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Real Exchange Rate Targeting Under Imperfect Asset Substitutability

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Abstract

This paper presents a model of an economy that uses nominal exchange rate policy to keep the real exchange rate constant at a certain target level, under imperfect asset substitutability. The paper discusses the determinants of inflation under such a policy, and examines the consequences of exogenous and policy-induced shocks on inflation, the external accounts, and the fiscal accounts. The shocks considered include changes in the real exchange rate target, changes in fiscal policy, changes in foreign interest rates, and open market sales of public sector domestic bonds.

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Summary

This paper presents a model of an economy that uses nominal exchange rate policy to keep the real exchange rate constant at a certain target level, under the assumption that domestic and foreign assets are imperfect substitutes. The paper discusses the determinants of inflation under such a policy and examines the consequences of exogenous and policy-induced shocks on inflation, the external accounts, and the fiscal accounts.

The paper concludes that under real exchange rate targeting, there seems to be a trade-off between external trade performance and inflation. The more ambitious the external trade objectives, and thus the more depreciated the real exchange rate target, the higher the resulting rate of inflation.

How fiscal tightening affects inflation depends on the instrument that is used. An increase in taxes or a reduction in public sector expenditure on nontraded goods would reduce inflation in both the short run and the long run. A reduction in public sector expenditure on traded goods, on the other hand, would have no effect on inflation. The consequences of fiscal tightening for the trade balance are also instrument specific. While reducing public sector expenditure on traded goods would improve the trade balance by the same amount, increasing taxes would have no effect on the trade balance as private sector expenditure would remain constant due to reduced inflation tax payments. Furthermore, a reduction in public sector expenditure on nontraded goods would cause the trade balance to worsen; the decline in inflation tax payments would cause private expenditure to rise by more than the reduction in public expenditure.

The model indicates that high domestic interest rates brought about by open market sales of domestic bonds can be effectively used to contain inflation, but only in the short term. Eventually, private sector demand will expand owing to increased real interest receipts on private sector holdings of domestic bonds, thereby generating higher inflation.

This pattern also has implications for designing a response to exogenous changes in world financial markets. For example, a fall in foreign interest rates in the absence of a policy response would induce capital inflows, a decline in domestic interest rates, and higher inflation in the short run. Eventually, however, lower real interest receipts by the private sector would lead to lower private expenditure and, in turn, to lower inflation. If the monetary expansion resulting from the capital inflows were sterilized by sales of domestic bonds, the authorities would be able to contain the initial increase in inflation but would forfeit (at least part of) the fall in inflation that would follow if sterilization did not occur.

I. Introduction

A number of countries have adopted active exchange rate policies in order to prevent high domestic inflation from eroding their international competitiveness. In many cases, the domestic currency is continuously depreciated by the difference between domestic and foreign inflations so as to keep the real exchange rate constant at some target level. This policy raises a number of macroeconomic issues that are receiving increasing attention in the literature. For example, there is the question of whether any arbitrary real exchange rate target can be attained by this policy. Also, since both the exchange rate and the money supply become endogenous under such regimes, it is unclear how inflation is determined and how it responds to exogenous and policy-induced shocks.

Some of these issues were discussed recently in Lizondo (1991) in the context of a model with domestic and foreign non-interest-bearing financial assets, in which domestic inflation and the real exchange rate are associated through the inflation tax. 1/ The paper argues that the real exchange rate is a relative price that adjusts to ensure equilibrium in the nontraded goods market, and that inflation tax payments affect private sector demand in that market. The higher the inflation tax payments, the lower the private sector demand for nontraded goods, and thus the higher the real exchange rate that equilibrates the nontraded goods market. 2/ In this model, therefore, the long run rate of inflation is determined by the condition that inflation tax payments generate a level of private sector demand that is consistent with equilibrium in the nontraded goods market at the targeted real exchange rate. Two significant corollaries follow from this basic result. First, attaining a more depreciated real exchange rate target requires higher inflation tax payments, which implies a higher rate of inflation as long as the elasticity of the demand for money is below unity. 3/ And second, the range of sustainable real exchange rate targets is determined by the range of feasible inflation tax payments. The maximum sustainable real exchange rate is the one associated with the maximum inflation tax payment that can be obtained from the given demand for money.

1/ Previous papers have discussed related issues within different theoretical frameworks. Dornbusch (1982) examines the effect of nominal exchange rate rules on the trade-off between output stability and price level stability in a model defined in terms of deviations from trends. Adams and Gros (1986) assume an exogenously given long run real exchange rate and discuss the inflationary consequences of purchasing power parity rules for the nominal exchange rate.

2/ The real exchange rate is defined as the relative price of traded to nontraded goods, so that an increase in the real exchange rate indicates a real depreciation.

3/ Lizondo (1991) allows for a demand for money with elasticity above unity over a certain range and examines the implications of this assumption. Keeping with the usual practice in papers on this subject, however, the discussion here will focus on the inelastic section of the demand for money.

The discussion on these issues was extended by Montiel and Ostry (1991) in the context of a more complex model that includes perfect substitutes interest-bearing domestic and foreign financial assets under perfect capital mobility. The authors show that the basic results mentioned above hold in their model, and examine the consequences of various macroeconomic shocks, distinguishing between the impact effect on the price level and the effect on the rate of inflation. Since the price level and the rate of inflation must be consistent with equilibrium in the nontraded goods market, any given shock to the economy affects these variables only to the extent that it disturbs the initial equilibrium in this market. In essence, the price level and the rate of inflation respond so as to offset the original impact of the shock on the nontraded goods market, thereby maintaining continuous equilibrium in this market at the targeted real exchange rate.

Thus, for example, an increase in public sector expenditure on nontraded goods creates an excess demand for these goods, and results in an immediate increase in the price level and an increase in the rate of inflation. The immediate increase in the price level reduces private sector wealth, which reduces private sector demand for nontraded goods, thus restoring equilibrium in this market at the targeted real exchange rate instantaneously. The increase in the rate of inflation increases inflation tax payments, which keeps private sector wealth and thus private demand for nontraded goods at their new lower equilibrium levels. The paper also shows that an increase in world real interest rates leads to a fall in the price level and a subsequent increase in the rate of inflation. The effects of changes in the terms of trade and import tariffs depend on whether the authorities target the *importables* or the *exportables* real exchange rate.

The authors also examine the effectiveness of tight credit policy in reducing inflation. They conclude that under real exchange rate targeting and perfect capital mobility any attempt at controlling the money supply by tightening domestic credit is immediately offset by additional capital inflows, so that the money supply cannot be used as an anchor for the price level. The authors continue the discussion of this subject in Montiel and Ostry (1992), where they explore whether using capital controls can restore some effectiveness to tight credit policy in reducing inflation. Capital controls are modelled as a dual exchange rate system with an official exchange rate subject to targeting (which applies to non-interest current transactions) and a parallel exchange rate that floats freely (which applies to all other transactions). As long as capital controls are effective in preventing leakages between the markets, the authorities regain control of the money supply and tight credit policy can be used to contain inflation. However, the spread between the official and the parallel exchange rates would increase continuously. Under these conditions, the effectiveness of capital controls in preventing leakages is likely to be eroded, thus making it impossible for the authorities to simultaneously target the real exchange rate and keep control of the money supply for a long period of time.

The assumption of perfect asset substitutability coupled with perfect capital mobility, or a dual exchange rate that floats freely, is not well

suited for examining some cases of real exchange rate targeting. Some countries have implemented this exchange rate policy under basically unified foreign exchange markets, and have been able to influence domestic interest rates by altering domestic credit conditions. In these cases, it seems more appropriate to treat domestic and foreign financial assets as imperfect substitutes. This raises the issue of whether the conclusions derived for the case of perfect asset substitutability continue to hold when assets are imperfect substitutes. Furthermore, since imperfect substitutability allows the authorities to have some control over domestic interest rates, there is the question of whether a policy of high domestic real interest rates could be effective in containing inflation.

This paper presents a model of real exchange rate targeting under the assumptions of a unified foreign exchange market and imperfect asset substitutability. The paper shows that introducing imperfect asset substitutability does not alter the conclusions mentioned above regarding the basic determinants of inflation, and the response of the price level and inflation to various shocks, including changes in the real exchange rate target, changes in public sector expenditure on nontraded goods, and changes in world real interest rates. The paper also examines an increase in taxes, which results in an immediate fall in the price level and a decline in the rate of inflation, and an increase in public sector expenditure on traded goods, which have no effect on either the price level or the rate of inflation. 1/ In addition, the paper shows that an increase in the domestic real interest rate results in an immediate fall in the price level and an increase in the rate of inflation. The paper also discusses in some detail the determinants of the external accounts under real exchange rate targeting. In particular, it shows that a given fiscal tightening may have different consequences for the external accounts depending on the specific instruments that are used to implement such tightening.

Section II presents the model, which is based on Montiel and Ostry (1991). Section III examines the consequences of some exogenous and policy-induced shocks on the price level, inflation, the external accounts, and the fiscal accounts. Section IV contains some concluding remarks. An appendix at the end of the paper presents a formal derivation of the various results.

II. The Model

The model presented below includes a private sector that produces and consumes traded and nontraded goods, pays taxes, and allocates its wealth among domestic money, foreign bonds, and domestic government bonds. There is no investment. The government consumes traded and nontraded goods, collects taxes, issues domestic bonds, borrows from the central bank, and borrows abroad. The central bank lends to the government, and manages the

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1/ Since the public sector is subject to an intertemporal budget constraint, these policies may need to be accompanied by a future fiscal adjustment that ensures solvency, as explained below.

nominal exchange rate so as to keep the real exchange rate constant at a given target level.

1. Production

Prices and wages are perfectly flexible so that full employment always prevails. 1/ Production takes place along a concave transformation curve with

$$(1) \qquad y_t = y_t(e) \quad y_t' > 0,$$

$$y_n = y_n(e) \quad y_n' < 0$$

where y_t is output of traded goods, y_n is output of nontraded goods, and e is the real exchange rate defined as (P_t/P_n). 2/

2. Consumption

Private sector total consumption is given by

$$(2) \qquad c = c(y-t;r;w),\ 0<c_1<1,\ c_2<0,\ c_3>0$$

where c denotes total consumption in real terms, y real factor income, t taxes in real terms, r the domestic real interest rate, and w private sector financial wealth in real terms. 3/ Private sector preferences are such that a constant share of total private expenditure is devoted to each type of good. 4/ Denoting the share devoted to nontraded goods by θ and defining the price level as $P=P_t^{1-\theta}P_n^{\theta}$, we have

$$(3) \qquad c_t = (1-\theta)\ e^{-\theta}\ c$$

$$(4) \qquad c_n = \theta\ e^{1-\theta}\ c$$

where c_t denotes consumption of traded goods, c_n consumption of nontraded goods, and $e^{-\theta}=(P/P_t)$ and $e^{1-\theta}=(P/P_n)$.

1/ This formulation of the production structure abstracts from any influence that real exchange rate targeting may have on employment and thus on aggregate supply. Therefore, the model focuses primarily on the effects that operate through the demand side of the economy.

2/ Importables and exportables are aggregated into traded goods by assuming free trade and constant terms of trade.

3/ For simplicity, real factor income y will be treated as constant throughout the paper. If the real exchange rate is kept fixed, y is effectively constant so that no additional assumption is needed. However, if the real exchange rate changes, we need to assume that $(y_t/c_t)=(y_n/c_n)$ at the initial equilibrium.

4/ In the context of an optimizing model this would be consistent with a Cobb-Douglas utility function.

3. Private sector portfolio

The private sector allocates its financial wealth among three assets: non-interest bearing domestic money M, foreign bonds F, and domestic government bonds b that are indexed to the price level. 1/ Denoting the exchange rate by S,

(5) $w = (M/P) + F\,(S/P) + b = m + f + b$

Private sector portfolio preferences are given by

(6) $m = L(r+\pi;\ y) \quad L_1<0,\ L_2>0$

(7) $b = b(r;r^*;w) \quad b_1>(-L_1)>0,\ b_2<0,\ 0<b_3<1$

where π is the domestic rate of inflation, r is the real interest rate on domestic bonds, and r^* is the real interest rate on foreign bonds. 2/ Thus, the demand for money is assumed to depend negatively on the domestic nominal interest rate and positively on real factor income, while the demand for domestic bonds is assumed to depend positively on its own real interest rate and on financial wealth, and negatively on the real interest rate on foreign assets. The demand for foreign bonds can be derived from the wealth constraint (5) and the demand for the other two assets (6) and (7). 3/

The accumulation of private sector financial wealth is equal to the difference between its income (including factor income and interest earnings on its holdings of domestic and foreign bonds) and its expenditure on consumption, tax payments, and inflation tax "payments". This can be expressed as

(8) $\dot{w} = [y-t-c(y-t;r;w)] + r^*w + (r-r^*)b-(r^*+\pi)L(r+\pi;y)$

which can be rewritten as

(9) $\dot{w} = h(y;t;r;r^*;w;b;\pi),\ h_1\gtrless 0,\ h_2<0,\ h_3>0,\ h_4>0,\ h_5<0,\ h_6>0,\ h_7<0$

1/ Assuming non-indexed bonds would not affect the conclusions.

2/ For a constant real exchange rate, the real interest rate on foreign bonds is equal to the foreign currency interest rate on foreign bonds minus the rate of change of the foreign currency price of traded goods. Assuming that the price of traded goods is constant in terms of foreign currency, r^* can be interpreted as both the real interest rate on foreign bonds and the foreign currency interest rate on foreign bonds.

3/ Thus the demand for f depends positively on w, r^*, and π, and negatively on r and y.

where the sign of some of the partial derivatives require additional assumptions. 1/

4. Public sector

In presenting the public sector, the accounts of the central bank are consolidated with those of the government. For simplicity, the model abstracts from the rest of the financial system, so that the entire stock of money is a liability of the central bank, and assumes that the central bank extends credit only to the government. 2/ Thus, once the accounts are consolidated, the public sector has the stock of international reserves as an asset and the stock of money as a liability.

Therefore, the public sector collects taxes t, buys g_t units of traded goods and g_n units of nontraded goods, and issues domestic bonds b (paying real interest rate r), foreign currency bonds (net of international reserves) B^* (paying real interest rate r^*), and money m. Defining $b^*=B^*(S/P)$, and choosing units so that the foreign currency price of traded goods is unity, and thus $P_t=S$, the public sector budget constraint is

$$(10) \qquad \dot{m} + \dot{b} + \dot{b}^* = (e^{\theta-1}g_n + e^{\theta}g_t - t) + rb + r^*b^* - \pi m$$

Thus, the public sector operational deficit is financed by issuing domestic debt $\dot{b}$, foreign debt $\dot{b}^*$, by an increase in the real stock of domestic money $\dot{m}$, and by the inflation tax πm. 3/

Fiscal policy is subject to an intertemporal budget constraint that ensures solvency. Expression (10), which describes the evolution of public sector net liabilities through time, must converge to zero in order to rule out the possibility that either the public sector's or the rest of the world's net worth be negative in the long run.

Although the discussion below notes the fiscal consequences of various policies and exogenous shocks, it does not focus on the implications for public sector solvency. Implicitly, the discussion assumes that solvency is ensured by an appropriate future adjustment in public sector expenditure on

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1/ Thus, $h_5<0$ assumes $c_3>r^*$, $h_6>0$ assumes $r>r^*$, and $h_7<0$ holds under the assumption that the elasticity of the demand for money is below unity.

2/ If the central bank lends to the private sector (and charges a real interest rate r) the analysis below is unaltered, with b denoting public sector domestic bonds net of central bank credit to the private sector.

3/ The "operational" deficit includes non-interest payments and receipts, and the real interest component of interest payments and receipts. Thus, it is equal to $(e^{\theta-1}g_n + e^{\theta}g_t - t) + rb + r^*b^*$.

traded goods. 1/ This allows us to derive the long run behavior of inflation by focusing only on current variables. If solvency were to be achieved by a future fiscal adjustment based on some other policy, the rate of inflation would be affected following the future adjustment, as can be appreciated from the discussion in section III below. 2/ Notice also that in the absence of an appropriate future fiscal adjustment that ensures solvency real exchange rate targeting becomes unsustainable, since public sector net liabilities would increase (or decline) without bound under existing policies. These caveats should be kept in mind when interpreting the "long run" effect on inflation of the various policies and exogenous shocks examined below.

5. Nontraded goods market

It is assumed that the nontraded goods market is always in equilibrium, which requires that the supply be equal to the sum of private sector plus public sector demand, i.e.,

$$(11) \qquad y_n(e) = \theta\, e^{1-\theta}\, c(y-t;r;w) + g_n$$

Other things constant, a real depreciation, an increase in wealth, or an increase in public sector expenditure on nontraded goods, generate an excess demand for nontraded goods, while an increase in taxes or an increase in the real interest rate, generate an excess supply of nontraded goods.

6. The external sector

The trade balance, measured in foreign currency terms and denoted by T, is equal to the supply of traded goods minus the demand for traded goods by both the private sector and the public sector.

$$(12) \qquad T = y_t(e) - (1-\theta)\, e^{-\theta}\, c(y-t;r;w) - g_t$$

Thus, other things constant, the trade balance improves with a real depreciation, with an increase in taxes, and with an increase in the real interest rate, and worsens with an increase in wealth and with an increase public sector expenditure on traded goods.

1/ Clearly, the adjustment in public sector expenditure on traded goods that ensures solvency could also take place in the present. However, we prefer to set the problem in terms of a future adjustment so as to separate clearly the effect of a current policy or exogenous shock from the effect of the corrective measures that will be needed to ensure solvency.

2/ In an optimizing intertemporal model, the policy composition and the timing of the fiscal adjustment would have implications not only for the long run rate of inflation but also for private sector current behavior.

The current account of the balance of payments, denoted by CA, is given by the trade balance plus interest receipts on private sector net foreign assets and minus interest payments on public sector net foreign debt.

$$(13) \qquad CA = y_t(e) - (1-\theta)\, e^{-\theta}\, c(y-t;r;w) - g_t + r^* (F-B^*)$$

7. Equilibrium

In this model the steady state is reached immediately. At any point in time, given the exogenous variables (y and r^*) and the policy variables (e, t, g_n, g_t, and b), w and r are determined simultaneously by the conditions for equilibrium in the markets for domestic bonds (7) and for nontraded goods (11). 1/ Since (7) and (11) contain no additional endogenous variable, the solution thus obtained is the steady state solution. Since π is the only remaining endogenous variable in (9), and w is constant, the rate of inflation is determined by setting $\dot{w}=0$ in (9). Once w, r and π are known, (6) can be used to determine m, and then (5) to determine f.

When examining the consequences of various shocks in the next section, it is important to distinguish between the impact effect on the price level and the effect on inflation. The effect on inflation is obtained from equations (7), (11), and (9), as described in the previous paragraph. However, any shock that modifies the equilibrium value of w also produces an immediate jump in the price level that brings about the required change in w. From equation (5), since M, F and b are predetermined, w can change only as a result of changes in P and/or (S/P). For any shock other than a change in the real exchange rate target, (S/P) is fixed and thus P changes to bring about the necessary change in w. In contrast, when the real exchange rate target is modified, both (S/P) and P change; (S/P) changes according to the modification in the target, and P changes to bring about the necessary adjustment in w.

III. Exogenous and Policy-induced Shocks

This section discusses the effects of various shocks on the price level, inflation and other endogenous variables. The evolution of some of the variables is depicted in figures 1-3. The left panel shows equations (7) and (11) represented by curves bb and nn respectively, while the right panel shows the evolution of the price level through time. As mentioned previously, a formal derivation of the results is presented in the Appendix.

1/ The assumption that b is a policy variable implies that the public sector decides how much domestic debt to place in the market. Since at each point in time total net liabilities of the public sector are given, and the stock of money is demand determined by the private sector, the stock of public sector net foreign debt is an endogenous variable.

1. Choosing a more depreciated real exchange rate target

Choosing a more depreciated real exchange rate target implies that the authorities implement an initial devaluation large enough to move the real exchange rate to its new target level, and then keep depreciating the domestic currency on a continuous basis so as to offset the effect of domestic inflation. Below there is first a description of the effects of this policy, and then an interpretation of those effects. 1/

A more depreciated real exchange rate, all other things constant, generates an excess demand in the market for nontraded goods as supply declines and private sector demand increases. Equilibrium is restored by a drop in wealth and an increase in the domestic interest rate that reduce private sector demand, thus bringing total demand for nontraded goods to a level consistent with supply at the new real exchange rate. In terms of figure 1, a more depreciated real exchange rate shifts the nn curve to the left, thus resulting in a lower w and a higher r. From (9), both the increase in r and the decline in w create an incipient accumulation of wealth, which is offset in equilibrium by an increase in the inflation rate (so as to restore $\dot{w}=0$). On impact, the price level jumps upwards and the nominal exchange rate undergoes an even larger devaluation so as to produce the real depreciation sought by the new policy. 2/

Although the impact effect takes place simultaneously for all the variables, it is possible to tell a "sequential story" as follows. In order to obtain a more depreciated real exchange rate, the central bank devalues the domestic currency. This creates an excess demand in the nontraded goods market, so the price of nontraded goods increases. This increase, together with the devaluation, imply an upward jump in the price level that reduces real wealth. With a lower real wealth, however, the demand for domestic bonds declines, inducing an increase in the domestic interest rate that restores equilibrium in the bonds market. Both the reduction in wealth and the increase in the domestic interest rate contain the excess demand for nontraded goods. This ensures that the increase in the price of nontraded goods required to restore equilibrium in the nontraded goods market is proportionally lower than the nominal devaluation. Thus, the new equilibrium is consistent with a real depreciation of the domestic currency.

1/ This sequence for the presentation also applies to the discussion of the other shocks below.

2/ Choosing a more depreciated real exchange rate target requires on impact a higher (S/P) and a lower w, which according to (5) can only be obtained by an upward jump in the price level and a proportionally higher upward jump in the exchange rate.

After the impact effect, private wealth tends to increase from its new level. 1/ This incipient increase in private sector wealth generates an incipient increase in consumption (including on nontraded goods) that tends to appreciate the real exchange rate. As the central bank accelerates the rate of nominal devaluation to avoid the real appreciation, inflation increases. In equilibrium, the new rate of inflation has to be high enough to produce the inflation tax necessary to prevent the accumulation of wealth, and thus prevent real demand for nontraded goods from increasing.

Regarding the external sector, the real depreciation improves the trade balance and the current account due to the increase in supply and the fall in private sector demand for traded goods. 2/ The impact effect on private capital flows is ambiguous. 3/ Private sector demand for foreign assets declines due to the lower level of wealth and the higher domestic real *interest rate, but increases due to the higher inflation rate.* 4/

The effect of a more depreciated real exchange rate on the public sector operational deficit is ambiguous. The real value of public sector expenditure can go either way depending on its composition between traded and nontraded goods. Real interest payments on domestic debt increase due to the higher domestic interest rate, while real interest payments on net

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1/ The tendency for wealth to increase from its new (lower) level, before any change in the rate of inflation, can be interpreted in terms of equation (8). It is necessary to look at the effects of changes in r and w on $\dot{w}$, for a constant π. Notice first that private sector consumption declines due to the increase in r and the fall of w on impact, and that the demand for money declines due to the increase in r. Thus (for a given rate of inflation) wealth tends to <u>increase</u> due to: (i) a decline in consumption (the term in square brackets increases); (ii) the higher interest receipts on domestic debt due to the higher interest rate (the term $(r-r^*)b$ increases); and (iii) the gain in income that the private sector obtains by reducing its money holdings and allocating those resources to foreign assets (the term $(r^*+\pi)L(r+\pi;y)$ declines). Wealth tends to <u>decline</u> due to the loss of foreign interest receipts that results from the (impact) decline in wealth (the term r^*w declines). The net effect on $\dot{w}$ of all these changes is positive, so inflation has to increase to compensate for this (to keep $\dot{w}=0$), as shown in the Appendix. This type of reasoning can be applied also when discussing the other shocks in order to see whether wealth tends to increase or decline after impact. However, the explanation for the other shocks is not included in the paper as it would be rather cumbersome and tedious.

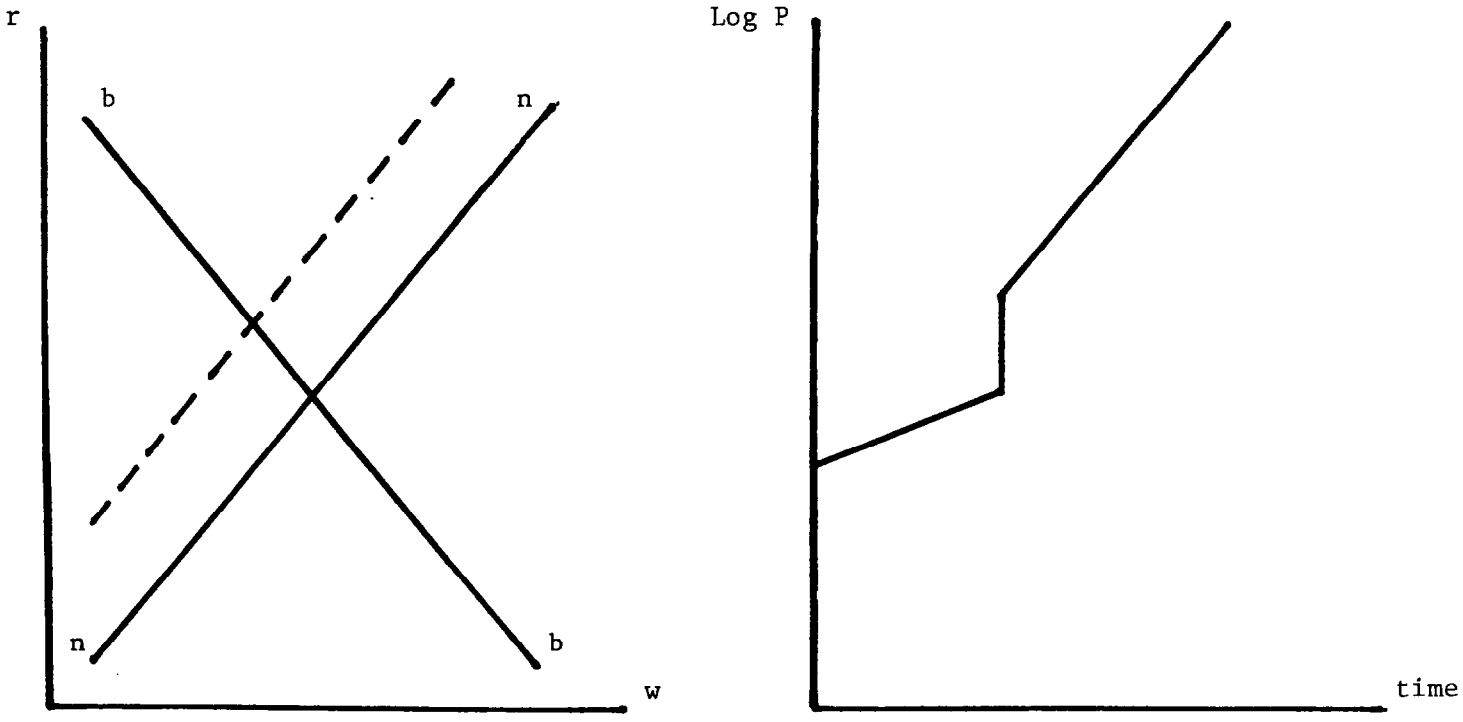
2/ Unless there is a change in the foreign interest rate, any given shock has the same effect on the trade balance and on the current account.

3/ In the steady state private capital flows are zero (f is constant) and, therefore, policies can have only an impact effect on those flows.

4/ This can be looked also in terms of the wealth constraint (5). The level of wealth falls, but the demand for money also falls and the stock of domestic bonds is constant. So the effect on foreign asset holdings is undetermined.

Figure 1

A More Depreciated Real Exchange Rate Target
An Increase in Public Sector Expenditure on Nontraded Goods



foreign liabilities may increase or decline. Interest payments on foreign liabilities are denominated in foreign currency, and thus they increase in real terms, for a given level of net foreign liabilities. However, the level of net foreign liabilities itself may increase or decline depending on whether there is a private sector capital outflow or inflow on impact.

2. An increase in taxes

An increase in taxes, other things constant, reduces private sector demand and thus generates an incipient excess supply of nontraded goods. This is offset by an increase in wealth and a reduction in the domestic real interest rate that brings private sector demand back to its initial level, thereby restoring equilibrium in the nontraded goods market at the given real exchange rate. In terms of figure 2, the increase in taxes shifts curve nn to the right, resulting in a higher w and a lower r. The price level drops on impact, followed by a lower-than-before rate of inflation.

The "sequential story" in this case is as follows. On impact, the increase in taxes creates an excess supply of nontraded goods, so the price of nontraded goods declines. To prevent this from resulting in a real depreciation, the central bank revalues the domestic currency by the same percentage, so the price level falls on impact at a constant relative price. The drop in the price level implies a higher level of wealth, which increases the demand for domestic bonds and thus causes a decline in the domestic real interest rate. Both the increase in real wealth and the decline in the domestic real interest rate offset the initial impact of higher taxes on private demand, and thus eliminates the initial excess supply of nontraded goods.

After the impact effect, wealth tends to decline from its new level, producing an incipient reduction in private expenditure that would depreciate the real exchange rate. This is prevented by the central bank slowing down the rate of nominal devaluation, thus generating a lower rate of inflation and lower inflation tax payments than before.

The trade balance and the current account are not affected by the increase in taxes because, as mentioned above, the increase in wealth and the decline in the domestic real interest rate keep private sector demand at the same level as before. The impact effect on private capital flows is ambiguous as private sector demand for foreign assets increases due to the lower domestic real interest rate and the higher level of wealth but declines due to the lower rate of inflation. 1/

The public sector operational deficit declines with the increase in taxes. The direct effect of higher taxes and the effect of lower real

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1/ In terms of the wealth constraint, the level of wealth increases, but the demand for money also increases and the stock of domestic bonds is constant. So the effect on foreign asset holdings is undetermined.

interest payments on domestic debt more than offset any higher interest payments on public net foreign debt that might be originated from a private capital outflow that takes place on impact.

3. An increase in public sector expenditure

The consequences of a given change in public sector expenditure depend on whether it involves traded or nontraded goods. An increase in public sector expenditure on traded goods has no effect on either the market for domestic bonds or the market for nontraded goods, and thus has no effect on prices. The only effect of this policy is to worsen the trade balance, the current account, and the public sector operational deficit by the same amount as the increase in expenditure.

In contrast, an increase in public sector expenditure on nontraded goods, other things constant, generates an incipient excess demand for nontraded goods. This is offset by a reduction in private sector demand that is brought about by a fall in wealth and an increase in the domestic real interest rate. The situation is depicted in figure 1; curve nn shifts to the left, resulting in a lower w and a higher r. The price level increases on impact, followed by a higher-than-before rate of inflation.

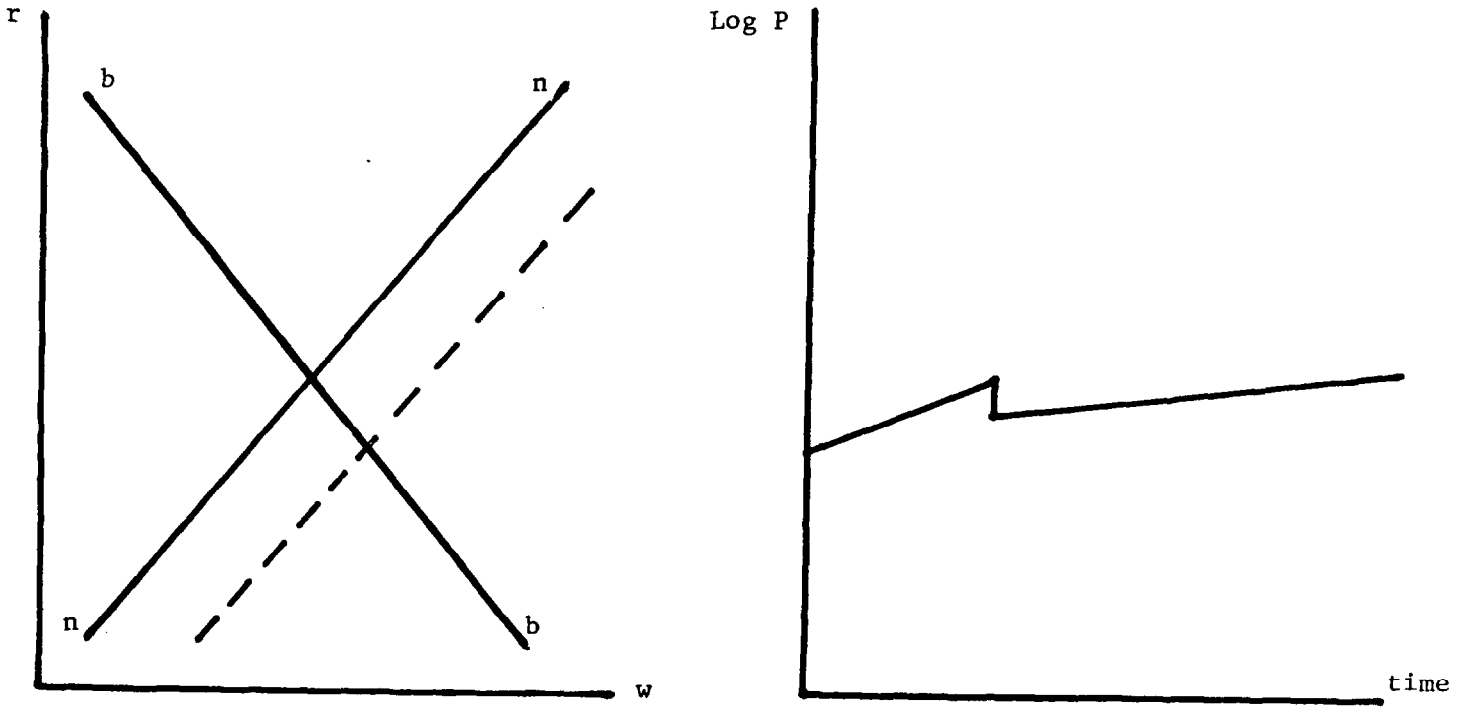
The "sequence" on impact is as follows. The increase in public sector expenditure on nontraded goods creates an excess demand in this market, so the price of nontraded goods rises. To prevent a real appreciation the central bank devalues the domestic currency, which results in an upward jump in the price level at a constant relative price. The upward jump in the price level reduces real wealth, thereby diminishing the demand for domestic bonds and thus causing an increase in the domestic real interest rate. The decline in real wealth together with the increase in the domestic real interest rate reduce private sector demand for nontraded goods by an amount equal to the increase in public sector demand, and thus restore equilibrium in the nontraded goods market at the original real exchange rate.

After impact, wealth tends to increase, thus inducing an incipient increase in private expenditure that tends to appreciate the real exchange rate. The central bank prevents this real appreciation by increasing the speed of nominal devaluations, thus generating a higher rate of inflation and higher inflation tax payments than before.

An increase in public sector expenditure on nontraded goods improves the trade balance and the current account due to the reduction in private

Figure 2

An Increase in Taxes



sector demand for traded goods. 1/ The impact effect on private capital flows is ambiguous. Private sector demand for foreign assets declines due to the lower level of wealth and the higher domestic real interest rate, but increases due to the higher inflation rate. 2/

The public sector operational deficit increases with the increase in public sector expenditure on nontraded goods. The direct effect of increased expenditure and the effect of higher interest payments on domestic debt more than offset any reduction in interest payments on public net foreign debt that might be caused by a private capital inflow that takes place on impact. 3/

4. An increase in foreign interest rates

An increase in foreign interest rates, other things constant, reduces the demand for domestic bonds thus generating an incipient excess supply in this market. This is offset by an increase in wealth and an increase in the domestic real interest rate. In terms of figure 3, the increase in the foreign interest rate shifts the bb curve to the right, resulting in a higher w and a higher r. The price level falls on impact, followed by a higher-than-before rate of inflation.

The "sequential story" is as follows. On impact, the increase in the foreign interest rate generates an excess supply in the market for domestic bonds causing an increase in the real domestic interest rate. This induces a reduction in private sector expenditure that leads to an incipient real depreciation. To prevent the real depreciation from taking place, the central bank revalues the domestic currency, causing a drop in the price level at a constant relative price, and thus increasing real wealth. The effects of a higher real wealth and a higher domestic real interest rate on

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1/ This counter-intuitive result can be explained also in terms of a decline in aggregate spending (private sector expenditure declines by more than public sector expenditure increases). Private sector expenditure on nontraded goods must decline by the same amount that public sector expenditure on nontraded goods increases so as to keep equilibrium in this market at an unchanged real exchange rate. However, since the private sector is facing unchanged relative prices, private demand for both types of goods move together. Thus, lower private expenditure on nontraded goods is necessarily accompanied by lower private expenditure on traded goods, thereby resulting in lower aggregate spending for the economy as a whole.

2/ In terms of the wealth constraint, the level of wealth falls but the demand for money also falls and the stock of domestic bonds is constant. So the effect on foreign asset holdings is undetermined.

3/ A sufficient condition for this to hold is $r^{*}<(b_3 b/b_1)$. If the foreign interest rate were "too high", a private capital inflow (which would reduce public sector net foreign debt by the same amount) could conceivable reduce public sector foreign interest payments by an amount sufficiently large to reduce the operational deficit.

private sector demand offset each other so that the market for nontraded goods clears at the original real exchange rate. At the same time, the higher real wealth and higher domestic real interest rate restore equilibrium in the market for domestic bonds.

After impact, wealth tends to increase thus originating an incipient real appreciation. To prevent this, the central bank devalues the domestic currency faster, generating a higher rate of inflation and higher inflation tax payments.

The trade balance is not affected by an increase in the foreign interest rate, as both the demand and the supply of traded goods remain constant. The current account may worsen or improve depending on whether the country is a net foreign debtor or creditor. On impact, there is a private sector capital outflow as the private sector demand for foreign assets increases. The effects of a higher foreign interest rate, higher wealth, and higher inflation, more than offset the effect of a higher domestic real interest rate. 1/

The public sector operational deficit increases due to both higher interest payments on domestic debt (brought about by the higher domestic real interest rate) and higher interest payments on foreign debt (brought about by the higher foreign interest rate and the higher level of public net foreign debt induced by the private sector capital outflow that takes place on impact).

5. An open market sale of domestic bonds

An open market sale of bonds, other things constant, generates an excess supply in the market for domestic bonds. The incipient excess supply is offset by a higher domestic real interest rate and a higher level of private sector wealth. As depicted in figure 3, the sale of domestic bonds shifts the bb curve to the right, producing an increase in both w and r. The price level falls on impact, followed by a higher-than-before rate of inflation.

These results can be interpreted sequentially as follows. The open market sale of bonds creates an excess supply of bonds, leading to an increase in the domestic real interest rate that tends to reduce private sector expenditure. The incipient decline in private sector demand for nontraded goods produces an incipient real depreciation which the central bank prevents by a nominal revaluation of the domestic currency. As a result, the prices of all goods fall on impact, causing an increase in real wealth. The effects of a higher domestic real interest rate and a higher wealth on the demand for nontraded goods offset each other, thereby keeping

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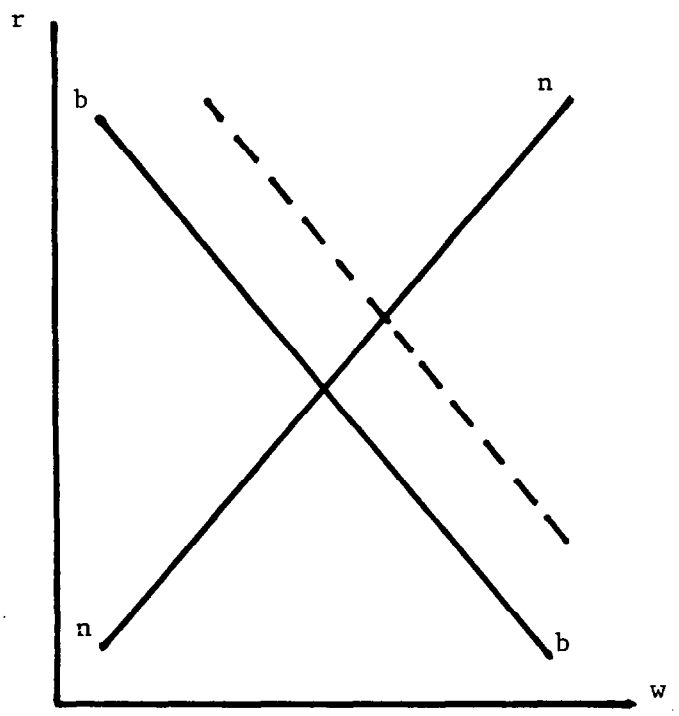
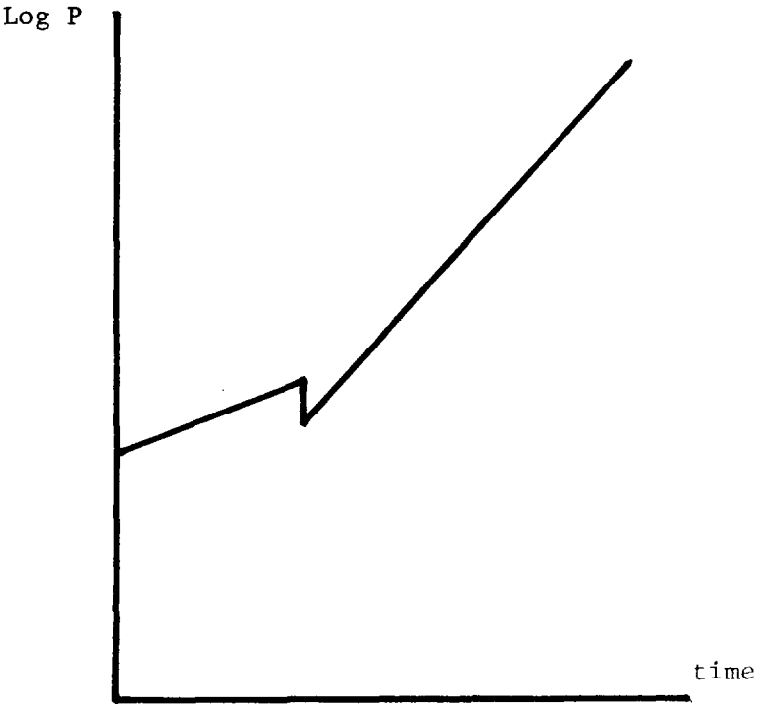
1/ In terms of the wealth constraint, wealth increases while the demand for money falls and the stock of domestic bonds is constant. Thus, holdings of foreign assets necessarily increase.

Figure 3

An Increase in Foreign Interest Rates
An Open Market Sale of Domestic Bonds





equilibrium in the nontraded goods market at the original real exchange rate. The higher real interest rate and the higher wealth also restore equilibrium in the bonds market.

After impact, wealth tends to increase, thus inducing an incipient increase in private expenditure that tends to appreciate the real exchange rate. The central bank prevents this by accelerating the rate of nominal devaluation, thus generating a higher rate of inflation and higher inflation tax payments.

The trade balance and the current account are not affected by the open market sale of domestic bonds, as both the supply and the demand for traded goods remain constant. The impact effect on private capital flows is ambiguous. Private demand for foreign assets declines due to the higher domestic interest rate, but increases due to due to the increase in wealth and the increase in inflation. 1/

The public sector operational deficit increases. Higher real interest payments on domestic debt (due to both a higher domestic real interest rate and a higher stock of domestic debt) more than offset any decline in foreign interest payments that might result from a private capital inflow that takes place on impact.

IV. Concluding Remarks

The discussion above has important implications for countries that follow a nominal exchange rate policy aimed at targeting the real exchange rate. Since those implications are derived from a model based on a number of restrictive assumptions, they must be interpreted in broad terms when applied to specific circumstances. In particular, the assumption of instantaneous price adjustment may be too restrictive for countries with widespread price and wage indexation or other features that introduce significant inertial elements in the determination of prices. In those cases, the instantaneous impact effect on the price level derived from the model should be interpreted more appropriately as a short run effect on the rate of inflation. This suggestion is followed in the remarks below.

In interpreting the various results, it is also important to remember that the discussion above assumed that public sector solvency is ensured by an appropriate future fiscal adjustment in public sector expenditure on traded goods. Thus, the conclusions regarding the "long run" effect on inflation of the various policies and exogenous shocks are conditional on this type of fiscal adjustment taking place. Otherwise, the references to "long run" inflation below should be interpreted as valid until a (different type of) fiscal adjustment to ensure solvency takes place or the policy of

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1/ In terms of the wealth constraint, the level of wealth increases and the demand for money falls, but the stock of domestic bonds also increases. So the effect on foreign asset holdings is undetermined.

real exchange rate targeting is abandoned. Subject to these caveats, the main implications of the paper are those mentioned below.

Targeting the real exchange rate may be an effective way of preserving international competitiveness and thus ensuring a satisfactory external trade performance in the presence of high domestic inflation. The rate of domestic inflation, however, is not independent of the external trade objectives of the authorities. Specifically, the more ambitious the external trade objectives, and thus the more depreciated the real exchange rate target, the higher is the resulting rate of inflation in both the short run and the long run. Thus, other things constant, there seems to be a tradeoff between a better external trade performance and a lower rate of inflation.

The effect of fiscal tightening on inflation seems to depend primarily on the instrument that is used to implement this policy. An increase in taxes or a reduction in public sector expenditure on nontraded goods would reduce inflation in both the short run and the long run. In contrast, a reduction in public sector expenditure on traded goods would have no effect on inflation.

The consequences of fiscal tightening for the trade balance are also instrument specific. While reducing public sector expenditure on traded goods would improve the trade balance by the same amount, increasing taxes would have no effect on the trade balance as private sector expenditure would remain constant due to reduced inflation tax payments. Furthermore, if the fiscal tightening is implemented through a reduction in public sector expenditure on nontraded goods, the trade balance would actually worsen. Inflation tax payments would decline enough to induce an expansion in private sector expenditure on nontraded goods sufficient to offset the reduction in public sector expenditure, thus restoring equilibrium in the nontraded goods market at the initial real exchange rate. Since private sector expenditure on traded goods would also expand as a result of the lower inflation tax payments, the trade balance would worsen.

In the context of this model, the use of high domestic interest rates brought about by open market sales of domestic bonds seems to be effective in containing inflation, but only transitorily. Higher real interest rates would initially contain private expenditure and thus would lead to a decline in inflation. After a certain period, however, private sector demand would expand as a result of private sector increased real interest receipts on its holdings of domestic bonds. In order to prevent this expansion in private demand from resulting in a real appreciation, the central bank would be forced to depreciate the nominal exchange rate faster, thus generating higher inflation. Therefore, in the absence of other policy changes, high domestic interest rates do not seem to provide lower inflation on a sustained basis, but rather lower inflation in the present in exchange for higher inflation in the future.

This also has implications for designing a response to exogenous changes in world financial markets conditions. For example, a fall in foreign interest rates in the absence of a policy response would induce private capital inflows, a decline in domestic interest rates, and higher inflation in the short run. After a certain period, however, lower real interest receipts by the private sector would lead to lower private expenditure, and thus a lower rate of inflation. If the initial monetary expansion resulting from private capital inflows is sterilized by open market sales of domestic bonds, the authorities would be able to prevent domestic interest rates from falling and thus contain the initial increase in inflation. However, this would be obtained at the expense of foregoing (at least partially) the subsequent fall in inflation that would take place in the absence of sterilization.

The analysis of real exchange rate targeting could advance in various directions. In particular, it would be valuable to examine this exchange rate policy in the context of an optimizing intertemporal model. This would provide an appropriate framework for the explicit consideration of the public sector's intertemporal budget constraint, and would permit studying how private sector's current behavior depends on expectations regarding the type of future fiscal adjustment that will ensure solvency. Also, the analysis could be enriched by the explicit incorporation of uncertainty, and by allowing for transitory deviations of the real exchange rate from its target level.

Appendix

This appendix derives the effects of various shocks on w, r, π, inflation tax payments πm, the trade account T, and the current account CA. The effects on w and r are obtained from equations (7) and (11).

(A1) $(dw/de) = \Delta\ \Omega\ b_1\ \theta^{-1}\ e^{\theta-1} < 0$

(A2) $(dr/de) = -\ \Delta\ \Omega\ b_3\ \theta^{-1}\ e^{\theta-1} > 0$

(A3) $(dw/dt) = \Delta\ b_1\ c_1 > 0$

(A4) $(dr/dt) = -\ \Delta\ b_3\ c_1 < 0$

(A5) $(dw/dg_n) = -\ \Delta\ b_1\ \theta^{-1}\ e^{\theta-1} < 0$

(A6) $(dr/dg_n) = \Delta\ b_3\ \theta^{-1}\ e^{\theta-1} > 0$

(A7) $(dw/dr^*) = \Delta\ b_2\ c_2 > 0$

(A8) $(dr/dr^*) = -\ \Delta\ b_2\ c_3 > 0$

(A9) $(dw/db) = -\ \Delta\ c_2 > 0$

(A10) $(dr/db) = \Delta\ c_3 > 0$

where Δ and Ω are defined by

(A11) $\Delta = (b_1\ c_3 - b_3\ c_2)^{-1} > 0$

(A12) $\Omega = [y_n' - \theta\ (1-\theta)\ e^{-\theta}\ c(y-t;r;w)] < 0$

The effects on π are obtained by using (9) with $\dot{w}=0$ and (A1)-(A10).

(A13) $(d\pi/de) = \Phi\ \{(r^*-c_3)(dw/de) + [b-c_2-(r^*+\pi)\ L_1]\ (dr/de)\} > 0$

(A14) $(d\pi/dt) = \Phi\ \{(c_1-1) + (r^*-c_3)(dw/dt) + [b-c_2-(r^*+\pi)L_1](dr/dt)\} < 0$

(A15) $(d\pi/dg_n) = \Phi\ \{(r^*-c_3)(dw/dg_n) + [b-c_2-(r^*+\pi)\ L_1]\ (dr/dg_n)\} > 0$

(A16) $(d\pi/dr^*) = \Phi\ \{f + (r^*-c_3)(dw/dr^*) + [b-c_2-(r^*+\pi)\ L_1]\ (dr/dr^*)\}$

$= \Phi\ \{f - \Delta\ b_2\ [b\ c_3 - (r^*+\pi)\ L_1\ c_3 - r^*\ c_2]\} > 0$

(A17) $(d\pi/db) = \Phi\ \{(r^*-c_3)(dw/db) + [b-c_2-(r^*+\pi)\ L_1]\ (dr/db) + (r-r^*)\}$

$= \Phi\ \{\Delta\ [b\ c_3 - (r^*+\pi)\ L_1\ c_3 - r^*\ c_2] + (r-r^*)\} > 0$

where Φ is defined by

(A18) $\Phi = [m + (r^*+\pi)\ L_1]^{-1} > 0$

The effects on inflation tax payments πm are obtained from (A13)-(A17).

(A19) $(d\pi m/de) = \Phi\Delta\Omega\theta^{-1}e^{\theta-1}\{\Gamma[(r^*-c_3)\ b_1 - (b-c_2)\ b_3] + m\ r^*\ L_1\ b_3\} > 0$

(A20) $(d\pi m/dt) = \Phi\{\Gamma[(c_1-1)+(r^*-c_3)b_1c_1\Delta-(b-c_2)b_3c_1\Delta] + mr^*L_1b_3c_1\Delta\} < 0$

(A21) $(d\pi m/dg_n) = \Phi\Delta\theta^{-1}e^{\theta-1}\{\Gamma[(c_3-r^*)\ b_1 + (b-c_2)\ b_3] - m\ r^*\ L_1\ b_3\} > 0$

(A22) $(d\pi m/dr^*) = \Phi\{\Gamma[f - b_2\ \Delta\ (b\ c_3 - r^*\ c_2)] + m\ r^*\ L_1\ b_2\ c_3\ \Delta\} > 0$

(A23) $(d\pi m/db) = \Phi\{\Gamma[\Delta\ (b\ c_3 - r^*\ c_2) + (r - r^*)] - m\ r^*\ L_1\ c_3\ \Delta\} > 0$

where Γ is defined by

(A24) $\Gamma = (m + \pi\ L_1) > 0$

The effects on the trade balance T and the current account balance CA are obtained from (12), (13), and (A1)-(A10).

(A25) $(dT/de) = (dCA/de) = y_t' - \theta^{-1}(1-\theta)\ e^{-1}\ y_n' + (1-\theta)\ e^{-\theta-1}\ c > 0$

(A26) $(dT/dt) = (dCA/dt) = 0$

(A27) $(dT/dg_t) = (dCA/dg_t) = -1$

(A28) $(dT/dg_n) = (dCA/dg_n) = \theta^{-1}\ (1-\theta)\ e^{-1} > 0$

(A29) $(dT/dr^*) = 0 \qquad (dCA/dr^*) = (F-B^*) \gtrless 0$

(A30) $(dT/db) = (dCA/db) = 0$

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