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REAL EXCHANGE RATE EFFECTS OF FISCAL POLICY

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ABSTRACT

This paper develops a framework for analyzing the effects of fiscal policy on the real exchange rate. The short-run impact of various types of fiscal measures are considered as well as the dynamics of adjustment to long-run steady states. The analysis and related simulations suggest that the effect of fiscal policy changes on the real exchange rate can vary widely and will depend closely on a number of structural features, including the degree of asset substitutability, the composition of government spending, and the initial size of the public debt and net external position.

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1. Introduction

The famous and simple dictum of the static Mundell-Fleming model that a fiscal expansion induces a real exchange rate appreciation is found by ignoring several of the key channels linking exchange rates and fiscal policy. The Mundell-Fleming model ignores: (1) the growth of public debt that may follow a fiscal expansion; (2) the fiscal measures that must ultimately be taken to service the growing debt; (3) the wealth and portfolio implications of current account deficits induced by the fiscal expansion; and (4) forward-looking expectations in the asset markets. Once these factors are brought to bear, the conclusions regarding both short- and long-term exchange rate movements may easily be reversed.

A fiscal policy change has direct effects on the level and composition of national spending, as well as on the level and composition of national wealth. Spending effects may pull the exchange rate in one direction, while portfolio effects pull in the other. A thorough analysis of these effects is made difficult by the fact that a "single" fiscal policy change is itself, in general, a sequence of actions, in which different stages of the fiscal action have differing implications for the exchange rate. A debt-financed tax cut, for example, involves a sequence of growing public debt and rising debt-service obligations. Over time, taxes must increase, or expenditures must fall, in order to service the debt. In forward-looking asset markets, the current exchange rate will react to the current tax change, as well as to the anticipated growth in debt and the future changes in taxes and expenditures.

There is not, to date, a simple framework for sorting out the short-run and long-run effects of fiscal policy on the real exchange rate. It is the purpose of this paper to offer such a framework, by recasting the standard Mundell-Fleming framework in a dynamic setting. Surprisingly few studies have focused on fiscal policy in a dynamic setting. Some results can be found in Kouri (1976) for the case of perfect substitutability of domestic and foreign assets and perfect foresight. The assumption of perfect capital substitutability is dropped in Turnovsky (1976), but his model, as those of Branson (1976) and Hodrick (1980), abandon the assumption of forward looking expectations. On the other side, the models of Branson and Buiter (1982) and Kouri are in many respects close to ours, except that these authors choose not to take into account the important role of a growing public debt. For a recent survey and extensive bibliography on exchange rates and fiscal policy, see Penati (1983).

The model analyzed in this paper, and presented in the following section, focuses on the real side of the economy. It specifies a goods market with standard spending and trade balance equations, and a portfolio balance model which takes perfect asset substitutability as a special case. To this basic static structure are added three dynamic considerations: the effect of budget deficits on the stock of public debt, the effect of current account imbalances on the stock of foreign asset holdings, and the assumption of perfect foresight governing the exchange rate. The steady state effects of fiscal policy are taken up in Section 3, where we consider the case of a balanced budget expansion and of a tax cut. The case of an increase in public spending is not included as it can be thought of as the combination of a balanced budget expansion together with a tax cut. We then deal with the dynamics. In the balanced budget case, we offer a graphical solution, in Section 4. In the case of a tax cut, we study analytically the impact effect and resort to simulations in order to examine the entire transition path. This is done in Section 5.

In order to keep the model analytically tractable, we have had to resort to some simplifying assumptions, which are spelled out in detail in the next section. Most of them are of pure convenience and relaxing them does not modify the results in any essential way, as we show through simulation experiments, presented in Section 6. One of them should be pointed out at the outset: we assume here that prices are perfectly flexible so that output never departs from the full employment level. Although we believe that we still capture the main forces relating the real exchange rate to a fiscal expansion, we are clearly unable to cover the stabilization aspects of fiscal policy in an open economy.

The main results of the paper can be broadly stated as follows. When domestic and foreign assets are close substitutes, a fiscal expansion leads to a short-run appreciation and a long-run depreciation. Exactly the opposite occurs with low asset substitutability, namely the real exchange rate depreciates in the short run and appreciates in the long run. Intuitively, the fiscal expansion creates an excess demand for domestic goods. Unless output is fully responsive, and in most of the paper we actually assume fixed output, goods market equilibrium is restored by crowding out private demand, through a reduction of wealth or a rise in the real interest rate, or by crowding out foreign demand through a real exchange rate appreciation. High asset substitutability means that the domestic interest rate is closely tied to the world rate of interest (taking into account, of course, the expected rate of depreciation), and cannot adjust to the goods market disequilibrium. Furthermore, in the short run, wealth is fixed, except possibly for valuation effects. Hence we need an immediate appreciation to eliminate excess demand. In the long run, the current account must be brought back to equilibrium, which calls for a depreciation, while wealth is reduced to crowd out private demand and maintain goods market equilibrium. When asset substitutability is low, the domestic interest rate is free to increase in response to goods market pressure and to allow for the anticipated portfolio reshuffling. If this effect is strong enough that the crowding out of private spending outweighs the direct fiscal expansion, it is easy to see how the results obtained under close substitutability get reversed.

2. The Model

The static part of the model describes the goods market equilibrium condition. We consider an economy specialized in the production of a good which is an imperfect consumption substitute for a single foreign good. The relative price of the foreign good is denoted λ, which we will also term "the real exchange rate." The economy is small in the market for foreign capital and output, so that world interest rates and prices of the foreign good are exogenous. This is the traditional set up as found in Mundell (1963) and Kouri (1976). The goods market clearing condition is:

(1) $\bar{y} = c + g + T$

where $\bar{y}$ is the domestic output, assumed to be constant, c is total private spending, g is public spending and T represents the trade balance. All variables are real and defined in terms of the domestic good.

Private spending is an increasing function of disposable income $(y-\tau)$ and financial wealth, w, and a decreasing function of the interest rate, r. This is described by the following linear equation:

(2) $c = (1-s)(y-\tau) + \delta w - \phi r$

As suggested by finite-horizon optimizing behavior of households (see, e.g., Blanchard (1983)), the coefficient δ in (2) will generally exceed the interest rate, i.e., $\delta > r$. We will maintain this assumption throughout.

Domestic residents hold two categories of interest bearing assets: domestic public debt B and foreign bonds B*. We denote the real value of the public debt as $b = B/P$ (and similarly $b^* = B^*/P^*$). With the real exchange rate equal to λ, private real financial wealth is:

(3) $w = b + \lambda b^*$

Foreign residents do not hold domestic assets. The trade balance, expressed in units of domestic goods, is a decreasing function of domestic spending, and an increasing function of foreign spending c* and of the real exchange rate:

(4) $T = -mc - m^G g + m^* c^* + \alpha\lambda$

In (4), we allow for the public marginal prospensity to import m^G to differ from the private sector's marginal propensity m. Throughout the paper c* is assumed to remain constant and will be dropped.

We now introduce the three dynamic equations of the model. First is the government budget constraint, which describes the path of the real value of public debt:

$$(5) \qquad \dot{b} = r + g - \tau$$

where a dot represents a time derivative ($\dot{b}$ = db/dt). This equation is linearized around the initial steady state (an initial steady value is characterized by the 0 subscript as in b_0) and, for simplicity of notation, we express all variables as deviations from their initial steady state values (so that $\bar{y}$=0).

$$(5') \qquad \dot{b} = r^*b + b_0 r + g - \tau$$

The initial value of r is set equal to the world rate of interest r*. As will be seen shortly, this assumption implies a zero risk premium in the initial steady state.

Foreign assets are acquired through current account surpluses, which equal the sum of trade surpluses and net service account receipts:

$$(6) \qquad \dot{b}^* = T + r^*\lambda b^*$$

This equation can be linearized around the initial steady state, where $\lambda_0 = 1$:

$$(6') \qquad \dot{b}^* = r^*b^* + r^*b_0^*\lambda + T$$

The evolution of λ is tied to the interest rate differential $r-r^*$ so as to maintain portfolio balance. A simple linear portfolio balance condition can be cast as:[1]

$$\theta\lambda b^* - (1-\theta)b = \sigma(r^*-r+\dot{\lambda}/\lambda)$$

It expresses the relative demand for foreign and domestic assets as a function of the expected yield differential. As we assume perfect foresight, the yield differential is given by the real interest differential plus the rate of depreciation. The parameter θ is interpreted as the marginal propensity to hold foreign assets out of wealth, while σ is a measure of the degree of asset substitutability. This formulation allows two channels for deviations from the interest parity condition: less than perfect substitutability (σ finite), or no capital mobility ($\theta = 0$). It can be inverted and re-arranged to give:

$$(7) \qquad \dot{\lambda}/\lambda = r - r^* + \psi[\theta\lambda b^* - (1-\theta)b], \text{ with } \psi = 1/\sigma$$

Linearizing (7) and assuming no risk premium in the initial steady state yields the following condition:

$$(7') \qquad \dot{\lambda} = r - r^* + \psi[\theta b^* + \theta b_0^*\lambda - (1-\theta)b]$$

Pending the description of the fiscal policy experiments to be conducted, the model is now complete. It focuses solely on the real side of the economy, as no equations have been given for the nominal variables such as the price level or nominal exchange rate. A more complete model, with these equations, shows that our set-up is restrictive in one key way. As prices are implicitly and in particular the stock of outstanding public debt, so that $b(0) < b_0$. We overlook this effect by taking $b(0) = b_0$ by assumption. This simplification is exactly correct under any of the following three circumstances: 1) there is no initial outstanding public debt ($b_0 = 0$); 2) government bonds are indexed; or 3) the demand for money is interest inelastic and independent of wealth, so that a constant money supply implies a constant price level. Our treatment is approximately correct if the interest elasticity of money is small. The simplification is crucial to keeping down the dimmensionality of the model, and thereby to deriving analytical results. In section 6.1 we explain how the model is changed if we eliminate the simplification and show, through simulations, that the assumption seems to be of minor consequence.

We now turn to the specification of the fiscal policy rules. They have to satisfy (5). As is well known (see, e.g., Christ (1979)), (5) is a source of potential instability. This instability is removed if the policy rule implies that any budget deficit is corrected over time quickly enough to overcome the ever-increasing debt service component rb. A convenient (though by no means necessary1) way of guaranteeing stability is to assume that the government closes the deficit at a rate μ, bringing its debt to a long run target level $\bar{b}$:

(8) $$\dot{b} = \mu(\bar{b}-b)$$

With (5) and (8), it is easy to specify the three following types of fiscal expansion where, again, all variables are defined as deviations from their initial steady state values:

(9) Balance Budget Expansion $\quad g = \Delta \quad \tau = \Delta + b_0 r$

(10)	Tax Cut	$g = 0$	$\tau = -\mu\bar{b} + b_0 r + (\mu+r^*)b$
(11)	Government Spending Increase	$\tau = 0$	$g = \mu\bar{b} - b_0 r - (\mu+r^*)b$

The balanced budget expansion implies an immediate and equal increase in g and τ. Subsequently, as the interest rate changes, so do the interest payments on the existing debt. In order to maintain a balanced budget, the government must either raise taxes, as in (9), or reduce spending (not shown).

In the tax cut case, government spending is kept constant throughout. Taxes are initially cut by the amount $\Delta\tau = -\mu\bar{b}$. Thereafter, in order to satisfy (5) and (8), they must be raised so as to close gradually the budget deficit in the face of a rising debt, and to service the interest on existing debt. The last case, the spending expansion, is analogous: g is initially increased by $\mu\bar{b}$, and then is gradually reduced.

It is important to realize two implications of (10) or (11). Consider the tax cut case: the government can only set two out of the three policy variables $\Delta\tau$, μ and $\bar{b}$. If, for example, it decides on the magnitude of the tax cut, the faster it decides to close the ensuing deficit (the larger μ), the lower will be the final level of the debt $\bar{b} = -\Delta t/\mu$. Conversely, if it accepts a high value for $\bar{b}$, it will imply a slow adjustment parameter μ.[2] The second implication of (10) and (11) is that the fiscal stance in the steady state is the <u>opposite</u> of the initial move: an initial expansion will lead to a long run contraction as is shown by the following steady state levels:

(10') $\bar{\tau} = b_0\bar{r} + r^*\bar{b}$

(11') $\bar{g} = -b_0\bar{r} - r^*\bar{b}$

From (10') we see that a tax cut that raises $\bar{b}$ ultimately raises τ. These results are the simple consequence of the long-run requirement that the budget be in equilibrium:

$$\dot{b} = 0 = \bar{r}\bar{b} + \bar{g} - \bar{\tau}$$

The full model consists of equations (1) to (8) together with any of the three policy regime equations (9), (10) or (11). It can be reduced to a system of two differential equations in λ and b^* as shown below for the balanced budget case (i.e., using (9)) and for the tax cut case (i.e., using (10)).

Balance Budget Expansion

$$(12) \quad \begin{bmatrix} \dot{\lambda} \\ \dot{b}^* \end{bmatrix} = \begin{bmatrix} \alpha/\Phi(1-m) + b_0^*(\delta/\Phi + \psi\theta) & \delta(\Phi + \psi\theta) \\ \alpha/(1-m) + r^* b_0^* & r^* \end{bmatrix} \begin{bmatrix} \lambda \\ b^* \end{bmatrix} + \Delta \begin{bmatrix} [(m-m^G) + s(1-m)]/\Phi(1-m) \\ (m-m^G)/(1-m) \end{bmatrix}$$

Tax Cut

$$(13) \quad \begin{bmatrix} \dot{\lambda} \\ \dot{b}^* \end{bmatrix} = \begin{bmatrix} \alpha/\Phi(1-m) + b_0^*(\delta/\Phi + \psi\theta) & \delta(\Phi + \psi\theta) \\ \alpha/(1-m) + r^* b_0^* & r^* \end{bmatrix} \begin{bmatrix} \lambda \\ b^* \end{bmatrix} + \Delta\tau\frac{e^{-\mu t}}{\mu} \begin{bmatrix} [\delta - (1-s)(\mu+r^*)]/\Phi - \psi(1-\theta) \\ 0 \end{bmatrix}$$

with $\Phi = \phi + (1-s)b_0$. Note that in (13) $\Delta\tau = -\mu\bar{b}$, and $b(t) = -(\Delta\tau/\mu)(1-e^{-\mu t})$.

Because of our specification (8), the public debt b follows a path independent of λ and b^*. As it turns out, the transition matrix governing the law of motion of λ and b^* is the same under both policy regimes. It differs in the case of a public spending expansion as described by (11).[3]

Because b^* is predetermined and λ is non-predetermined, stability requires that the determinant be negative. This is the case when:

$$(14) \qquad \delta + \Phi\theta\psi > r^*$$

As can be seen from (2), (3) and (6), this condition implies that an increase in foreign asset holdings will have a negative effect on the current account ($\partial\dot{b}^*/\partial b^* < 0$). Since we assume that $\delta > r^*$, (14) will always be satisfied.

3. Steady State Effects

The steady state is attained when both goods and assets markets are in equilibrium with $\dot{\lambda} = 0$, while the current account is in balance. We show below that, in general, a fiscal expansion leads to a long-run depreciation when domestic and foreign assets are close substitutes, and to a long-run appreciation in the case of a low degree of substitutability. Heuristically, the fiscal expansion creates an excess demand for domestic goods and a trade deficit. Given the spending and trade balance functions (2) and (4), a return to equilibrium requires adjustments in w, r and λ. Consider first the case of perfect asset substitutability. In the steady state, portfolio balance requires $r = r^*$, so that the adjustment will be achieved through changes in w, i.e., in λb^*, and in λ. In order to eliminate the excess demand for goods, we need either an appreciation or a reduction in wealth. But an appreciation would worsen the current account so that what actually happens is a drop in wealth (brought about by current account <u>deficits</u> along the adjustment path). The stability condition (14) implies that the drop in wealth has a stronger effect on spending than on the current account, because a reduction in λb^*, which decreases spending and improves the trade balance, also implies a worsening in the interest service account. So, while a reduction in wealth alone would restore goods market equilibrium, it has to be supplemented by a depreciation to bring the current account back into balance. Now, if domestic and foreign assets are imperfect substitutes, the reduction in λb^* must be accompanied by a higher interest rate in order to maintain portfolio balance. This, in turn, depresses private spending. If this effect is strong enough to more than offset the expansionary effect of the fiscal stimulus, the preceding results are inverted and the long-run adjustment is characterized by a high interest rate, an increase in wealth and an exchange rate appreciation (the country will then run current account <u>surpluses</u> on the adjustment to steady state).

We now formally establish and qualify these results, using Figure 1 for the case of a balanced budget expansion and Figure 4 for the case of a tax cut. The CA schedule depicts the balanced current account condition <u>together</u> with goods market equilibrium. Substituting (2) and (4) in the goods market equilibrium condition (1), we obtain the following expression for the trade balance:

$$(15) \qquad T = [\alpha\lambda + (m-m^G)g]/(1-m)$$

From (15), we see that the trade balance is only a function of λ and g. This is so because goods market equilibrium forces the other determinants of T, r and w to adjust so that private spending always exactly fills the gap left by public and foreign demand for domestic goods. What (15) implies is that net foreign asset holdings λb^* affect the current account only through the interest service account, $r^*\lambda b^*$. Starting then from current account balance, an increase in λb^* creates a surplus and requires an appreciation to restore equilibrium, thus the downward sloping CA schedule. The GG schedule describes goods market equilibrium together with portfolio balance when $\dot{\lambda} = 0$: the interest rate is solved out. It is downward sloping because an increase in λb^* raises wealth and therefore private spending. The resulting excess demand for domestic goods must be eliminated through an exchange rate appreciation. Note that, in addition to a direct wealth effect, under imperfect substitutability an increase in λb^* also raises spending by pushing down the interest rate, requiring a larger appreciation and leading to a steeper GG schedule. The GG schedule is steeper than the CA schedule because, holding λb^* constant, an appreciation reduces demand and worsens the current account by exactly the same amount (the reduction in net foreign demand), while the stability condition (14) is that the wealth effect on spending of an increase in λb^* is larger than the interest payment effect on the current account.

3.1 Balanced Budget Expansion

Figure 1 shows the case of a balanced budget expansion, where public debt remains unchanged.[4] We consider first the case where the private and public marginal propensity to import are equal: $m > m^G$. In this case, the fiscal expansion does not alter the composition of spending and, from (15), we see

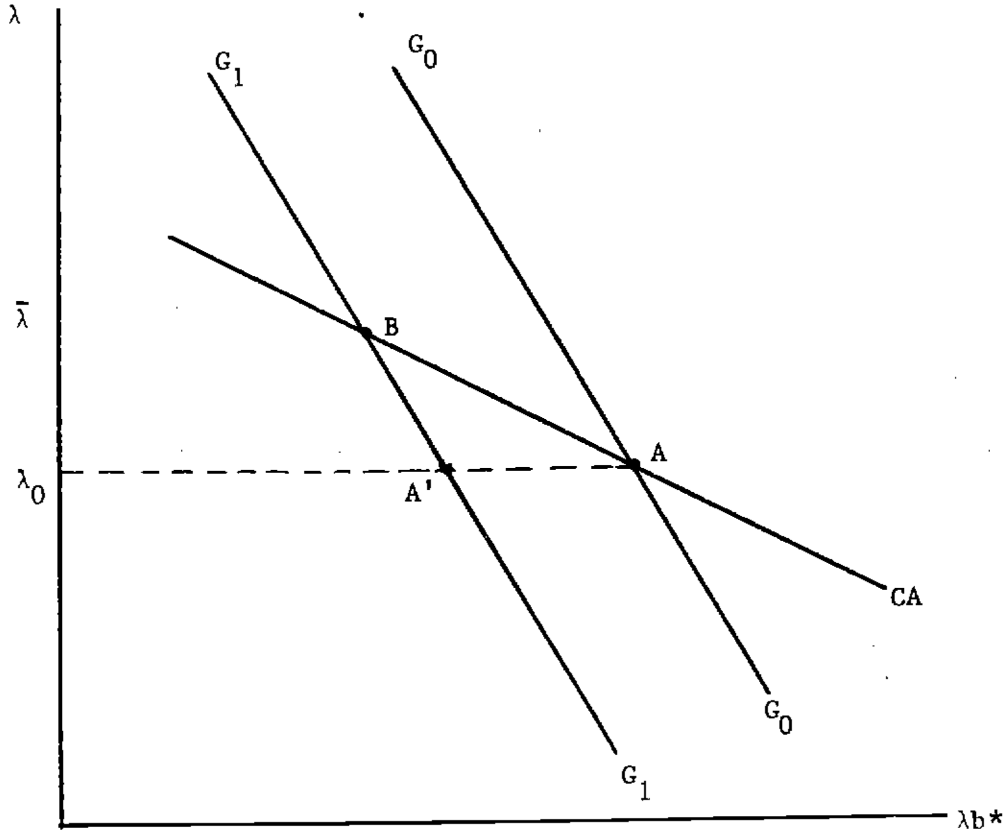


Figure 1

that it does not directly affect the current account, so that the CA schedule remains unchanged. Yet, a balanced budget expansion, as described by (9), raises demand for domestic goods by $s(1-m)\Delta$. Equilibrium in the goods market can be restored either by an appreciation or by a drop in wealth: the GG curve shifts down and to the left, from G_0G_0 to G_1G_1 in Figure 1. Consequently, if $m^G = m$, the exchange rate unambiguously depreciates in the long run, with foreign wealth, and therefore net foreign asset holdings, falling.[5]

It is easy now to consider the case when $m^G \neq m$, so that fiscal policy alters the composition of demand. We only need to add this new effect to the previous case. Starting then from point B, if $m^G < m$, the fiscal expansion displaces demand away from foreign goods toward domestic goods. This shift affects the goods market and the current account by the same amount, moving both schedules downwards as the same appreciation is required to crowd out foreign demand and restore both equilibria. Consequently, the change in λ is reduced when $m^G < m$. For m^G much less than m, λ may actually appreciate in the long run. On the contrary, with $m^G > m$, both curves shift upward, increasing the size of the depreciation. Thus, only a strong change of the composition of demand towards domestic goods is capable of producing a long run appreciation.

The portfolio balance effect (when assets are imperfect substitutes) does not alter this result. As b^* is reduced, with a constant stock of public debt b, the domestic interest rate must rise to convince domestic residents to hold a larger share of their wealth in the form of domestic assets. Higher interest rates, in turn, crowd out private spending, partially undoing the expansionary effect of fiscal policy. As a consequence, we obtain less of a depreciation and a smaller drop in wealth. Graphically, the GG curve becomes steeper because the wealth effect on spending is strengthened through the interest rate channel, but the downward shift is the same. What this implies, then, is that we now need a relatively smaller shift of the composition of demand ($m^G < m$) to obtain a long run appreciation.

This is summarized in Figure 2, where the long run change in the real exchange rate is described as a function of $\Phi\theta\psi$. The parameters $\theta\psi$ capture the portfolio balance effect on the interest rate, while Φ is the total interest elasticity of spending. With $\psi = 0$, the domestic interest rate cannot depart, in the steady state, from the world level r^*. As ψ increases, the interest rate bears a larger share of the adjustment to the excess demand of goods, leaving to λ the task of adjusting, when $m^G \neq m$, to the change in the composition of demand.

The role of the size of the initial outstanding public debt b_0 is entirely captured by $\Phi = \phi + (1-s)b_0$. The larger the initial debt, the more interest elastic is private spending because a rise in the interest rate raises the burden of the debt, forcing the government to raise taxes.

Finally, we consider the role of the initial debt position of the country vis-a-vis the rest of the world b_0^*. It does not affect either the change in λ or the change in wealth, i.e. in λb^*. Hence, the change in b^*, after linearization, is:

$$\tilde{b}^* = \tilde{\lambda}\bar{b}^* - b_0^*\tilde{\lambda} \qquad (16)$$

This is shown as Figure 3. When $b_0^* = 0$, b^* and wealth change by the same amount. If $b_0^* > 0$, a long run depreciation increases the domestic value of foreign assets and requires less of an increase in b^* to achieve a given

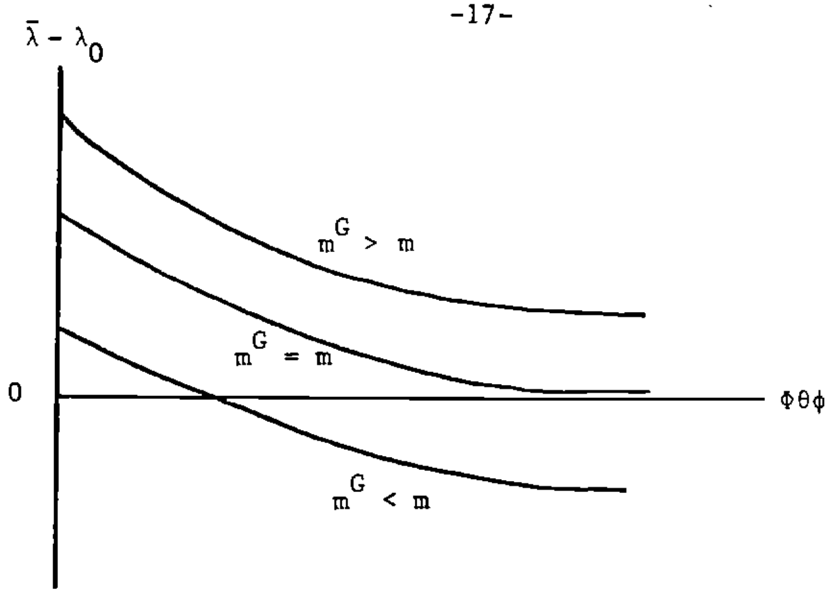


Figure 2

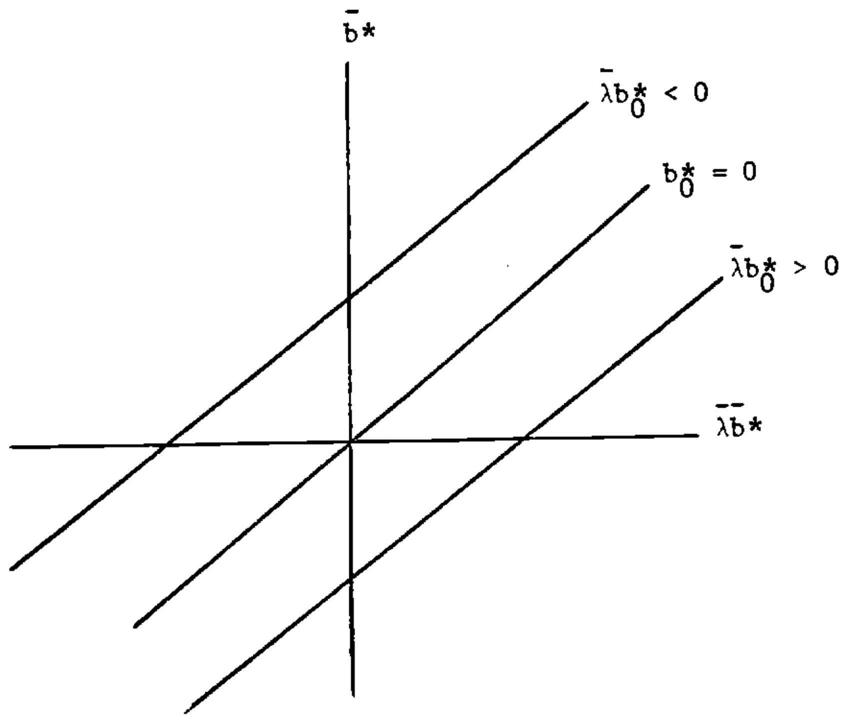


Figure 3

increase in wealth, while with $b_0^* < 0$, the depreciation amounts to a higher debt and calls for $\bar{b}^* > \lambda\bar{b}^*$. (The results are reversed when the exchange rate appreciates in the long run.) The only important point here is that for b_0^* sufficiently large in absolute value, b^* and wealth may actually move in opposite directions.

3.2 Tax Cut

As government spending is kept unchanged (see (10), we know from (15) that there is no direct effect of a tax cut on the trade balance so that the CA schedule never shifts, allowing us to focus exclusively on the goods market schedule GG.[6] The GG schedule may shift up or down, depending on the relative magnitudes of three effects. First is the long-run increase in taxes necessary to generate the revenues of a higher debt service (see (10')): this depresses spending. Second is the direct wealth effect of the public debt increase, which raises spending. The stability condition (14) guarantees that the first effect always dominates, so that the overall steady state direct effect of the tax cut is indeed expansionary. In Figure 4, this is shown as the shift from G_0G_0 to G_1G_1. The third effect is the portfolio balance effect. As b rises, with domestic and foreign assets imperfect substitutes, the home interest rate rises, reducing domestic spending. This tends to push the GG schedule back to the right in Figure 4. The conclusion is that if assets are close substitutes, the economy moves to a point like A_1. On the contrary, with low substitutability, the interest rate may increase by enough to depress demand, outweighing the first two effects, and pushing the GG schedule to the right, as G_2G_2 in Figure 4.[7]

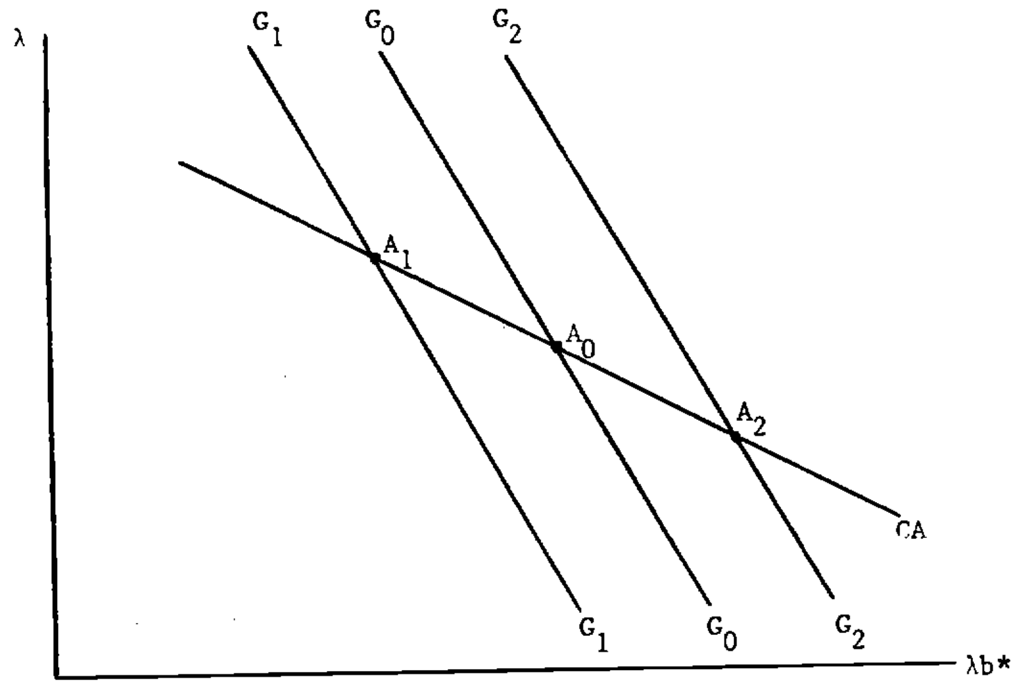


Figure 4

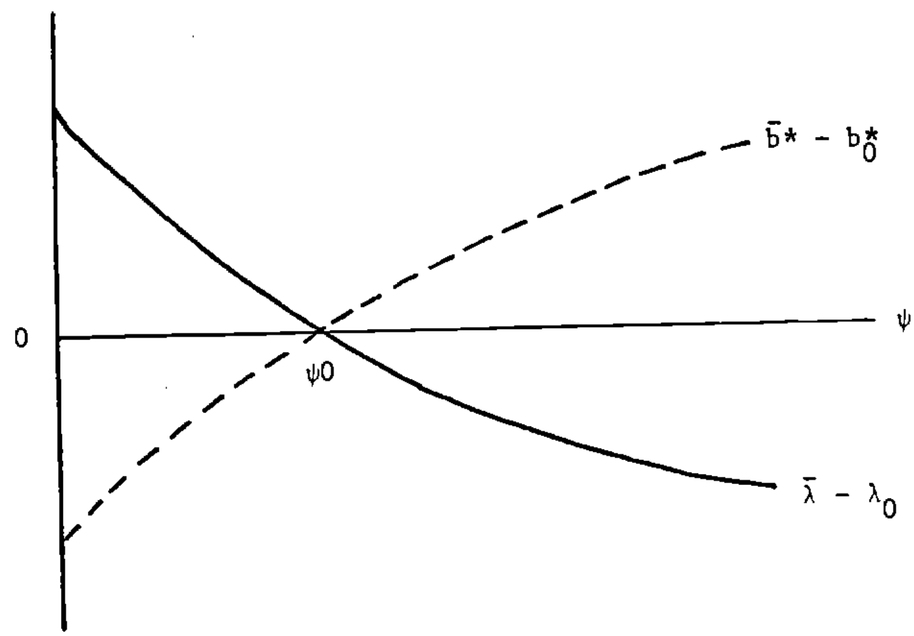


Figure 5

The conclusion, then, is that there exists a critical value of ψ, say ψ^0, such that $\psi < \psi^0$ leads to long-run depreciation, and $\psi > \psi^0$ leads to long-run appreciation. The critical value is given by $\psi^0 = [\delta - (1-s)r^*)/\Phi(1-\theta)]$.[8]

4. The Dynamics of a Balanced Budget Expansion

In this section, we describe graphically the behavior of the system defined by (12). From Section 3, we know that several combination of outcomes are possible for λ and b^* in the steady state. We only discuss here a subset of the possible cases. The laws of motion are described in Figure 6 with the schedules $\dot{\lambda} = 0$ and $\dot{b}^* = 0$. The interpretation of these schedules is similar to, respectively, those given for the GG and CA schedules of Section 3. The system is saddle-path stable when (14) is satisfied, convergence occurring along SS.

We first take up the case where $m^G = m$ so that the $\dot{b}^* = 0$ schedule remains unchanged after a balanced-budget expansion. In Figure 7.1, we show that, on impact, there is a jump appreciation as the economy moves from point A to point B. This corresponds to the excess demand for domestic goods created by the fiscal expansion. Equilibrium is restored through a crowding out of foreign demand as a result of the appreciation. There is also a crowding out of private spending as the home interest rate rises for two reasons: the expected depreciation and, with imperfect substitutability, a lower value of λb_0^* due to the appreciation.[9] The convergence process that follows, from point B to point C is one of a continuous depreciation and current account deficits.

When $m^G > m$, in addition to the previous effects, we now have a shift towards foreign goods which shifts back both schedules upwards as it reduces

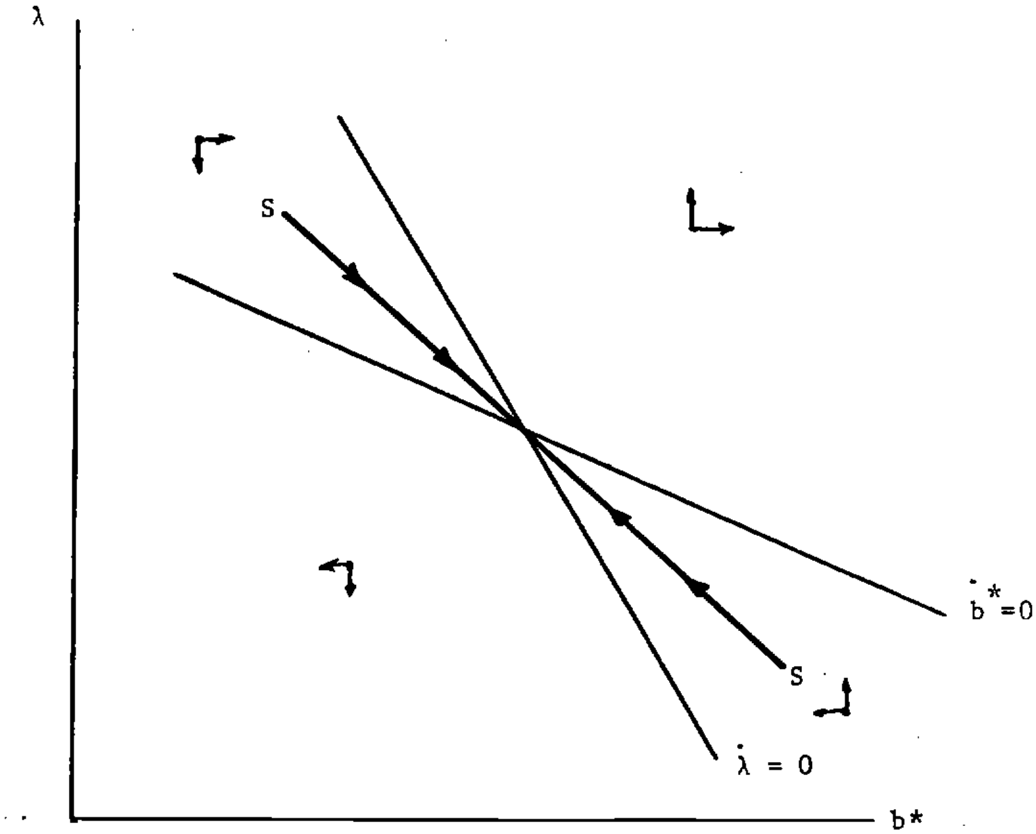


Figure 6

the excess demand for domestic goods and worsens the curent account surplus. When $m^G = m + s(1-m)$, for example, the $\dot{\lambda}=0$ schedule actually stays in its initial position as shown in Figure 7.2. In this case, the shift of spending away from domestic goods exactly offsets the expansion created by the fiscal policy change. Yet domestic demand weakens since asset market equilibrium requires an increase in the domestic interest rate to make up for the expected depreciation. Consequently, we need a crowding in of foreign demand, and this is achieved through a jump depreciation.[10] The convergence path is as in the previous case.

When, on the contrary, $m^G < m$, we have seen the possibility of a long run appreciation, together with an increase in b^*, provided assets are sufficiently imperfect substitutes. This is shown in Figure 7.3. There is a jump appreciation for two reasons. First, there is a strong excess demand for domestic goods as the change in the composition of spending reinforces the effect of the balanced budget expansion. Second, with the expectation of an appreciation, portfolio balance requires a drop in the interest rate. The ensuing convergence path includes a continuous appreciation and current account surpluses.

We conclude this section with a summary of the initial impact of the fiscal expansion on the real exchange rate.[11] The results are described in Figure 8. One channel is the change of composition of demand which occurs when the government's marginal propensity to import differs from the private sector's marginal propensity: this is crucial in determining the sign of the initial change. The size of the change is shown to be related to the portfolio balance effect. The lower the degree of asset substitutability, the more the burden

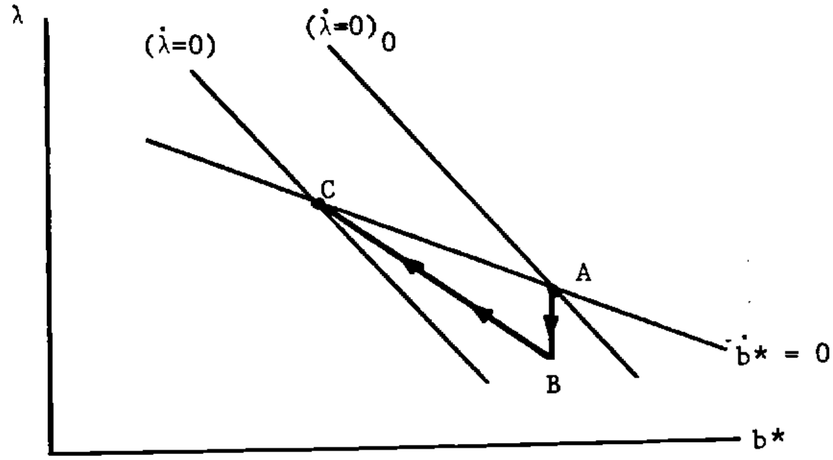


Figure 7.1

$m^G = m$

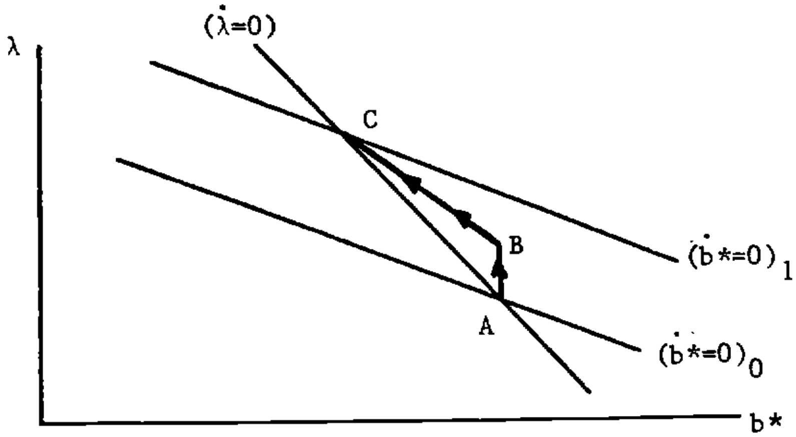


Figure 7.2

$m^G = m + s(1-m) > m$

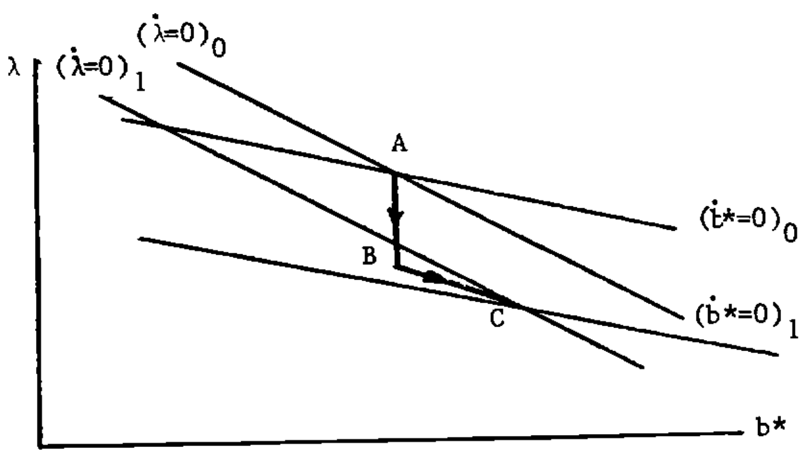
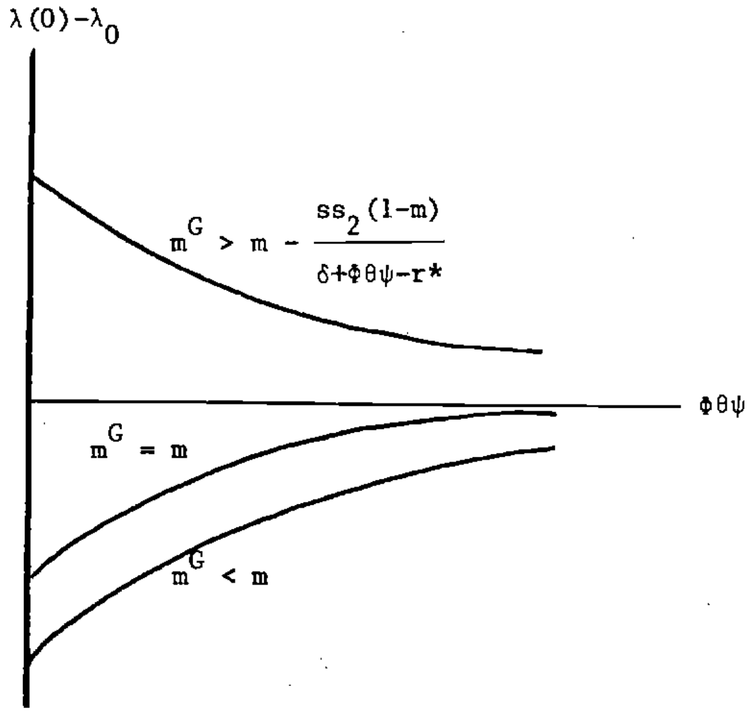


Figure 7.3

$m^G < m$

$\phi\theta\psi$ large



$\lambda(0)-\lambda_0$
$m^G > m - \frac{ss_2(1-m)}{\delta+\Phi\theta\psi-r^*}$
$\Phi\theta\psi$
$m^G = m$
$m^G < m$

Figure 8

of adjustment can be absorbed by a change in the interest rate, and the smaller the exchange rate jump.

5. The Dynamics of a Tax Cut

5.1 The Solution

The system (13) is not amenable to a simple diagrammatic solution as in the balanced budget case. Our strategy in this section, therefore, is to characterize the general structure of the convergence path, to show analytically the impact effect, and describe the convergence path through simulations.

The general solution to (13) is:

$$(17) \qquad b^* = \bar{b}^*(1-e^{s_2 t}) + \frac{A\bar{b}}{(s_1+\mu)(s_2+\mu)} \left(\frac{\alpha}{1-m} + b_0^* r^*\right) (e^{s_2 t} - e^{-\mu t})$$

$$(18) \qquad \lambda = \bar{\lambda} - \frac{r^* - s_2}{\alpha/(1-m)\ b_0^* r^*} (b^* - \bar{b}^*) + \frac{A\bar{b}}{s_1+\mu} e^{-\mu t}$$

where $A = \frac{\delta - \Phi\psi(1-\theta) - (1-s)(\mu+r^*)}{\Phi}$ and s_1, s_2 are the eigen values of the transition matrix, $s_1 > 0$, $s_2 < 0$.[12] As usual, all variables are expressed as deviations from the steady state.

Although the above laws of motion are hard to "see through," they yield a certain number of insights into the characteristics of the convergence path. From (18), we see that when the last term is small, there is a tendency for λ and b^* to move in opposite directions, i.e. to observe an appreciation (resp. a depreciation) together with a current account surplus (resp. a deficit).

Yet this will not always be the case, especially in the early part of the adjustment process. From (17) we see that the convergence path of b^*, and therefore λ, will not necessarily be monotonic as in the balanced budget case. This will be important in interpreting $\dot{\lambda}$ as the expected change of the exchange rate since it now may include a perfectly foreseen non-monotonic path. If in the long run net foreign asset holdings are to decrease (resp. increase), so that $\bar{b}^* < 0$ (resp. $\bar{b}^* > 0$), the first term in (17) shows that the current account will tend to be in deficit (resp. surplus). Yet, the second term alerts us to the possibility that this may not be true early in the adjustment process, if $\mu < -s_2$, i.e. if the government is slow in curbing its budget deficit.

5.2 The Impact Effect

Solving (18) at time zero when the tax cut is put in place and using the steady state solutions of footnote 7 we obtain the jump of λ at time $t = 0$:

$$\lambda(0) - \lambda_0 = \Delta\tau \frac{\delta + (1-s)(s_1 - r^*) - \Phi\psi(1-\theta)}{\Phi s_1(s_1+\mu)} \quad (19)$$

We observe the effects of the now familiar three channels: a wealth effect on spending (δ); a tax reduction effect $(1-s)$; and a portfolio balance effect $(\psi(1-\theta))$. The two first terms correspond to an increased demand for domestic goods and act toward an appreciation. The third term reflects the increase in the interest rate due to an increase in b, and the corresponding lessening of domestic spending. With perfect or high substitutability, the two first effects dominate and the exchange rate appreciates on impact. (Note that this is the case where the exchange rate depreciates in the long run!) On the contrary, when asset substitutability is low, the exchange rate depreciates on impact and appreciates in the long run![13] There is, finally, an intermediate situation where the exchange rate appreciates both on impact and in the long run. Note that the degree of substitutability enters as $\Phi\psi(1-\theta)$, where $\psi(1-\theta)$ is the effect of the increase in b on the interest rate, and Φ is the interest elasticity of private spending. If, at the margin, domestic residents want to hold mostly foreign assets, i.e. θ is close to 1, then the increase in b does not affect the exchange rate. Figure 9 summarizes the foregoing dicussion, describing the impact effect $\lambda(0) - \lambda_0$ for a given tax cut. It is based on simulations described in the next section.

5.3 Simulations

In order to examine the complete path of adjustment, we now turn to some simulation exercises. The simulations are based on the following parameter values:

$r^* = .05$	$\mu = .1$		
$s = .2$	$\delta = .1$	$\phi = .8$	
$m = m^* = .3$	$m^G = 0$	$\alpha = .12$	$\theta = .5$

and the initial steady state values chosen are:

$\bar{y} = 1.0$	$c_0 = 0.663$	$g_0 = 0.337$	$T_0 = 0$
$b_0 = 0$	$b_0^* = 0$	$\tau_0 = 0.337$	$\lambda_0 = 1$

The experiments reported concern a tax cut enacted at time t = 0. The reduction in taxes is $\Delta\tau = 0.05$, i.e. 5 percent of total output. With $\mu = .1$,

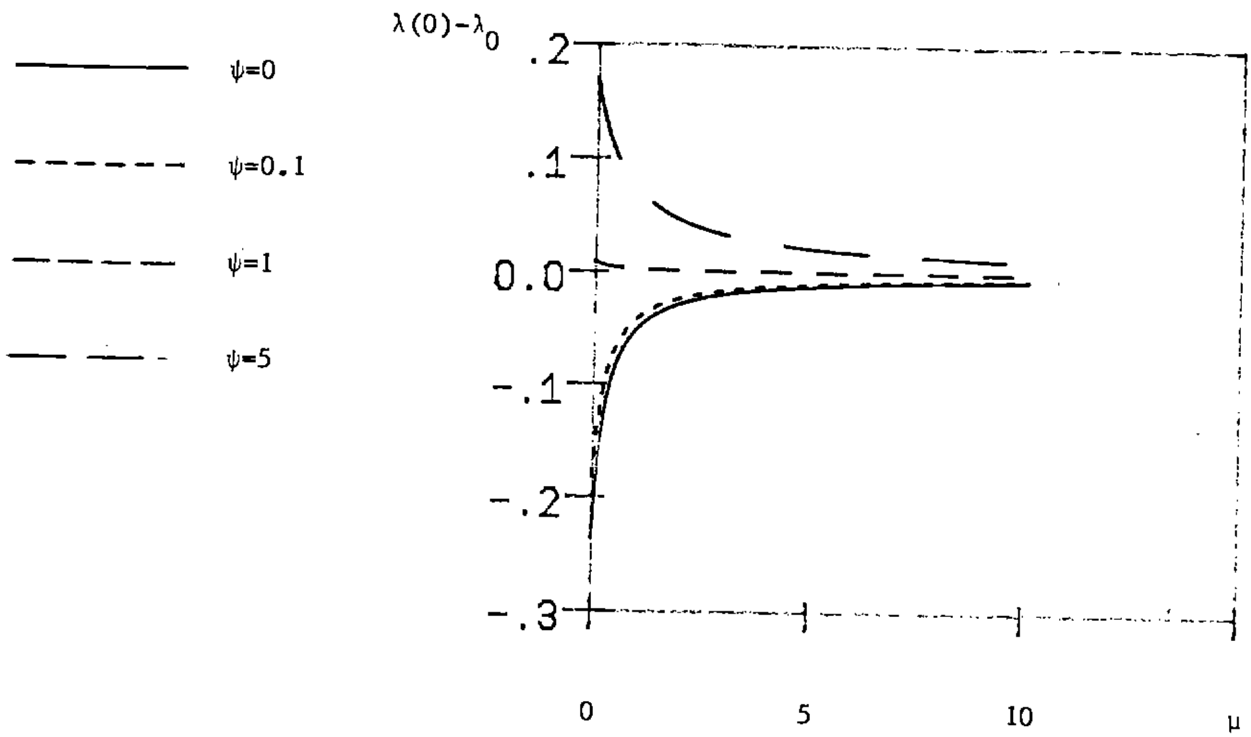


Figure 9

this implies that domestic debt increases in the long-run by .5, i.e. 50 percent of output.

A. Perfect Asset Substitutability

Figure 10 presents the results obtained when domestic and foreign assets are perfect substitutes. Following the initial jump appreciation, the exchange rate continuously depreciates towards its steady state value, which represents a long run depreciation relative to the initial value (the exact values obtained are shown in Table 1 at the end of the section). Public debt is accumulated by domestic residents, replacing net foreign asset holdings. This entails a path of continuous current account deficits. Notice that wealth must fall in the steady state so that the cumulative current account deficits exceed the accumulated budget deficits. The reason can be seen with the goods market equilibrium condition (15). As λ depreciates in the long run, it creates an excess demand for domestic good. With g unchanged, private spending must be reduced and this is brought about by the wealth reduction, since r returns to the world level r^*. The path of r is shown in the last panel of Figure 9. On impact it rises above r^* and then approaches monotonically its steady state value.

B. Moderate Imperfect Substitutability

As noted earlier, there is a range for ψ, the degree of imperfect asset substitutability, such that the exchange rate appreciates both in the immediate short run and in the long run. This case of "moderate" imperfect substitutability is shown in Figure 11, for $\psi = .2$, and exhibits a number of interesting particularities. First, as the possibility was noted in our earlier discussion of the laws of motion (17) and (18), the convergence paths of λ and b^* are not monotonic. Second, there is a period where λ and b^* move in the same direction, so that we obtain a depreciating exchange rate while the current account is in surplus. Third, the exchange rate jump appreciates on impact, and then immediately starts depreciating.

What happens can be explained as follows. On impact, the tax cut creates an excess demand for goods (smaller than when $\psi = 0$ because of the larger increase in the interest rate), hence the jump in appreciation. As asset stocks can only change gradually, at $t = 0$, we still have $b = b_0$ and $b^* = b_0^*$, so that with $r(0) > r_0$, portfolio balance requires that the exchange rate be (correctly) expected to depreciate. The surge in spending creates a trade deficit, rapidly reversed as the exchange rate depreciates. Over time b grows, so portfolio balance becomes compatible, with $r > r^*$ and $\dot{\lambda} < 0$.

C. Strong Imperfect Substitutability

Finally, in Figure 12, we show the simulation obtained for $\psi = 2$. Here we find an impact depreciation and a long run appreciation. After the fiscal expansion, the current account actually moves into surplus, as the sharp rise in home interest rates reduces domestic absorption. While the current account is always in surplus, the exchange rate, again, exhibits a non-monotonic path. For the same reason as in the previous case, the exchange rate must be expected to depreciate at $t = 0$, so that the initial upward jump of λ is followed by further depreciations.

In the last two cases, the long run interest rate lies above the world level because of the long-run increase in the share of domestic assets in

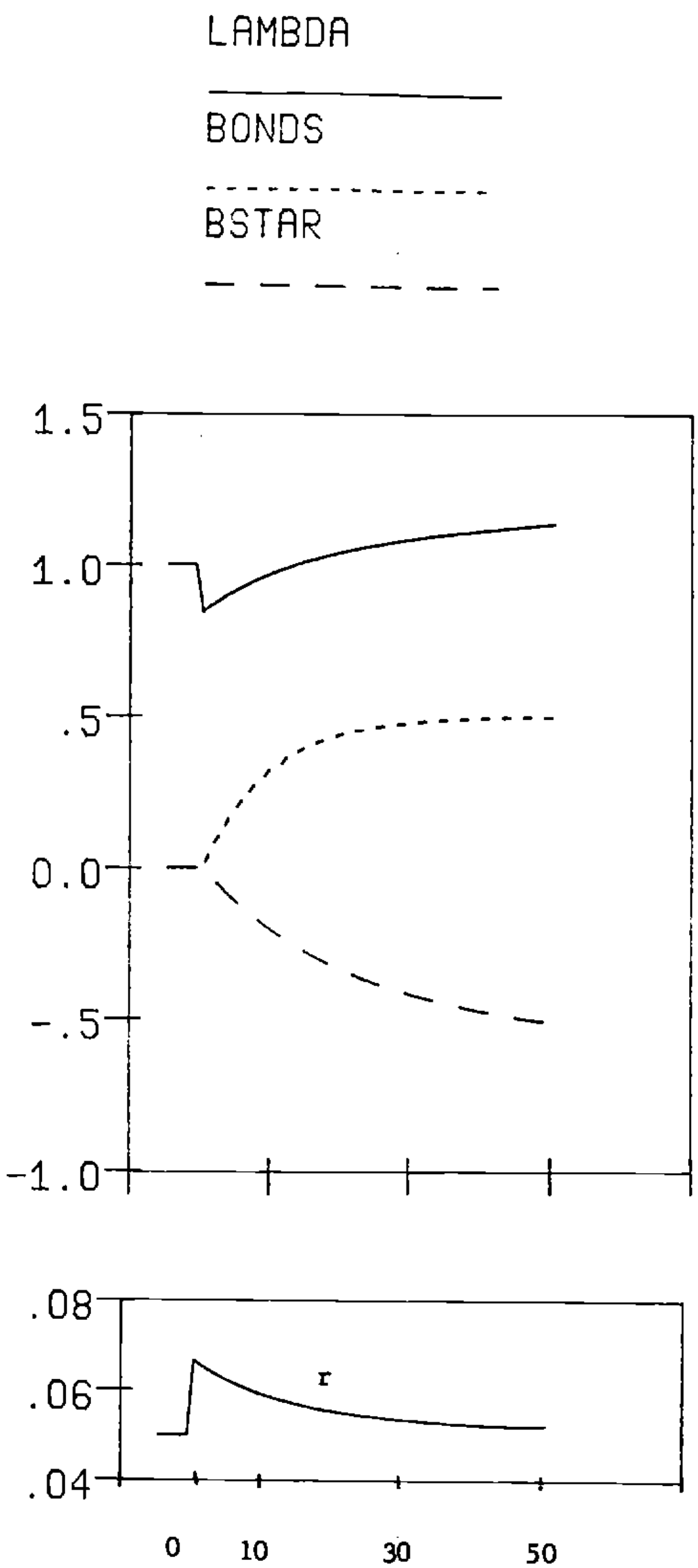


Figure 10 (ψ=0)

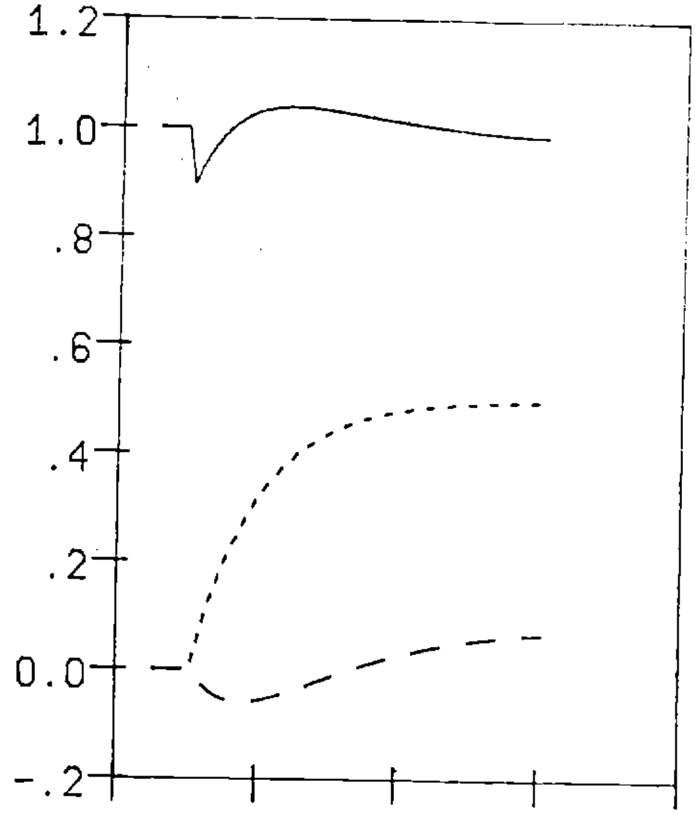


Figure 11 (ψ=.2)

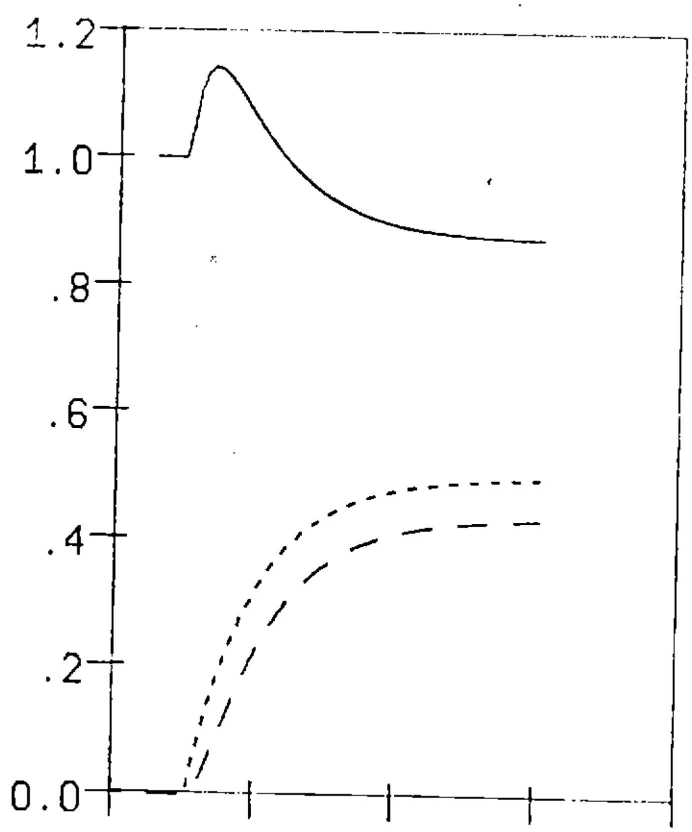


Figure 12 (ψ=2)

private portfolios. The relatively high interest rates crowd out private demand, leading to current account surpluses, the accumulation of foreign assets and the rise in private wealth.

The various simulation results discussed in this section are presented in Table 1:

Table 1

Simulation Results

	$\psi = 0$	$\psi = .2$	$\psi = .5$	$\psi = 2$
λ_0	1.0	1.0	1.0	1.0
$\lambda(0)$	0.844	0.897	0.946	1.046
$\bar{\lambda}$	1.175	0.976	0.918	0.873
$r(0)$	0.066	0.078	0.088	0.109
$\bar{r}$	0.050	0.091	0.104	0.114
$\bar{b}^*$	-0.6	0.081	0.283	0.436

It may be worth recalling here that what matters for $\lambda(0)$ is not ψ alone but $\Phi\psi$ where $\Phi = \phi + (1-s)b_0$. Here we have taken $b_0 = 0$. For a positive initial debt, the degree of imperfect substitutability ψ becomes much more powerful in reversing the perfect substitutability result. We will have examples of that in the next section.

6. Extensions

In this section, we propose to explore, through simulations of the tax cut case, the practical importance of some of the restrictive assumptions imposed on our earlier model. We consider, successively, the effect of price changes on the real value of nominal domestic bonds, the case of variable output, and the distinction between short and long term interest rates.

6.1. Real and Nominal Debt

As the fiscal expansion is bound to bring about changes in the price level, the real value of the domestic public debt is going to be affected.[14] We have assumed away this complication so far, by assuming a zero interest elasticity in the demand for money as a way of making the price level constant. In this section we reconsider the question by adding to the model (equations (1) to (7), (10)) the following equations:

(20) $b = B/P$

(21) $\dot{B} = P(g-\tau) + iB$

(22) $i = r + \dot{p}$

(23) $\bar{M} - p = \beta\bar{y} - \gamma i$

(24) $p = P - 1$

(25) $e = \lambda + p$

These equations need little explanation. We simply introduce the distinction between the nominal (B) and real (b) value of public debt, and write in (21) the government budget constraint in nominal terms. We also define in (22) the nominal interest rate through the Fisher relation. We introduce the interest rate in the demand for money equation (23), where $\bar{M}$ is the

(25) $e = \lambda + p$

These equations need little explanation. We simply introduce the distinction between the nominal (B) and real (b) value of public debt, and write in (21) the government budget constraint in nominal terms. We also define in (22) the nominal interest rate through the Fisher relation. We introduce the interest rate in the demand for money equation (23), where $\bar{M}$ is the log of the nominal money stock, which remains constant. $p = \log P$ is linearized in (24). Finally, we define the nominal exchange rate $e = \lambda p$ in the linearized form (25). This assumes constant prices abroad, normalized at 1, and in the initial steady state $e_0 = 1$. Prices are still assumed to be fully flexible, so that output stays at its full employment level. When $\gamma = 0$, this model is identical to the model of the previous sections. In Table 2, we report the results of simulations performed for selected values of γ, after linearization of (2) and (21). We have taken $\beta = 1$ and $i_0 = r_0 = r^*$, with the value of $\bar{M}$ adjusted so that in the initial steady state, $p_0 = 0$. Of course, we need to assume $b_0 \neq 0$, so that we put b_0 at 50 percent of GDP. Thus the simulations were run with:

$b_0 = 0.5$, $\bar{b} = 1$ (so that $\Delta\tau = -0.05$ as in Section 6)

$g_0 = 0.1875$ $\tau_0 = 0.213$.

and correspond as before to a tax cut of 5 percent of output.

Table 2

	$\psi = 0$			$\psi = 0.075$		$\psi = 0.2$	
	$\gamma=0$	$\gamma=0.5$	$\gamma=2$	$\gamma=0$	$\gamma=0.5$	$\gamma=0$	$\gamma=0.5$
$\lambda(0)$	0.864	0.863	0.862	0.974	0.973	1.117	1.114
$\bar{\lambda}$	1.175	1.175	1.175	0.953	0.953	0.845	0.845
$r(0)$	0.064	0.064	0.064	0.079	0.079	0.099	0.099
$\bar{r}$	0.05	0.05	0.05	0.080	0.080	0.097	0.097
$P(0)$	1.0	1.007	1.10	1.0	1.015	1.0	1.025
$b(0)$	0.5	0.497	0.45	0.5	0.493	0.5	0.488
$e(0)$	0.864	0.870	0.962	0.974	0.988	1.117	1.139

The three different values of ψ correspond to the three cases discussed in Section 5. It is interesting to note, first, that with $b_0 > 0$, considerably smaller values of ψ modify the qualitative results obtained under perfect substitutability (when $\psi = 0$). Actually, with an initial debt equal to 50 percent of GNP, small departures of the perfect substitutability case produce quite strong effects.

The other striking result is that with our parameter values, the effect of price increases on the real value of nominal assets produce effects of minimal importance on the real exchange rate (less than one percent). Even for an interest semi-elasticity as high as $\gamma = 2$, with the price level jumping on impact by 10 percent, the effect on λ remains trivial. At this stage, we conclude therefore that our earlier assumption $\gamma = 0$ is tenable.

6.2 Variable Output

In this section, we drop the assumption of perfectly flexible prices, by postulating a Phillips curve relationship:

$$\dot{p} = \omega(y - \bar{y}) \tag{26}$$

The model consists of equations (1) to (8), (10), and (22) to (26). Thus we revert to the zero interest elasticity assumption in the demand for money.

Two broad results stand out. First, the exchange rate is higher on impact the lower ω is. When output supply is allowed to respond to the expansionary pressure of the tax cut, the exchange rate appreciates by less, or

Table 3

	$\psi = 0$				$\psi = .2$		$\psi = 2$	
	$\omega=\infty$	$\omega=.5$	$\omega=.25$	$\omega=.01$	$\omega=\infty$	$\omega=.25$	$\omega=\infty$	$\omega=.25$
$\lambda(0)$	0.844	0.853	0.856	0.864	0.897	0.927	1.046	1.118
$r(0)$	0.066	0.062	0.063	0.065	0.078	0.078	0.109	0.101
$y(0)$	1.0	1.008	1.007	1.007	1.0	1.013	1.0	1.029

depreciates more, than in the fixed output case. Although this effect is by no means trivial, the qualitative features of our earlier results remain unchanged. The second result is the well known one that the output response to fiscal policy in an open economy is inversely related to the degree of asset substitutability. This is shown most clearly in Figure 13, where the output response is shown for different values of ψ when $\omega = 0.25$.

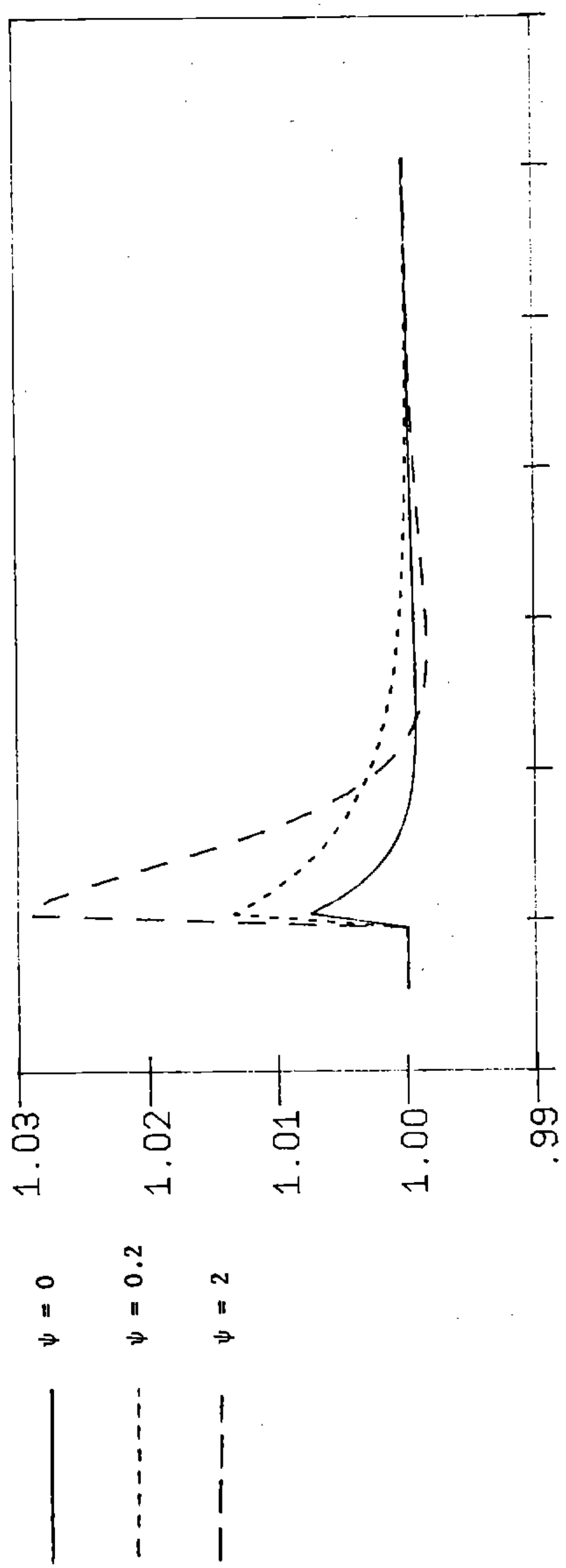


Figure 13: Output Response (ω=.25)

6.3 Short-Term and Long-Term Interest Rates

So far we have assumed that private spending is responsive to the short term interest rate r. The short term rate is the relevant one in the portfolio balance condition (assuming that portfolios can be costlessly re-arranged each period). But it would clearly be preferable to have private spending depend upon a long-term rate. The distinction may well be important, given the crucial role played by the interest effect on spending. We define the real long term interest rate as the rate associated with a consol which pays a constant flow of dividends equal to one. Accordingly, the price of the consol is 1/R and its total return includes both dividends and capital gains or losses. With capital gains equal to d(1/R)dt, the real return is therefore:

$$R + \frac{d(1/R)/dt}{1/R} = R - \dot{R}/R$$

We assume that the short-run public debt and the domestic consols are perfect substitutes, so that their returns must be the same:

$$(27) \qquad r = R - \dot{R}/R$$

Upon linearizing, we have:

$$(27') \qquad \dot{R} = r^*(R-r)$$

where we assume that in the initial steady state $R_0 = r_0 = r^*$. The resulting model consists of (1) to (8), (10) and (27), where in equation (2), r is replaced by R. The parameters and initial values used in the simulations are exactly as in Section 5. Note also that we revert to the full-employment case and assume $\gamma = 0$, thus eliminating the effects discussed in Sections 6.1 and 6.2. The results of the tax cut are presented in Figures 14, 15 and 16 and summarized in Table 4. These figures correspond to Figures 10, 11 and 12 above.

Table 4

	$\psi = 0$		$\psi = .2$		$\psi = 2$	
	No R	With R	No R	With R	No R	With R
$\lambda(0)$	0.844	0.811	0.897	0.939	1.046	1.110
$r(0)$	0.066	0.072	0.078	0.067	0.109	0.060
$R(0)$	---	0.059	---	0.086	---	0.123
$\bar{R} = \bar{r}$	0.05	0.05	0.092	0.092	0.114	0.114

Consider first the perfect substitutability case as in Figure 14. The long term interest rate smooths out the fluctuations of the short term rate. Hence on impact the long-run rate jumps less, and thus private demand is not so much reduced as when it depends on the short term rate. With a stronger excess demand in the goods market, the exchange rate impact appreciation is larger. Exactly the opposite occurs in Figure 15, where the long term interest rate increases by more than the short term rate on impact. In this case, both rates have to rise in the final steady state, and this increase is immediately anticipated by the long rate. With a strong effect of interest rates on demand, less of a real exchange rate appreciation is needed to crowd out private demand

——— no long-term rate

- - - - - with long-term rate

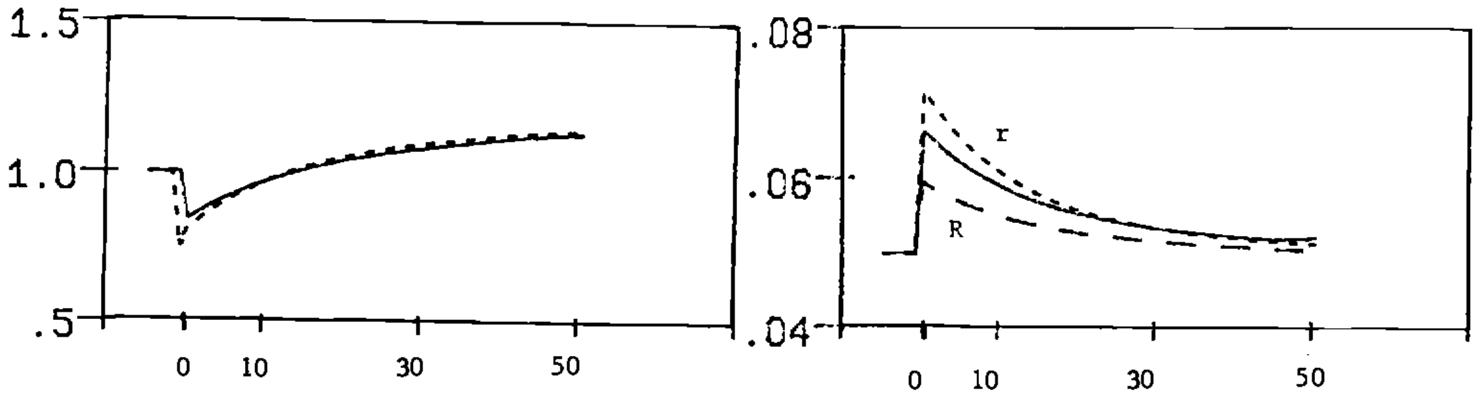


Figure 14 (ψ=0)

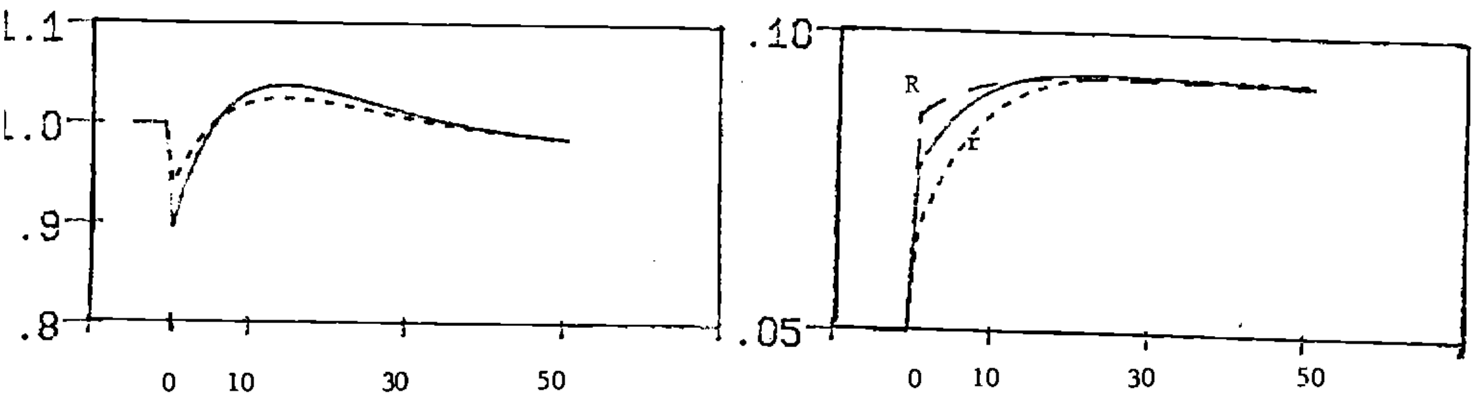


Figure 15 (ψ=0.2)

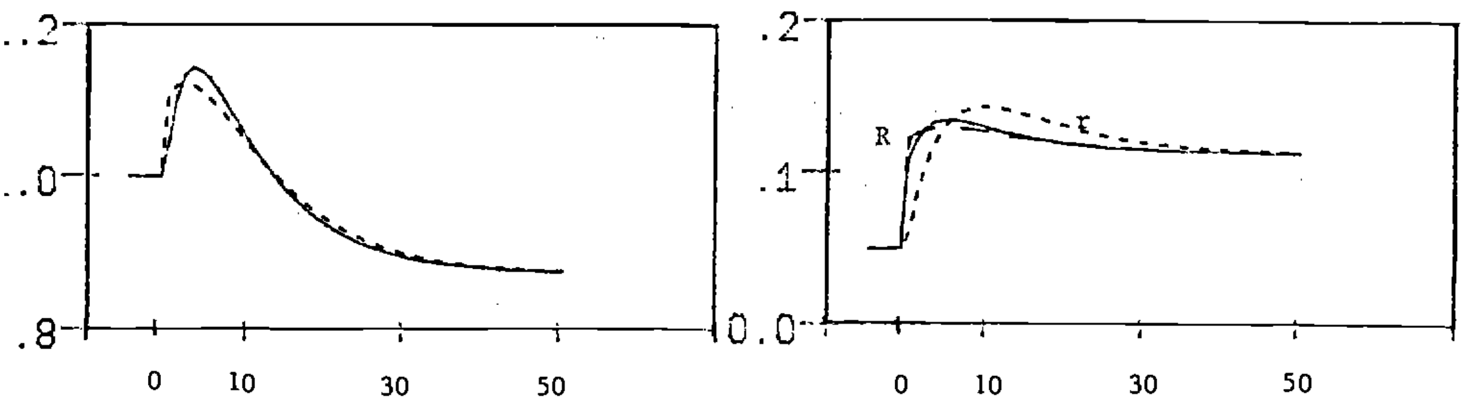


Figure 16 (ψ=2)

and maintain goods market equilibrium. In the case of Figure 16, the long-term rate increase leads to a larger jump depreciation.

7. Conclusion

The broad result which stands out from this analysis is that the behavior of the exchange rate, both on impact and in the long run, is ambiguous. The oft-cited benchmark case of a jump appreciation and a long run depreciation, is far from general. It is not robust to varying assumptions about the degree of asset substitutability or to the composition of government spending. It also appears that initial conditions, characterized by the initial size of the public debt or the net external position, play a significant role. Two countries, with an otherwise identical structure, can react differently to fiscal policy because of past history!

Several issues remain, of course, concerning the robustness of the results presented here. They rely on standard components of macroeconomic models which, we believe, are not particularly controversial. The questions, therefore, center around the many simplifying assumptions that have been made to allow for analytical tractability (for instance, the assumption that price flexibility ensures a fixed output). Variable output may well affect the determination of the real exchange rate, though at this stage, we have few general results to offer on this point. Also at issue is our treatment of monetary policy. There are many ways to describe "constant monetary policy," some more appealing than the case of a constant nominal money stock. Finally, we have no capital accumulation in our model. An investment function would introduce some new, potentially complicating features: domestic wealth would differ from our definition, the marginal productivity of capital would be driven in the long run to a level consistent with the real interest rate, thus making the full-employment output level endogenous.

Footnotes

1. This equation can be derived as follows. Consider a Tobin portfolio model: $\lambda b^* = B^*(r^* + \lambda/\dot{\lambda} - r)w$, with $B^{*\prime} > 0$ and $b = B(r^* + \dot{\lambda}/\lambda - r)w$, with $B' < 0$. Taking the ratio and linearizing we obtain the equation in the text.

2. More generally and more realistically, μ can be set to vary over time.

3. The reason is that r changes as a function of all three variables λ, b and b^*. With (11), as long as $b_0 \neq 0$, this brings about changes in g, and therefore in $T = \tilde{y} - c - g$, thus affecting the current account equation (6). With (8) or (9), (1) implies that c, and therefore T, is only a function of λ, as is shown in section 3. Note, however, that there are alternative policy regimes compatible with (5) and (8). For example, a government spending expansion can be represented as $g = \mu\bar{b} - (\mu + r^*)b$ and $\tau = b_0 r$, instead of (11). In this case the transition matrix is as in (12) and (13).

4. The equations of these schedules are:

(CA): $\alpha\lambda + (1-m)r^*w + (m-m^G)\Delta = 0$

(GG): $\alpha\lambda + (1-m)(\delta+\Phi\theta\psi)w + [(m-m^G) + s(1-m)]\Delta = 0$

5. The formal result is: $\bar{\lambda} = (\Delta/\alpha)[-(m-m^G) + (1-m)sr^*/(\delta+\Phi\theta\psi-r^*)]$

$\bar{w} = -s\Delta/(\delta+\Phi\theta\psi-r^*)$, and

$\bar{b}^* = -(\Delta/\alpha)[s(\alpha + (1-m)r^*b_0^*)/(\delta + \Phi\theta\psi-r^*) - (m-m^G)b_0^*]$.

This result can be understood as follows. With an excess demand in the goods market, a drop in wealth from point A to point A' provides the required adjustment. But as it implies a reduction in λb^*, interest earnings are reduced, prompting a current account deficit. This is corrected by a depreciation, and a further reduction in wealth to maintain goods market equilibrium, as we move along G_1G_1 from A' to B.

6. The equation of the schedules in this case are:

(CA) $\alpha\lambda + (1-m)r^*(\lambda b^*) = 0$

(GG) $\alpha\lambda + (1-m)(\delta+\Phi\theta\psi)(\lambda b^*) + \bar{b}[\delta - (1-s)r^* - \Phi\psi(1-\theta)] = 0$

7. The steady state solution is:

$\bar{\lambda} = r^*\bar{b}(1-m)[\delta-(1-s)r^*-\Phi\psi(1-\theta)]/\alpha(\delta+\Phi\theta\psi-r^*)$

$\bar{\lambda}\bar{b}^* = -\bar{b}[\delta-(1-s)r^*-\Phi\psi(1-\theta)]/\alpha(\delta+\Phi\theta\psi-r^*)$

$\bar{b}^* = -\bar{b}[1+(1-m)r^*b_0^*/\alpha][\delta-(1-s)r^*-\Phi\psi(1-\theta)]/(\delta+\Phi\theta\psi-r^*)$

8. We do not consider the case where b_0^* is negative and sufficiently large, in absolute value, to lead to an increase in $\bar{b}^*$ when the exchange rate depreciates. This case obtains when a devaluation worsens the current account because it aggravates interest payments on the external debt by more than it improves the trade balance.

9. The role of perfect foresight is seen by considering the polar case of static expectations when $\dot{\lambda} = 0$: more appreciation is required, as r either does not change at all under perfect substitutability, or increases by less otherwise, so that most of the crowding out is achieved at the expense of foreign demand. This is seen graphically as a jump to B' on the $\dot{\lambda} = 0$ schedule.

10. With static expectations, there is no need for a change in λ on impact as the interest rate stays constant: the economy remains in point A on the $\dot{\lambda} = 0$ schedule.

11. Applying the method proposed by Dixit (1980), it can be shown that the initial exchange rate change is, for $b_0^* = 0$:

$$\lambda(0) - \lambda_0 = (\Delta/\alpha)[m^G - m + \frac{ss_2(1-m)}{\delta+\Phi\theta\psi-r^*}]$$

where s_2 is the negative eigenvalue of (12).

12. They satisfy the condition:

$$s_1 + s_2 = \alpha/\Phi(1-m) + r^* + b_0^*(\delta/\Phi+\theta\psi)$$

If b^* is not too negative, we see that $s_1 > r^*$, $s_2 < 0 < r^*$.

13. From footnote 7, the condition for a long run appreciation is $\Phi(1-\theta)\psi > \delta - (1-s)r^*$. From (19), the condition for a jump depreciation is $\Phi(1-\theta)\psi > \delta - (1-s)r^* + (1-s)s_1$. Note the difference with the balanced budget case of Section 4, where (see Figure 8) a high ψ cannot alone bring about a short-run depreciation. The reason is that b does not change, so that we then miss the portfolio balance effect at work in the tax cut case.

14. This was pointed out to us by Rudi Dornbusch.

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