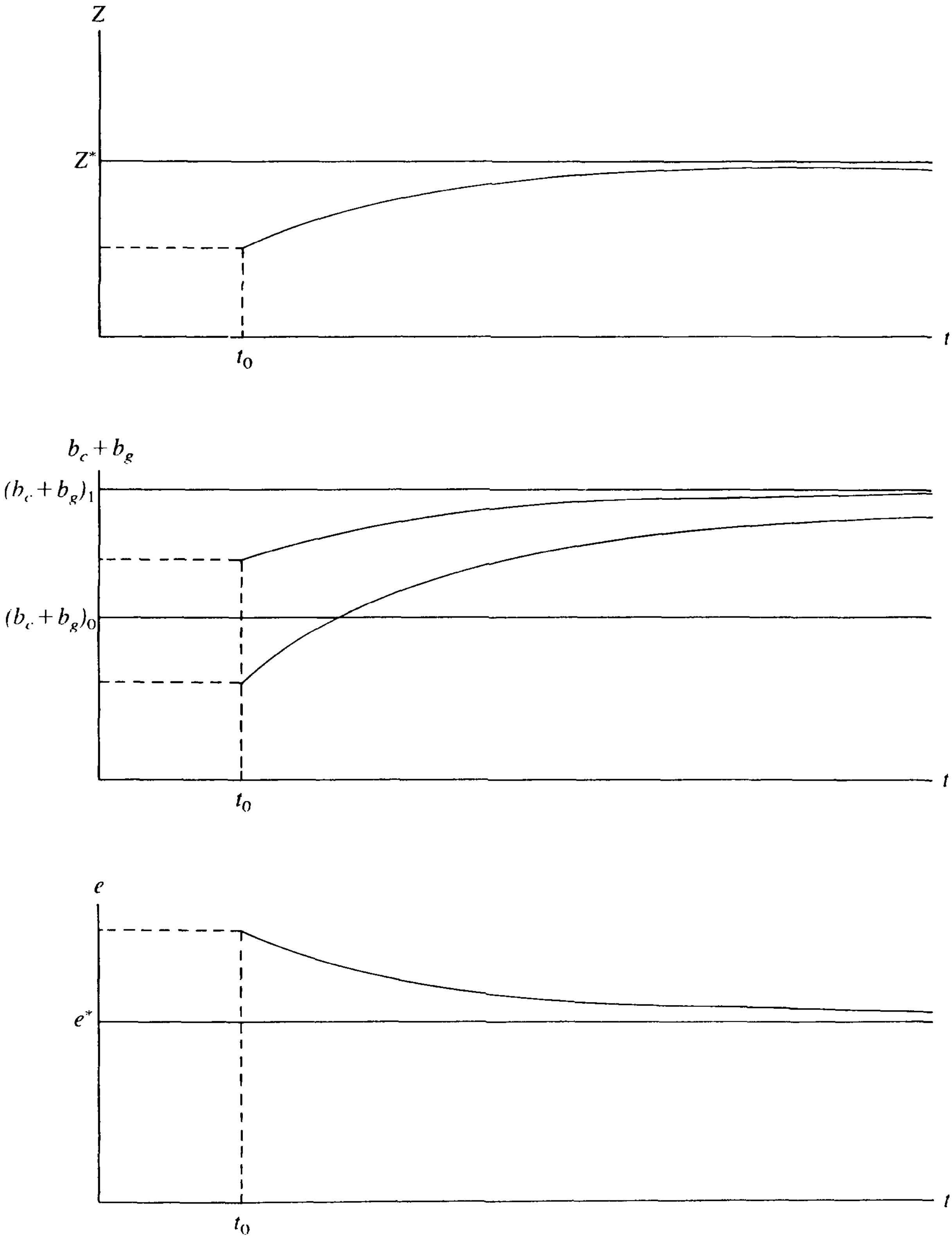
Consumption of traded goods is proportional to total consumption (equation (15)), so the reduction in total consumption is matched by a similar reduction in consumption of traded goods, followed by gradual recovery. From equation (31), the elasticity of e with respect to z is given by $-e_z e^{-1} z < 1$, so consumption of nontraded goods must fall as well, though less than in proportion to z (equation (16)). Thus consumers shift the composition of their spending from traded to nontraded goods, but reduce total spending on both. Since private consumption of nontraded goods has fallen while government purchases of such goods are unchanged, output of nontraded goods must fall as well. This is at least partially offset, however, by increased output of traded goods due to the real exchange depreciation (equation (26a)).

In spite of the reduction in output of nontraded goods and increase in output of traded goods, it is possible to derive the effects of devaluation on <u>total</u> real output measured in terms of the consumption bundle. After some manipulation, the derivative of the function y in equation (27) can be reduced to:

$$y' = -e^{\alpha-1}\alpha r b$$

Since $b = b_p + b_c = a + (b_c - me^{-\alpha})$, where $(b_c - me^{-\alpha})$ is the central bank's net worth, and since both of these terms have been taken to be positive, b is also positive (i.e., the country in question is a net international <u>creditor</u>). Thus y' is negative. That is, a real depreciation <u>reduces</u> the value of real output measured in terms of the consumption bundle. Since the real exchange rate e depreciates on impact, real output must fall. In this sense, then, devaluation is contractionary on impact. As the real exchange rate appreciates back to its original level, real output recovers its initial value over time. The basic results of this section are summarized in Figure 2, which illustrates the dynamic behavior of z, $b_c + b_G$, and e in response to a devaluation. The paths of both types of consumption as well as of real output can be inferred from the third panel of Figure 2, since these variables can all be expressed as functions of the real exchange rate.

Figure 2
Dynamic Effects of Devaluation on Private Spending, Reserves, and the Real Exchange Rate



2. The role of fiscal policy rules

What is the role of fiscal policy in these results? Notice that the conditions for Ricardian equivalence are present in our model. Future taxes are perfectly anticipated over an infinite horizon by consumers who can borrow and lend at the same rate as the government. In spite of this, devaluation is effective; an apparently paradoxical result, since devaluation simply transfers real wealth from the private to the public sectors. Presumably Ricardian consumers should pierce the government veil, leaving their behavior unaffected. In particular, though the private sector is poorer, the enhanced resources of the public sector should reduce future tax liabilities by an equivalent amount, leaving households no worse off than before. The reason this is not the case is the nature of the fiscal policy rule in effect. The government is assumed to devote its increased resources to the purchase of traded goods, not to tax reductions. Thus the private sector is indeed poorer after the devaluation. Suppose we had assumed instead that the government fixed its total spending measured in terms of traded goods (g) and altered taxes so as to keep its budget in balance. Then, setting $\dot{b}_G = 0$ in (22), using the resulting equation to solve for $\tau e^{-\alpha}$, substituting in equation (20), and using (17) the private sector's budget constraint would become:

$$\dot{a} = ye^{-\alpha}+rb-g-\bar{z} ,$$

which is unaffected by changes in a. Moreover, since $\dot{a} = \dot{b}$ in this case, the intertemporal budget constraint (6) now becomes:

$$\lim_{t\to\infty} \exp(-rt)b_t \geq 0$$

which is also unaffected by changes in a. Thus household behavior is unaffected by changes in a and the economy never leaves its steady-state configuration. Devaluation is effective in the sense that bonds are transferred from the private to the public sector, but the usual monetary dynamics are absent.

IV. Fiscal Policy

Since the objective of devaluation is to increase the public sector's steady-state stock of internationally-traded bonds, i.e., reserves, an alternative way to achieve the same result would be via temporary reductions in government spending or temporary tax increases--i.e., through temporary episodes of public saving. In this section we investigate the effects of a temporary reduction in government spending on nontraded goods and a temporary tax increase. 1/

1. Temporary reduction in government spending on nontraded goods

We continue to assume, as before, that the reduction in spending is motivated by a desire on the part of the public sector to increase its steady-state stock of bonds. In this sub-section, the government is assumed to achieve this end by temporarily reducing spending on nontraded goods, keeping spending on traded goods constant. When the original level of g_N is restored, g_T is raised to consume the additional interest receipts and maintain budget balance. Notice that, since the target is $(b_c + b_G)$, g_N may be returned to its original value <u>before</u> this target is reached, if b_c remains short of its steady-state value. This will become clear below. There is, of course, no unique path of g_N that will achieve the desired result. The authorities presumably face a choice between large reductions in g_N lasting for a short time and smaller but more prolonged budget cuts. The analysis below will be for an arbitrary path of g_N that achieves the steady-state outcome.

A reduction in g_N leaves the $\dot{Z} = 0$ locus unaffected (since $Z_{g_N} = 0$), but causes the $\dot{a} = 0$ locus to shift downwards by the amount:

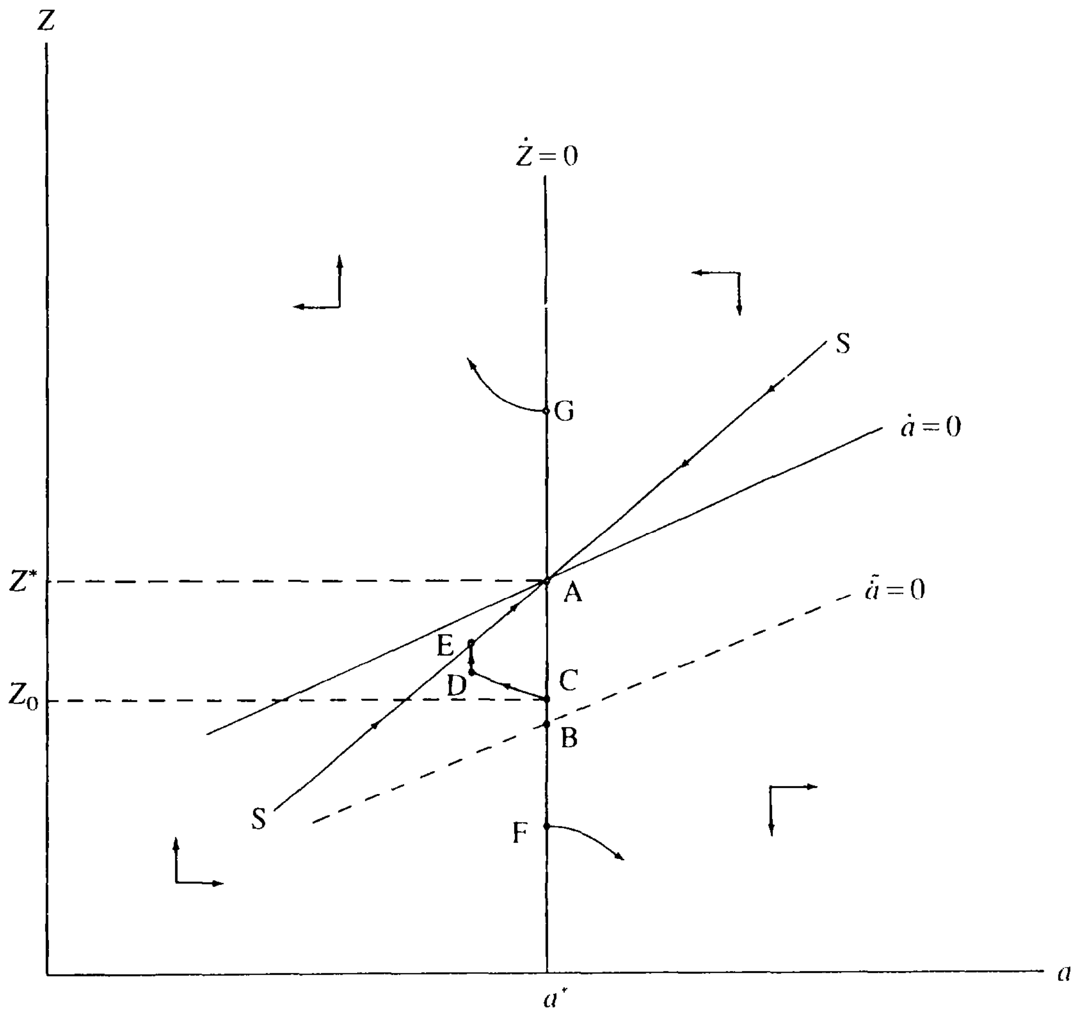
$$\left.\frac{dZ}{dg_N}\right|_{\dot{a}=0} = -a_4/a_1 \tag{39}$$

$$= \frac{-Z\alpha e^{-1}e_2}{1+\alpha e^{-1}Ze_1} > 0$$

The new configuration is depicted in Figure 3. Although, as we shall show below, the reduction in g_N lowers the domestic price level, it has no effect on a, which is measured in units of traded goods. In the absence of devaluation, the price of these goods is unchanged. The path followed by Z is governed by the following considerations: since private agents have perfect foresight, the reduction in g_N is known to be temporary. Thus it will be taken into account when agents formulate their optimal

1/ The case of reduced spending on <u>traded</u> goods (g_T) is uninteresting, since this policy has no effect on the private sector. Spending on traded goods is reduced until the desired accumulation b_G^* is achieved, and then g_T is raised to a level commensurate with the increase in interest receipts. Throughout, the economy's equilibrium at A in Figure 1 is undisturbed.

Figure 3
Effects of a Temporary Reduction in Spending on Nontraded Goods



plans. One characteristic of such plans is that the costate variable λ not be anticipated to undergo discrete changes. 1/ Since λ is a function of both g_N and Z (equation (33)), this means that when g_N returns to its original value, agents must plan compensating changes in Z that leave λ unchanged. From equation (33):

$$\left.\frac{dZ}{dg_N}\right|_{\lambda=\bar{\lambda}} = -\frac{\alpha e^{-1} e_2}{\lambda\delta/\beta V\delta'' + Z^{-1}(1+\alpha e^{-1} Z e_1)} > 0 \tag{40}$$

Thus an increase in Z must accompany the restoration of g_N to its original level. It follows, in terms of Figure 3, that the initial value of Z must place it on a divergent path with respect to the steady state at B with the property that when g_N is restored to its original value, Z can jump upwards to the saddle path SS. This rules out paths that begin above point A (such as that at G) and implies that Z must fall on impact. Furthermore, comparison of equations (39) and (40) reveals that the upward displacement of Z that must accompany the restoration of spending to its original level must fall short of the downward displacement of the $\dot{a} = 0$ locus. This rules out paths that begin below B and implies that Z falls initially to a point on the segment AB such as C. From then on, it follows the divergent path CD and jumps to the point E on SS when the spending cut is rescinded. Finally, the economy returns to the original steady state along EA.

The dynamics of the balance of payments are quite different in this case from the devaluation case. First, the reduction in g_N leads to a discrete capital outflow as the lower value of Z causes the private sector to shift its portfolio from money to foreign bonds. After this once-for-all portfolio adjustment, the balance of payments is in equilibrium at C, from which it gradually moves into surplus as Z rises. The increase in g_N is accompanied by a discrete capital inflow in response to the increase in Z from D to E in Figure 3. Finally, over the range EA the overall balance of payments exhibits a gradually decreasing surplus. Notice that, since $\dot{a}$ is negative over the range CD, the private sector runs a current account deficit over this range. Since its overall balance of payments is positive, however, its capital account must be in surplus. The government, on the other hand, runs offsetting current account surpluses and

---

1/ λ can be interpreted as the marginal contribution to the household's well-being of an extra unit of wealth. A path in which λ increased (say) discontinuously at time t+s could not be optimal, since it would be dominated by a otherwise identical path in which the household saved marginally more just prior to t+s.

capital account deficits, with a balanced overall account, over this range. As the economy moves to the segment EA, the behavior of its external accounts resembles the devaluation case.

Turning to domestic variables, notice that, as in the devaluation case, equation (31) implies that the real exchange rate will depreciate on impact (this time because both Z and g_N have fallen). The range CD is characterized by accelerating domestic inflation as Z moves away from the $\dot{Z} = 0$ locus. The domestic price level jumps discretely (and e appreciates) when government spending is restored at point D. Over the range EA domestic inflation continues, but at a gradually decreasing rate. This behavior of the price level implies that the domestic real interest rate begins to fall gradually on impact, reaches a minimum at point D when government spending rises, then gradually returns to its original level over the range EA.

Qualitatively, the behavior of private consumption of both kinds of goods, as well as of real output, resemble the devaluation case, except for the discontinuous increase in consumption--and also in real output--when the government spending cut is rescinded. The key to this is the behavior of the real exchange rate, which determines the behavior of c_T, c_N and y.

2. Temporary tax increase

The dynamics of a temporary tax increase prove to be quite different. Notice first from equations (32) and (34) that an increase in τ shifts both the $\dot{a} = 0$ and $\dot{Z} = 0$ loci by:

$$\frac{da}{d\tau}\Big|_{\dot{a} = 0} = re^{-1-\alpha} > 0$$

Also, from equation (33), when the tax increase expires, the costate variable λ will avoid a discontinuous jump if Z responds according to:

$$\frac{dZ}{d\tau}\Big|_{\lambda=\bar{\lambda}} = \frac{(\lambda/\delta)\beta Z^{-1}\delta' e^{-\alpha}}{\lambda Z^{-1}+\beta V\delta''\delta^{-1}Z^{-2}(1+\alpha e^{-1}Ze_1)} > 0$$

Thus, Z and τ must move in the same direction when the tax increase is removed.

These considerations govern the dynamics of the economy in response to a temporary tax increase. The paths of a and Z are depicted in Figure 4. If the tax increase is sufficiently prolonged, consumer spending Z will decrease on impact to a point like D on the segment AC. 1/ C is the point at which $\dot{Z} = 0$ intersects the saddle path S'S' through the steady-state B that would be associated with a permanent tax increase. Points below C are ruled out because Z would remain below S'S' from such an initial point, requiring a later increase to reach SS. This is inconsistent with $dZ/d\tau|\lambda = \bar{\lambda} > 0$. From point D, private consumption rises temporarily, eventually overshooting its steady-state value Z^*. Since consumption is initially depressed, private wealth increases during the initial portion of this path. As spending continues to rise, however, the private sector begins to dissave, eventually more than depleting the additional assets accumulated. Finally, when the tax increase is revoked, spending undergoes a discrete fall, to the point G on SS. 2/ Over the remainder of the trajectory, wealth and spending rise together.

In contrast to both devaluation and a spending cut, in the case of a tax increase the paths of private expenditure and wealth can be non-monotonic. It is not surprising, therefore, that the behavior of other macroeconomic variables is also more complicated in this case. The balance of payments, for example, exhibits a gradually increasing surplus over the range DE, in which the current account is in surplus while the capital account may be in surplus or deficit. Over the range EF, the private sector begins to run a current account deficit (due to a rising level of consumption), though one which falls short of its capital account surplus, while the public sector runs offsetting current account surpluses and capital account deficits. This situation comes to an abrupt end at point F when the tax increase is rescinded. Finally, over the range GA the overall balance is again in surplus, though this surplus gradually declines as the steady state is approached at A.

Unlike in the previous two exercises, in the case of a tax increase the real exchange rate overshoots its equilibrium value after an initial discrete depreciation. It appreciates continuously over the range DF as the domestic rate of inflation gradually increases, peaking at point F before undergoing a second discrete depreciation at that point. From G

1/ The proof of this proceeds as follows: the solution of the consumers' problem in (a,λ) space shows that λ rises when τ is increased. The longer the increase in τ lasts, the larger the initial jump in λ. By (33), this requires a smaller initial Z. If the jump in λ is sufficiently large, the initial change in Z must be negative.

2/ The coincidence of a tax cut and spending decrease may seem paradoxical. Recall, however, that this is an anticipated tax cut, the enactment of which does not increase the household's anticipated resources over its planning horizon.

on, it returns to its original value through a gradual appreciation. The behavior of consumption of both types of goods, as well as of real output, can be inferred directly from that of the real exchange rate.

The results of this section are summarized in Figure 5. Notice that both the relative positions of the times t_1 and t_2 at which the expenditure cut and tax increase respectively are rescinded, as well as the relative initial (time t_0) values of the variables illustrated in the figure, are arbitrary, since both depend on the size of the spending cut or tax increase.

V. Conclusions and Extensions

As stated previously, devaluation is motivated in this model by the public sector's desire to increase its steady-state stock of reserves. Temporary reductions in spending and/or tax increases are alternative ways of achieving the same objective. Our first conclusion is that the method chosen by the authorities to accumulate assets in the public sector matters, in the sense that the paths of the major macroeconomic variables --including the balance of payments and its components, the real exchange rate, the rate of inflation, the domestic real interest rate, private spending and its composition, and real output, turn out to be quite different depending on whether devaluation or temporary fiscal policy changes are undertaken.

In this paper we have examined the qualitative properties of these paths for alternative policies. In general terms these are the following:

1. Unless the desired accumulation of public sector assets can be achieved by a temporary reduction in government spending on traded goods, the private sector cannot be insulated from the effects of the government's reserve-accumulation policies. Specifically, even if the government eschews direct taxation or the capital levy that accompanies devaluation by curtailing its own spending on nontraded goods, the private sector will experience a loss in welfare. 1/

2. For the major macroeconomic variables, paths associated with temporary reductions in government spending on nontraded goods and temporary tax increases differ from those associated with devaluation in that the former exhibit discontinuities when the temporary policies are reversed. Devaluation, on the other

---

1/ In either of these cases, private consumption is always below the steady-state value that would prevail in the absence of government asset accumulation.

Figure 4
Effects of a Temporary Tax Increase

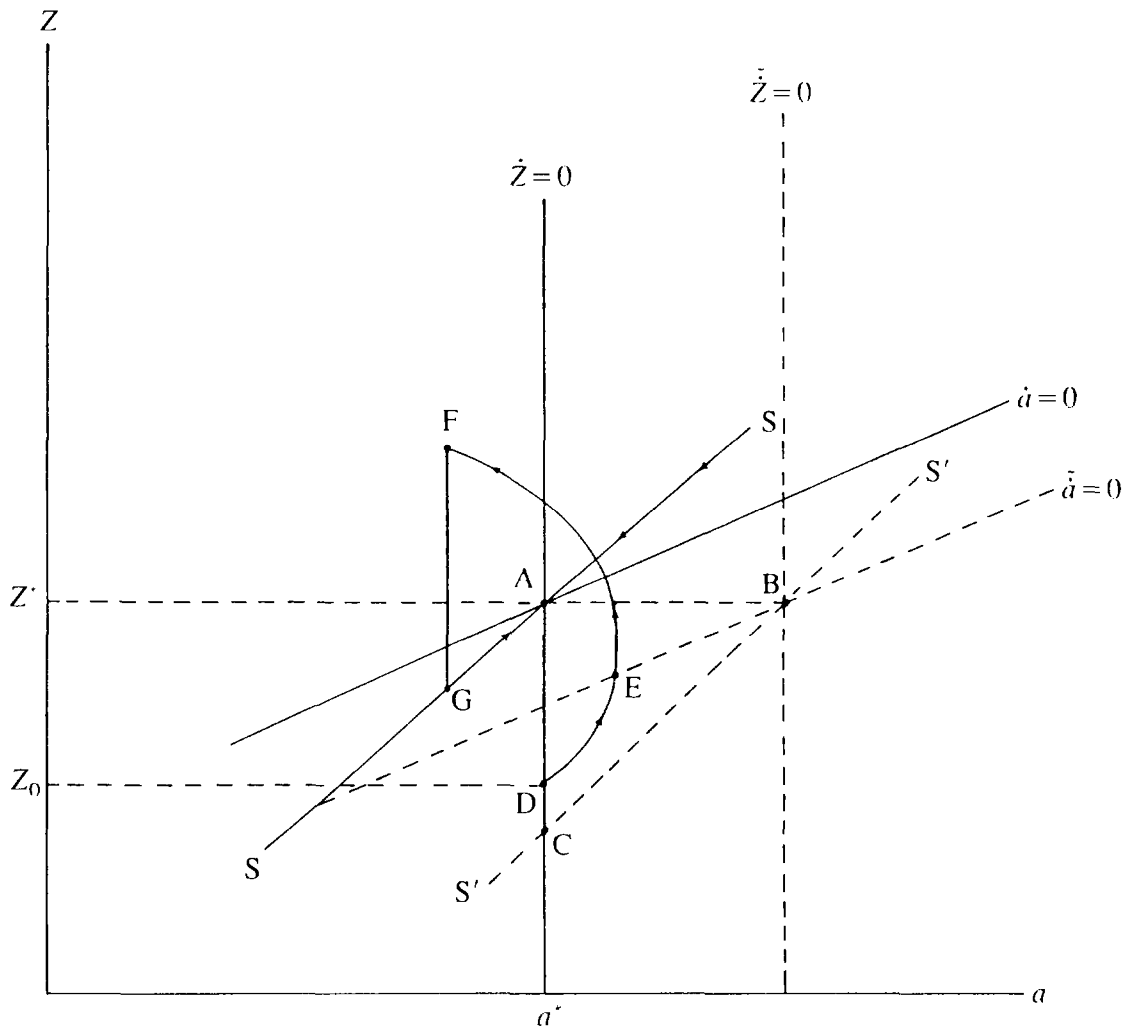
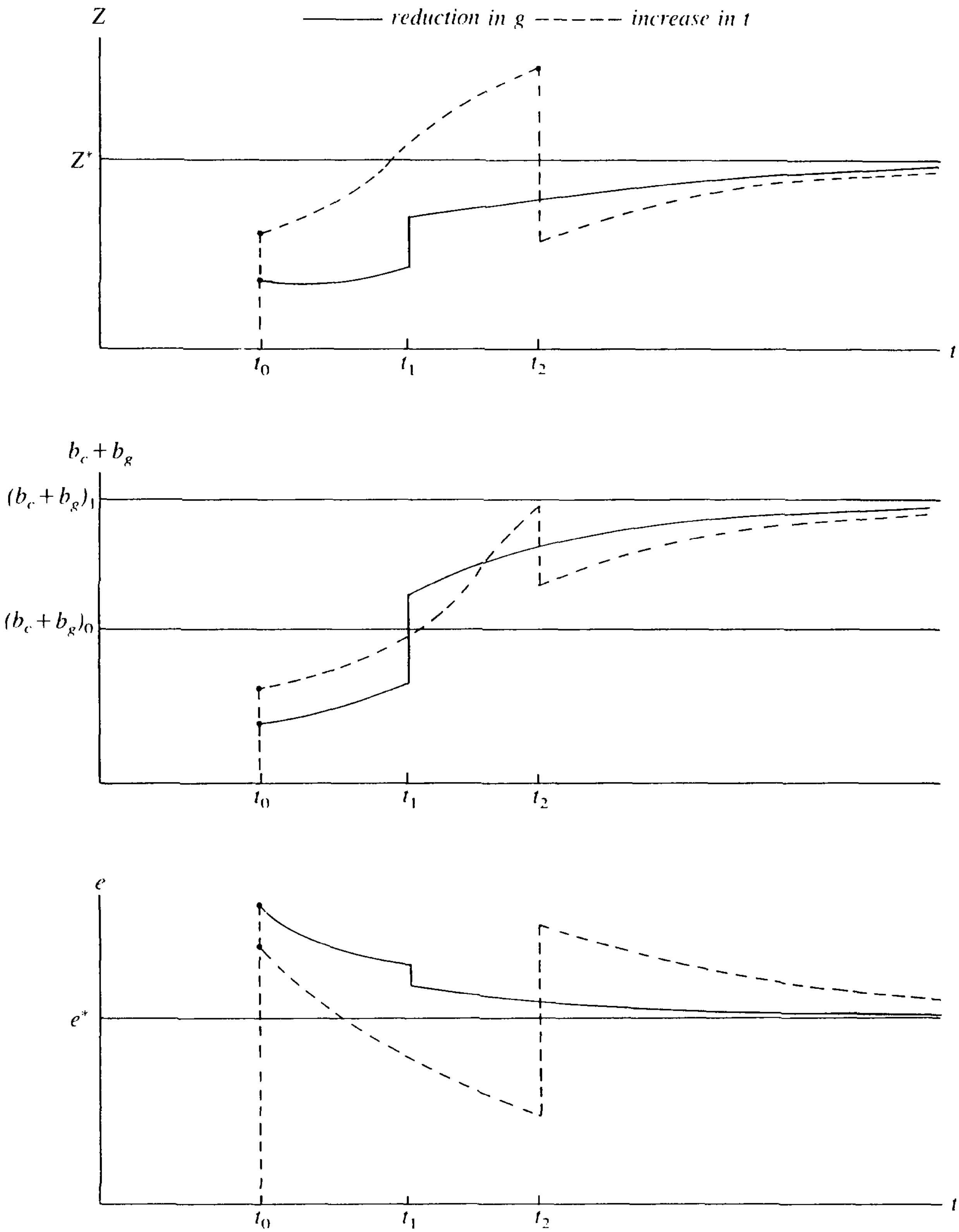


Figure 5
Dynamic Effects of Temporary Fiscal Measures on Private Spending, Reserves, and the Real Exchange Rate



hand, is associated with an increase in the steady-state price level. Notice, however, that neither of these characteristics has direct welfare implications in analytical frameworks of the type employed here.

3. The possibility of overshooting for key variables such as private consumption and the real exchange rate arises only in the context of a temporary tax increase. For other policies, the return to the steady state is monotonic.

4. The dynamic effects of devaluation depend in a crucial way on the fiscal policy rule in effect. Specifically, it depends on how the government spends the interest proceeds from its higher asset stocks. We have traced out in detail the implications of a rule which assigns these proceeds to expenditures on traded goods and indicated that under the alternative "Ricardian" assumption that they are devoted to tax cuts, the economy would remain in its steady-state configuration.

It would be desirable to extend the analysis in this paper to permit a more direct comparison of the alternative policies that the authorities can utilize to attain their desired steady-state asset stocks. For example, one may want to compare the size of the initial change in private consumption, or of the peak rate of inflation, across policies. Doing so, however, would require that the policies to be compared be restricted in a suitable way to permit a choice among the possible policy options of each type available through the size-duration tradeoff. One possible option would be, for example, to restrict the policies considered to those which are consistent not only with a given steady-state value of the net foreign assets of the public sector, but which also produce a given value of such assets at a designated moment of time. Such alternatives can be explored in our model.

A thornier problem which would require important revisions in the model is the assessment of the welfare consequences of alternative policies. Consider, for example, a comparison of devaluation with a temporary reduction in government spending on traded goods. It is easy to show that in our model the flow of utility depends only on the consumption level. Thus, since the path of consumption after a devaluation is everywhere below the constant level that would prevail with a temporary reduction in government spending on traded goods, a reduction in spending on traded goods would seem to be unambiguously preferable to devaluation. Such a conclusion would, however, rely entirely on the assumption that government spending on traded goods yields no social benefits. More explicit consideration of the economic benefits deriving from government activity would be necessary before conclusions of this sort could be drawn. To engage in welfare comparisons, therefore, would require sorting out these issues and making suitable adjustments to the framework developed here.

References

International Monetary Fund, Theoretical Aspects of the Design of Fund-Supported Adjustment Programs, Occasional Paper No. 55 (Washington D.C., 1987).

_____, IMF Survey, Vol. 17, Number 17, (August 19, 1988), p. 287.

Khan, Mohsin S. and J. Saul Lizondo, "Devaluation, Fiscal Deficits, and the Real Exchange Rate," World Bank Economic Review, Vol. 1 (January 1987), pp. 357-74.

_____, and Peter J. Montiel, "Real Exchange Rate Dynamics in a Small, Primary-Producing Country," IMF Staff Papers, Vol. 34 (December 1987), pp. 681-710.

Lizondo, J. Saul, and Peter J. Montiel, "Contractionary Devaluation in Developing Countries: An Analytical Overview," forthcoming in IMF Staff Papers (Washington, 1989).

Obstfeld, Maurice, "Capital Mobility and Devaluation in an Optimizing Model with Rational Expectations," American Economic Review Papers and Proceedings, Vol. 71 (May 1981), pp. 217-21.

Uzawa, Hirofumi, "Time Preference, the Consumption Function, and Optimum Asset Holdings, in J.N. Wolfe, ed., Value Capital, and Growth: Papers in Honor of Sir John Hicks (Chicago, 1968).