Philippine Review of Economics and Business
Volume XXXV, No. 1, June 1998

MONETARY AND FISCAL POLICIES, ENDOGENOUS CURRENCY SUBSTITUTION, AND EXCHANGE RATE VOLATILITY

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This paper employs two small, open economy macro models of exchange rate determination—a portfolio balance model and an asset market model—to examine the implications of endogenous currency substitution on exchange rate volatility arising from monetary and fiscal policies. It is shown that, in both models, the exchange rate response and the extent of exchange rate overshooting and undershooting depend on the degree of currency substitution.

1. Introduction

In the literature on the implications of currency substitution,[1] it has been claimed that currency substitution can be a source of increased exchange rate volatility and policy interdependence. This paper examines this conclusion arising from the currency substitution literature using two small, open-economy macro models of exchange rate determination—a portfolio balance model and an asset market model. The results of this paper suggest that monetary and fiscal policies may cause exchange rate volatility and overshooting and that increased currency substitution can dampen the extent of exchange rate overshooting.

This paper is organized as follows. Section 2 presents a portfolio balance model which incorporates currency substitution. In this model, it is fiscal policy which can have dynamic effects. As a result of a fiscal expan-

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[1] For the macroeconomic implications of currency substitution, see, among others, Girton and Roper (1981), McKinnon (1983), and Miles (1978, 1981).

sion, initially the interest rate will unambiguously rise but there are five possible exchange rate paths. When the long run and initial responses are both appreciation (depreciation), increased currency substitution will reduce (increase) the extent of appreciation (depreciation) and therefore will dampen the degree of overshooting (undershooting). Section 3 incorporates currency substitution into the Dornbusch model and, in this model, it is monetary policy which can have dynamic effects. As a result of a monetary expansion, the long run and initial responses are both a depreciation and, initially, if the interest rate declines (remain the same; rises), the domestic currency will have to depreciate and overshoot (neither overshoot nor undershoot; undershoot) its new long-run equilibrium value. In this model, increased currency substitution will also dampen the extent of initial depreciation and hence will dampen the extent of overshooting but will reinforce the extent of overshooting.[2] Section 4 summarizes the conclusions.

2. Endogenous Currency Substitution: A Portfolio Balance Model

The model can be summarized by the following set of relationships:

(1.1.*i*) $$y = y_t^d \equiv a_1 a_t + a_2 T_t, \qquad 0 < a_1 < 1$$

(1.1.*ii*) $$a_t = \alpha_0 + \alpha_1 w_t,$$

(1.1.*iii*) $$T_t = \alpha_3 \left(e_t - p_t + p_f\right) - \alpha_2 w_t,$$

(1.2) $$dF/dt = T_t,$$

(1.3.*i*) $$m - p_t = \phi y - \lambda i_t - \beta E\left(de/dt\right) + \mu w_t, \quad 0 < \mu < 1$$

(1.3.*ii*) $$w_t = b_1 \left(m - p_t\right) + b_2 F_t, \qquad 0 < b_1 < 1$$

(1.4) $$i_t = i_f + E\left(de/dt\right),$$

(1.5) $$E\left(de/dt\right) = de/dt,$$

where e = log of exchange rate measured in units of domestic currency per unit of foreign currency; $e - p + p_f$ = log of real exchange rate; i, i_f = domestic

[2] Other papers which have examined the implications of currency substitution on exchange rate volatility are Lapan and Enders (1983), Zervoyianni (1988), Isaac (1989), Koustas and Ng (1991), Gartner (1993), Akiba (1996).

and foreign interest rates; p, p_f = logs of domestic and foreign price levels; m = log of money supply; y = log of income or output; y^d = log of aggregate demand; a = log of real domestic absorption; T = real net exports; w = log of real wealth; F = real net foreign assets; and, α_0 = log of exogenous spending.[3] Foreign variables i_f and p_f are exogenous, and all parameters are positive.

Equations (1.1.*i*) to (1.2) describe the goods market. Income or output is exogenously fixed while the price level is fully flexible. In equilibrium, aggregate demand, which is composed of domestic absorption and net exports, is equal to the exogenously fixed level of output [(1.1.*i*)].[4] Domestic absorption depends on income and real wealth [(1.1.*ii*)] while net exports depend on real wealth and the real exchange rate [(1.1.*iii*)].[5] Given equations (1.1.*ii*) and (1.1.*iii*), equation (1.1.*i*) can be rewritten as

$$(1.1.i)' \qquad y = y_t^d \equiv u + (\eta - \nu)w_t + \delta(e_t - p_t + p_f),$$

where $u = a_1\alpha_0$, $\eta = a_1\alpha_1$, $\nu = a_2\alpha_2$, and $\delta = a_2\alpha_3$. It is assumed that the wealth elasticity of domestic absorption exceeds that of net exports, i.e., the wealth elasticity of aggregate demand, $(\eta - \nu)$, is positive.

Under flexible exchange rates, the balance of payments must equal zero. Thus, the balance of payments equilibrium condition implies that the accumulation of net foreign assets is equal to the trade balance [(1.2)].

The asset market, on the other hand, is described by equations (1.3.*i*), (1.3.*ii*), and (1.4).[6] Money market equilibrium [(1.3.*i*)] obtains, and money demand is a function not only of output and the interest rate but also of real

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[3] The model is adopted from Kouri (1976), Calvo and Rodriguez (1977), Dornbusch and Fischer (1980), and Isaac (1989). The portfolio approach was pioneered by Tobin (1969).

[4] Equation (1.1.*i*), $y = y_t^d \equiv a_1 a_t + a_2 T_t$, is derived from $Y = Y_t^d \equiv A_t + T_t$, where $0 < a_1 = A^0/Y^{d0} < 1$ and $a_2 = 1/Y^{d0} > 0$ (see Bhandari, Driskill, and Frenkel, 1984).

[5] For simplicity, domestic absorption is assumed not to depend on the interest rate.

[6] There are three assets in the portfolio: an interest bearing asset, foreign money and domestic money. F denotes real net foreign assets measured in terms of domestic currency, $(EP_f/P)(M_f/P_f)+(EP_f/P)(B/i_f)$, where M_f is the amount of foreign money held by domestic residents and B denotes net domestic holdings of bonds, which are real perpetuities that pay one unit of foreign output indefinitely (Dornbusch and Fischer, 1980). This aggregation of bonds and foreign money is simply for notational convenience.

wealth and an endogenous currency substitution variable, the expected rate of change in the exchage rate.[7] Real wealth is the sum of real money supply and real net foreign assets [(1.3.*ii*)].[8]

The money market is linked to the foreign exchange market by the uncovered interest rate parity condition [(1.4)] that interest differentials must equal expected exchange rate changes.[9] Equation (1.5) imposes perfect foresight on exchange-rate expectations.

The steady state of the model, attained when $dF/dt = 0$ and $de/dt = E(de/dt) = 0$, is described by:

$$\bar{p} = m + \lambda\bar{i} - \mu\bar{w} = m - \left(\phi + \frac{\mu}{\eta}\right)y + \lambda i_f + \frac{\mu}{\eta}u, \tag{2.1}$$

$$\bar{i} = i_f, \tag{2.2}$$

$$\bar{e} = \bar{p} - p_f + \frac{1}{\delta}y - \frac{(\eta-\nu)}{\delta}\bar{w} - \frac{1}{\delta}u = m - p_f + \lambda i_f + \left(\frac{\nu-\mu\delta}{\delta\eta} - \phi\right)y - \frac{(\nu-\mu\delta)}{\delta\eta}u, \tag{2.3}$$

$$\bar{F} = \frac{\lambda b_1}{b_2}i_f + \frac{(1-\mu b_1)-\phi b_1\eta}{\eta b_2}y - \frac{(1-\mu b_1)}{\eta b_2}u, \tag{2.4}$$

where $y = \bar{y}^d \equiv a_1\,\bar{a} + a_2\,\bar{T}, \bar{a} = (1/a_1)(u + \eta\bar{w}), \bar{T} = (1/a_2)\left(\delta\left(\bar{e} - \bar{p} + p_f\right) - \nu\bar{w}\right)$, $w = b_1(m-\bar{p}) + b_2\bar{F}$, and "–" denotes a long run equilibrium value.

The dynamics of the system can be represented by:

$$p - \bar{p} = \frac{(\lambda+\beta)\delta}{Z}(e-\bar{e}) + \frac{(\lambda+\beta)(\eta-\nu)b_2}{Z}\left(F-\bar{F}\right), \tag{3.1}$$

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[7] The specification of asset demands follows from those in Cuddington (1983) and Branson and Henderson (1986). The adding up requirement (Tobin, 1969) is satisfied. One asset demand function is redundant, and equations (3.1.*i*) and (1.4) are chosen to represent equilibrium in the asset market. Here, *E(de/dt)* is the currency substitution variable, which is endogenous.

[8] Equation (3.1.*ii*) is derived from $W_t = (M/P_t) + F_t$, $w_t = b_1(m - p_t) + b_2F_t$, where $0 < b_1 = (M^0/P^0)/W^0 < 1$, $b_2 = 1/W^0 > 0$.

[9] There is no distinction between domestic and foreign bonds because of the perfect capital substitutability and perfect capital mobility assumptions embodied in equation (1.4).

(3.2) $$i-\bar{i}=\frac{(1-\mu b_1)\delta}{Z}(e-\bar{e})+\frac{(\delta\mu+(\eta-\nu))b_2}{Z}(F-\bar{F}),$$

(3.3) $$\begin{bmatrix} de/dt \\ dF/dt \end{bmatrix}=\begin{bmatrix} \frac{(1-\mu b_1)\delta}{Z} & \frac{(\delta\mu+(\eta-\nu))b_2}{Z} \\ \frac{(\lambda+\beta)\delta\eta b_1}{Z} & -\frac{(\lambda+\beta)\delta\eta b_2}{Z} \end{bmatrix}\begin{bmatrix} (e-\bar{e}) \\ (F-\bar{F}) \end{bmatrix},$$

where $Z=(\delta+(\eta-\nu)b_1)(\lambda+\beta)>0$ and $0<(1-\mu b_1)<1$, since $0<b_1<1$ and, by assumption, $\eta-\nu>0$ and $0<\mu<1$. The determinant of the coefficient matrix in equation (3.3) is negative, implying that the two roots, R_1 and R_2, are real and opposite in sign and that the system yields a saddlepoint equilibrium.[10] Given an initial steady state where $e=\bar{e}_0$ and $F=\bar{F}_0$, any disturbance which affects the equilibrium price level will yield a new steady state where $e=\bar{e}$ and $F=\bar{F}$. To ensure that the system will converge toward this new steady-state, there must be boundary conditions on the values, e_0 and F_0, that the state variables will take following some disturbance.

Since the level of real foreign assets is sticky, its initial value F_0 is predetermined and is equal to $\bar{F}_0$. It follows that the boundary condition for the level of foreign assets is

(4.1) $$F_0-\bar{F}=\bar{F}_0-\bar{F},$$

where $\bar{F}_0-\bar{F}=-d\bar{F}$.

The boundary condition for the free variable, the exchange rate, is standard in linear rational expectations models: the coefficient associated with the unstable root must equal zero. If R_2 is the unstable root, this transversatility condition implies that

[10]The solution to the characteristic equation associated with equation (3.3), $R^2+(-tr(A))R+det(A)=0$, is R_1, $R_2=\left\{tr(A)\pm\left((-tr(A))^2-4det(A)\right)^{1/2}\right\}/2$, where $tr(A)=R_1+R_2=((1-\mu b_1)\delta-(\lambda+\beta)\eta b_2\delta)/Z$ and $det(A)=R_1R_2=-\eta b_2\delta/Z<0$.

$$(4.2) \qquad e_0 - \bar{e} = -\frac{\left(\mu\delta + (\eta - \nu)\right)b_2}{(1 - \mu b_1)\delta + Z(-R_1)}\left(F_0 - \bar{F}\right),$$

where $R_1 < 0$ and $-\left(\mu\delta + (\eta - \nu)\right)b_2 / \left((1 - \mu b_1)\delta + Z(-R_1)\right) < 0$ is the slope of the saddle path.[11] Since the level of foreign assets cannot jump, the exchange rate must jump to place the system on the stable arm of the saddlepoint. This unique, stabilizing jump is given by equation (4.2).[12]

Consider a fiscal expansion and assume that $u = u_0 + u_1 g$ where g denotes government spending. In the long run [see (2.1) to (2.5)], a fiscal expansion will increase the price level $\left(d\bar{p}/dg = (\mu/\eta)u_1\right)$ and hence reduce real wealth $\left(d\bar{w}/dg = -(1/\eta)u_1\right)$, real money balances $\left(d(m - \bar{p})/dg = -\lambda d\bar{i}/dg + \mu d\bar{w}/dg = -(\mu/\eta)u_1 = -d\bar{p}/dg\right)$, and real net foreign assets $\left(d\bar{F}/dg = -\left((1 - \mu b_1)/\eta b_2\right)u_1\right)$, but will not affect domestic absorption $\left(d\bar{a}/dg = (1/a_1)\left(du/dg + \eta d\bar{w}/dg\right) = 0\right)$, net exports $\left(d\bar{T}/dg = (1/a_2)\left(\delta d(\bar{e} - \bar{p} + p_f)/dg - \nu d\bar{w}/dg\right) = 0\right)$, and the interest rate $\left(d\bar{i}/dg = 0\right)$. Net exports will remain the same since the effect of the decline in real wealth is fully offset by the real appreciation of the domestic currency $\left(d(\bar{e} - \bar{p} + p_f)/dg = \left(-(\nu/\eta\delta)u_1\right)\right)$, and domestic absorption will also remain the same since the direct effect of an increase in government spending is fully offset by the effect of the decline in real wealth, and thus aggregate demand will remain the same.

However, in nominal terms, the domestic currency may appreciate, remain the same, or depreciate $\left(d\bar{e}/dg = (1/\delta)\left(-du/dg - \eta d\bar{w}/dg + \delta d\bar{p}/dg\right.\right.$ $\left.\left.\nu d\bar{w}/dg\right) = -(1/\delta)(1/\eta)(\nu - \delta\mu)u_1 \lesseqgtr 0 \text{ as } \nu - \delta\mu \gtreqless 0\right)$. Specifically, since output

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[11] This condition requires $K_2 = 0 = \left\{(1 - \mu b_1)\delta/Z + (-R_1)/(R_2 - R_1)\right\}(e_0 - \bar{e}) + \left(\left((1 - \mu b_1)\delta/Z + (-R_1)\right)/(R_2 - R_1)\right)(e_0 - \bar{e}) + \left(\left(\left(\mu\delta + (\eta - \nu)\right)b_2/Z\right)/(R_2 - R_1)\right)\left(F_0 - \bar{F}\right)$, where K_2 is the coefficient associated with the unstable root R_2.

[12] After the jump, the system moves along the stable path where $de/dt = R_1(e_t - \bar{e})$, $e_t - \bar{e} = -\left(\left(\mu\delta + (\eta - \nu)\right)b_2 / \left((1 - \mu b_1)\delta + Z(-R_1)\right)\right)\left(F_t - \bar{F}\right)$, and $-R_1 > 0$ is the system's speed of adjustment.

is exogenously fixed and if the direct effect of a fiscal expansion on aggregate demand, $du/dg = u_1$, is greater than (equal to; less than) the | sum | of the effects of the resulting increase in the price level on domestic absorption through wealth and on net exports through the real exchange rate and real wealth, $\eta(d\overline{w}/d\overline{p})(d\overline{p}/dg) - (\delta d\overline{p}/dg + \nu(d\overline{w}/d\overline{p})(d\overline{p}/dg) = -(\delta + (\eta - \nu)b_1)(\mu/\eta)u_1 = -(1-(\nu-\delta\mu)/\eta)u_1 < 0$ or, equivalently, if ν is greater than (equal to; less than) $\delta\mu$, then the domestic currency must appreciate (remain the same; depreciate) to maintain equilibrium in the goods market.

The impact effects [see (3.1), (3.2), (4.1) and (4.2) and (2.1) to (2.5)], on the other hand, are $dF_0/dg = 0, d\left(F_0 - \overline{F}\right)/dg = -d\overline{F}/dg = \left((1-\mu b_1)/\eta b_2\right)u_1$, and

$$\text{(5.1.}i\text{)} \qquad \frac{dp_0}{dg} = (\lambda+\beta)(-R_1)\left(\frac{\mu\delta + (\eta-\nu)}{(1-\mu b_1)\delta + Z(-R_1)}\right)\frac{1}{\eta}u_1 > 0,$$

$$\text{(5.1.}ii\text{)} \qquad \frac{d\left(p_0 - \overline{p}\right)}{dg} = \left(\frac{-\mu\delta + (\eta-\nu)(\lambda+\beta)(-R_1)}{(1-\mu b_1)\delta + Z(-R_1)}\right)\frac{(1-\mu b_1)}{\eta}u_1$$

$$= \left(\frac{\delta}{\delta + (\eta-\nu)b_1}\right)\frac{d\left(e_0 - \overline{e}\right)}{dg} < 0,$$

$$\text{(5.2)} \qquad \frac{di_0}{dg} = \frac{d\left(i_0 - \overline{i}\right)}{dg} = (-R_1)\left(\frac{\mu\delta + (\eta-\nu)}{(1-\mu b_1)\delta + Z(-R_1)}\right)\frac{(1-\mu b_1)}{\eta}u_1 > 0,$$

$$\text{(5.3.}i\text{)} \qquad \frac{de_0}{dg} = -\frac{\nu - \mu\delta}{\eta\delta}u_1 - \left(\frac{\mu\delta + (\eta-\nu)}{(1-\mu b_1)\delta + Z(-R_1)}\right)\frac{(1-\mu b_1)}{\eta}u_1$$

$$= - \frac{\nu\left(\frac{1 + Z(-R_1)\,\nu/\eta\delta}{\nu b_1/\delta + Z(-R_1)\,\nu/\eta\delta}\right) - \delta\mu}{\left((1-\mu b_1)\delta + Z(-R_1)\right)\eta\delta} u_1$$

$$\eta b_1 + Z(-R_1)$$

$$= -(1/\delta)\left(\frac{du}{dg} - \left(\delta + (\eta - \nu)b_1\right)\frac{dp_0}{dg}\right) \lesseqgtr 0,$$

(5.3.*ii*)
$$\frac{d(e_0 - \bar{e})}{dg} = -\left(\frac{\mu\delta + (\eta - \nu)}{(1-\mu b_1)\delta + Z(-R_1)}\right)\frac{(1-\mu b_1)}{\eta} u_1 < 0,$$

where $d(e_0 - \bar{e})/dg < 0$, implying that the value of the exchange rate on impact will always "fall below" the new long run equilibrium value and hence the response of neither overshooting nor undershooting cannot occur in this model, while the sign of de_0/dg is ambiguous.

However, on impact, since output is exogenously fixed and if the direct effect of a fiscal expansion on aggregate demand, $du/dg = u_1$, is less than (equal to; greater than) the |sum| of the effects of the resulting increase in the price level on domestic absorption through wealth and on net exports through the real exchange rate and real wealth, $\eta(dw_0/dp_0)(dp_0/dg) - \delta(dp_0/dg) - \nu(dw_0/dp_0)(dp_0/dg) = -(\delta + (\eta - \nu)b_1)(dp_0/dg) < 0$, or equivalently if $\nu(.)$ is greater than (equal to; less than) $\delta\mu$, the domestic currency must appreciate (remain the same; depreciate) to maintain equilibrium in the goods and assets market, where $(.) = \left((1 + Z(-R_1)\,\nu/\eta\delta)/(\nu b_1/\delta + Z(-R_1)\,\nu/\eta\delta)\right)$.

At the initial interest rate, price level, and exchange rates, a fiscal expansion increases domestic absorption and causes an excess demand for goods. Since output is exogenously fixed and the level of real net foreign assets is sticky, the price level must increase to maintain goods market equilibrium [(1.1.*i*) to (1.1.*iii*) and (5.1.*i*)]. An increase in the price level, in turn, reduces real wealth and hence reduces the demand for money. Thus, at the initial interest rate there is an excess demand for money and the interest rate must rise to maintain money market equilibrium [(1.3.*ii*), (1.3.*i*), and (5.2)]. Since the foreign interest rate remains the same and the interest rate rises, foreign exchange market equilibrium requires that there must be an expectation of a subsequent depreciation, i.e., that $E(de/dt)$ be positive, which will hold only if the value of the exchange rate on impact is "below" its new long run equilibrium value [(1.5, (5.3.*i*), and (5.3.*ii*)]. These changes in the price level, interest rate, and exchange rate will maintain equilibrium in both goods and assets markets.

What specific initial and long run nominal exchange rate responses will create an expectation of a subsequent depreciation? Given the long run and impact effects, there are five possibilities, depending on the relative magnitudes of the wealth elasticity of money demand (μ), the marginal propensity to import out of wealth (ν), the real exchange rate elasticity of net exports (δ), and other parameters. These are: (1) long run appreciation and initial appreciation and overshooting, $\nu(.) > \delta\mu$ and $\nu > \delta\mu$; (2) constant long run exchange rate and initial appreciation, $n(.) > \nu = \delta\mu$; (3) long run depreciation and initial appreciation, $\nu(.) > \delta\mu > \nu$; (4) long run depreciation and constant initial exchange rate, $\nu(.) = \delta\mu > \nu$; (5) long run depreciation and initial depreciation and undershooting, $\delta\mu > \nu(.) > \nu$, as shown in Figures 1.1 to 1.5.

In all cases, the $dF/dt = 0$ locus is upward sloping and, given the assumption that the wealth elasticity of aggregate demand is positive, $\eta - \nu > 0$, both the $de/dt = 0$ locus and the SS curve are downward sloping. As a result of a fiscal expansion: the $de/dt = 0$ locus will shift down in all cases (since $0 < \mu < 1$); the $dF/dt = 0$ locus may shift down, remain the same, or shift up in Case 1 (since $\nu(.) > \delta\mu$, $\nu > \delta\mu$, $0 < b_1 < 1$ and $0 < \mu < 1$, $\nu > \nu b_1$ and $\delta > \delta\mu$, but $\nu b_1 \gtreqless \delta$ and thus $(.) \lesseqgtr 1$) and will shift up in Cases 2, 3, 4, and 5 (since $\nu(.) > \nu$ and thus $\nu b_1 < \delta$ or $(.) > 1$); and, the SS curve will shift by an amount equal to the exchange rate jump $\left(de_0/dg \lesseqgtr 0\right)$.[13]

[13] In the $e - F$ space, as a result of an increase in g, the vertical shift of the $de/dt = 0$ is equal to $-\left((1/\delta)+(1-\mu)/\eta\right)u_1 < 0$, that of the $dF/dt = 0$ locus is equal to $-\left((\nu-\mu\delta)/\eta\delta+(1-\mu b_1)/\eta b_1\right)u_1 = \left((\delta-\nu b_1)/\eta b_1\delta\right)u_1$ which is ambiguous, and that of the SS curve is the same as the exchange rate jump. Thus, if $\nu - \mu\delta > 0$ ($\nu - \mu\delta = 0$; $\nu - \mu\delta < 0$ and $\mu - (.) < 0$; $\nu - \mu\delta < 0$ and $\mu - (.) = 0$; $\nu - \mu\delta < 0$ and $\mu - (.) > 0$), the $de/dt = 0$ locus shifts down, the $dF/dt = 0$ locus may shift down, remain the same, or shift up (shifts up; shifts up; shifts up; shifts up), and the SS curve shifts down (shifts down; shifts down; remains the same; shifts up), where $(.) = \left((\eta\delta + \nu Z(-R_1))/\delta(\eta b_1 + Z(-R_1))\right)$ as shown in Figure 1.1 (1.2; 1.3; 1.4; 1.5).

Figure 1.1
Fiscal expansion in a PB model: long run appreciation and initial appreciation and overshooting

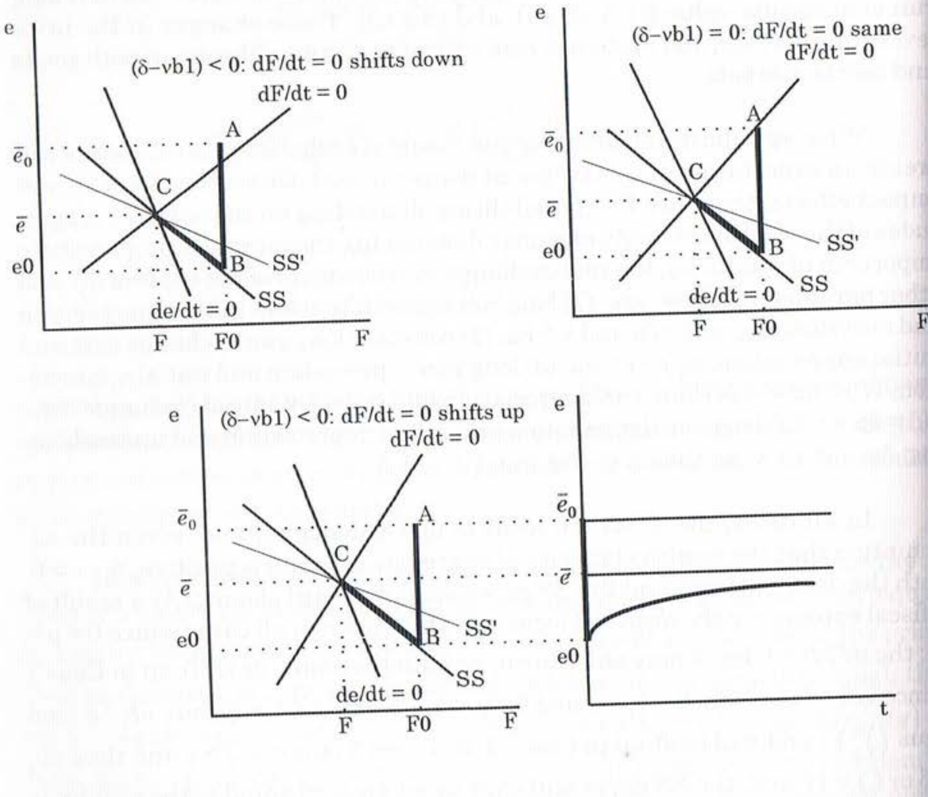


Figure 1.2
Fiscal expansion in a PB model: constant long run exchange rate and initial appreciation

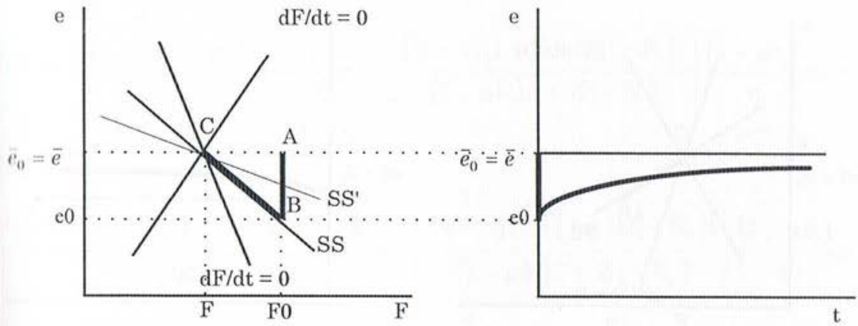


Figure 1.3
Fiscal expansion in a PB model: long run depreciation and initial appreciation

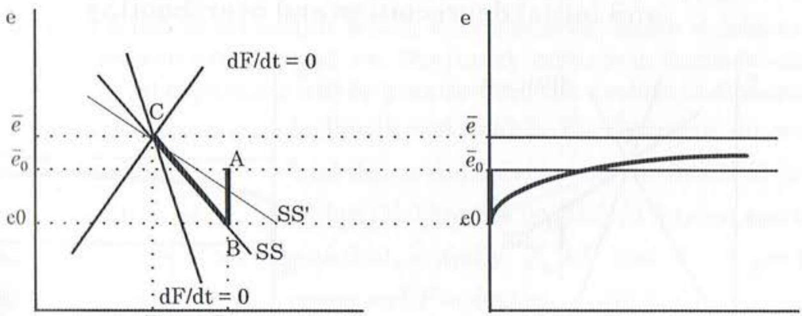


Figure 1.4
Fiscal expansion in a PB model: long run depreciation and constant initial exchange rate

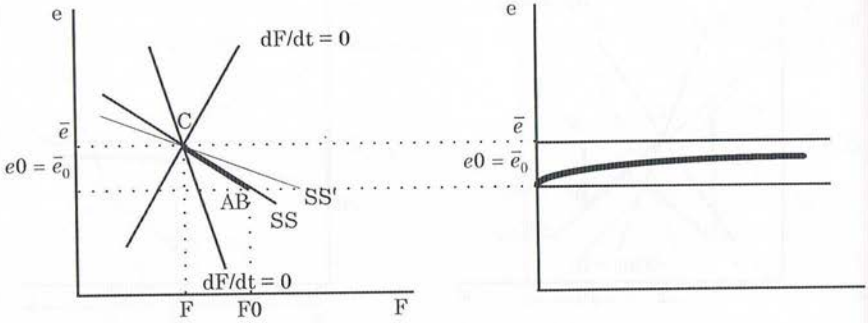
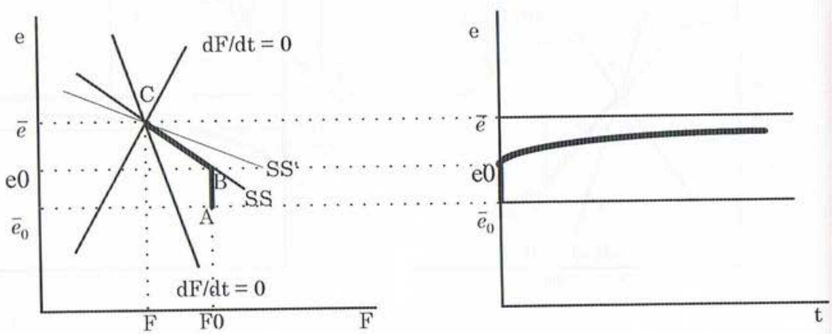


Figure 1.5
Fiscal expansion in a PB model: long run depreciation and initial depreciation and overshooting



Given the increase in the price level and whatever is the change in the nominal exchange rate, a fiscal expansion will cause the domestic currency to appreciate in real terms and overshoot its new long run equilibrium value,

(5.4.i) $$\frac{d\left(e_0 - p_0 - p_f\right)}{dg} = -\frac{\nu}{\eta\delta}u_1 - \left(\frac{(\eta-\nu)\left(1+(\lambda+\beta)(-R_1)\right)}{(1-\mu b_1)\delta + Z(-R_1)}\right)\frac{(1-\mu b_1)}{\eta}u_1 < 0,$$

(5.4.ii)
$$\frac{d\left(\left(e_0 - p_0 + p_f\right) - \left(\bar{e} - \bar{p} + p_f\right)\right)}{dg} = -\left(\frac{(\eta-\nu)\left(1+(\lambda+\beta)(-R_1)\right)}{(1-\mu b_1)\delta + Z(-R_1)}\right)\frac{(1-\mu b_1)}{\eta}u_1 < 0,$$

such that the resulting decline in net exports will more than offset the increase in net exports due to decline in real wealth; thus, net exports will decline $\left(dT_0/dg = -\left((1-\mu b_1)\delta\left(1+(\lambda+\beta)(-R_1)\right)/\left((1-\mu b_1)\delta + Z(-R_1)\right)\right)(1/a_2)u_1 < 0\right)$ and will fall below its unchanged long run equilibrium value $\left(d\bar{T}/dg = 0\right)$. Since aggregate demand must equal output which is exogenously fixed, it follows that domestic absorption will increase; i.e., the direct increase in domestic absorption due to a fiscal expansion will be greater than the decline in domestic absorption due to the resulting decline in real wealth. Furthermore, since $dF/dt = T$, it follows that $dF/dt < 0$, and this is consistent with the fact that foreign assets cannot jump $(dF_0/dg = 0)$ but the long run level of net foreign assets will decline $\left(d\bar{F}/dg < 0\right)$. This means that, initially, $T_0 < \bar{T}$ and $F_0 > \bar{F}$ and that over time, T is below $\bar{T}$ but rising and F is declining $(dF/dt < 0)$.

Given the effects of fiscal expansion, what will be the implication of increased currency substitution? An increase in the degree of currency substitution (an increase in the value of β) will reduce the volatility of the exchange rate resulting from a fiscal expansion. Specifically,

(5.4.*iii*)

$$\frac{d\left(de_0/dg\right)}{d\beta}=\frac{d\left(d\left(e_0-\bar{e}\right)/dg\right)}{d\beta}=\frac{\left(\mu\delta+(\eta-\nu)\right)\eta b_2\delta\left(1+(\lambda+\beta)(-R_1)\right)(1-\mu b_1)}{\left((1-\mu b_1)\delta+Z(-R_1)\right)^2(\lambda+\beta)\emptyset^{1/2}\eta}u_1>0,$$

where $\emptyset^{1/2}=\left(\left(-tr(A)\right)^2-4det(A)\right)^{1/2}>0$ and, since $d\left(d\bar{e}/dg\right)/d\beta=0$, it follows that $d\left(de_0/dg\right)/d\beta=d\left(d\left(e_0-\bar{e}\right)/dg\right)/d\beta$. Thus, equation (5.4.*iii*) is positive. This means that, given a fiscal expansion and the resulting increases in the price level and the interest rate, if for some given value of β the long run exchange rate response is an appreciation (zero; depreciation; depreciation; depreciation) and the initial exchange rate response is an appreciation and overshooting (an appreciation; an appreciation; zero; a depreciation and undershooting), then an increase in the value of β will initially cause a smaller rise in the interest rate, an expectation of a subsequent smaller depreciation, and a smaller appreciation and overshooting (a smaller appreciation; a smaller appreciation; a depreciation; a larger depreciation).[14]

The implication is that increased currency substitution will dampen both the initial rise in the interest rate and the expectation of subsequent depreciation and, hence, will moderate (mitigate) the extent of initial appreciation (depreciation) and reduce the extent of overshooting (undershooting) resulting from a fiscal expansion. This is because increased currency substitution makes downward sloping saddle path flatter.

Consider next a monetary expansion. On impact and in the long run, money is neutral, i.e., a change in the money supply affects only nominal variables ($de_0/dm=d\bar{e}/dm=1$ and $dp_0/dm=d\bar{p}/dm=1$, i.e., a change m yields equiproportionate changes in e and p) and has no effect on real variables. This monetarist result—that a change m yields equiproportionate

[14] As β increases, the slope of the $de/dt=0$ locus $\left(\left(de/dF\right)_{|de/dt=0}=-\left(\mu\delta+(\eta-\nu)\right)b_2/\right.$ $\left.-\left(\mu\delta+(\eta-\nu)\right)b_2/(1-\mu b_1)\delta<0\right)$ and the slope of the $dF/dt=0$ locus $\left(\left(de/dF\right)_{|dF/dt=0}=b_2/b_1>0\right)$ remain the same, but the slope of the SS curve $\left(\left(de/dF\right)_{|de/dt=0}=-\left(\mu\delta+(\eta-\nu)\right)b_2/\left(\delta(1-\mu b_1)+Z(-R_1)\right)<0\right)$ becomes flatter (see Figures 1.1 to 1.5). It follows that $d(-R_1)/d\beta=\emptyset^{1/2}(\lambda+\beta)^{-1}\left(\left((1-\mu b_1)\delta/Z\right)(-R_1)-\left(\eta b_2\delta/Z\right)\right)<0.$

changes in nominal variables e and p and has no effect on real variables—which holds even in the short run, stems from the exogeneity of output and the full flexibility of price level.

There are no dynamic effects resulting from a monetary expansion. This is because a change in the money supply does not affect $\overline{F}$ and hence the steady state and impact effects are the same, i.e., the system simply jumps from the initial to the new steady state. Since a monetary expansion has no dynamic effects, the degree of currency substitution does not matter.

Thus, in this model, fiscal policy can be a source of exchange rate volatility and endogenous currency substitution tends to dampen appreciation (mitigate depreciation) and therefore tends to dampen the extent of exchange rate overshooting (undershooting) resulting from a fiscal expansion.

3. Endogenous Currency Substitution and The Dornbusch (1976) Model

The Dornbusch model which is modified to incorporate currency substitution can be summarized by the following set of relationships:

(6.1) $$y_t = y_t^d \equiv u + \gamma y_t + \delta\left(e_t - p_t + p_f\right), \quad 0 < \gamma < 1$$

(6.2) $$dp/dt = \pi\left(y_t - \bar{y}\right),$$

(6.3) $$m - p = \phi y_t - \lambda i_t - \beta E\left(de/dt\right),$$

(6.4) $$i_t = i_f + E\left(de/dt\right),$$

(6.5) $$E(de/dt) = de/dt,$$

where y = log of short run income or output; y^d = log of short run aggregate demand; $\bar{y}$ = log of exogenously fixed natural output level; and, the other variables are as defined in the previous section. Except for currency substitution variable in equation (6.3) and the absence of interest rate in equation (6.1), the model described by equations (6.1) to (6.5) is exactly the Dornbusch model. Unlike in the portfolio balance model discussed in the preceding section, here, in the short run, income or output is variable and the price level is sticky.

Equations (6.1) and (6.2) describe the goods market while equations (6.3), (6.4) and (6.5) describe the assets market. Aggregate demand, which depends on output and the real exchange rate, determines output in the short run [(6.1)]. The Phillips curve shows price adjustment as a function of the gap between short run output and fixed natural output [(6.2)].

Equation (6.3) is the money market equilibrium condition, where money demand is a function of output, the interest rate, and a currency substitution variable, the expected rate of change in the exchange rate. Equation (6.4) is the uncovered interest rate parity condition while equation (6.5) is the perfect-foresight assumption.

This model differs from the portfolio balance model of the previous section in the following respects: the links between the trade balance and the slow accumulation of net foreign assets and between real wealth and net foreign assets; the influence of real wealth on money demand, domestic absorption, and trade balance; and, the behavior of output and the price level.

The steady state of the model, attained when $dp/dt = de/dt = E\left(de/dt\right) = 0$, is described by:

(7.1) $$\bar{p} = m - \phi\bar{y} + \lambda i_f,$$

(7.2) $$\bar{i} = i_f,$$

(7.3) $$\bar{e} = \bar{p} - p_f + \frac{(1-\gamma)}{\delta}\bar{y} - \frac{1}{\delta}u = m - p_f + \lambda i_f + \frac{(1-\gamma) - \phi\delta}{\delta}\bar{y} - \frac{1}{\delta}u,$$

where $\bar{y}^d = \bar{y}, \bar{y} = \bar{y}^d \equiv a_1\bar{a} + a_2\bar{T}, \bar{a} = (1/a_1)(u + \gamma\bar{y}),\ \bar{T} = (1/a_2)\delta\left(\bar{e} - \bar{p} + p_f\right)$, and $\bar{y}$ is the natural level of output which is assumed to be exogenously fixed.[15]

[15]Equation (1.1.*i*), $y_t = y_t^d \equiv u + \gamma y_t + \delta\left(e_t - p_t + p_f\right)$, may be derived from $Y_t = Y_t^d \equiv A_t + T_t$ and $y_t = y_t^d \equiv a_1 a_2 + a_2 T_t,\ a_t = \alpha_0 + \alpha y_t$, and $T_t = \alpha_3\left(e_t - p_t + p_f\right)$, where $u = a_1\alpha_0,\ a_1\alpha = \gamma,\ a_2\alpha_3 = \delta,\ 0 < a_1 = A^0/Y^{d0} < 1$, and $a_2 = 1/Y^{d0} > 0$.

The dynamics of the system can be described by:

$$(8.1)\qquad y-\bar{y}=\frac{(\lambda+\beta)\delta}{V}(e-\bar{e})-\frac{(\lambda+\beta)\delta}{V}(p-\bar{p}),$$

$$(8.2)\qquad i-\bar{i}=\frac{\phi\delta}{V}(e-\bar{e})+\frac{(1-\gamma)-\phi\delta}{V}(p-\bar{p}),$$

$$(8.3)\qquad \begin{bmatrix} de/dt \\ dp/dt \end{bmatrix}=\begin{bmatrix} \dfrac{\phi\delta}{V} & \dfrac{(1-\gamma)-\phi\delta}{V} \\ \dfrac{\pi(\lambda+\beta)\delta}{V} & -\dfrac{\pi(\lambda+\beta)\delta}{V} \end{bmatrix}\begin{bmatrix} (e-\bar{e}) \\ (p-\bar{p}) \end{bmatrix},$$

where $V=(1-\gamma)(1+\beta)>0$ and $0<(1-\gamma)<1$, since $0<\gamma<1$. The determinant of the coefficient matrix in (8.3) is negative, implying that the system also yields a saddlepoint equilibrium.[16] Given an initial steady state where $e=\bar{e}_0$ and $p=\bar{p}_0$, any disturbance which affects the equilibrium price level will yield a new steady state where $e=\bar{e}$ and $p=\bar{p}$. Following some disturbance, since the price level is sticky and cannot jump, i.e.,

$$(9.1)\qquad p_0-\bar{p}=\bar{p}_0-\bar{p}=-d\bar{p},$$

the exchange rate must jump to place the system on the stable arm of the saddlepoint,[17] i.e.,

$$(9.2)\qquad e_0-\bar{e}=-\frac{(1-\gamma)-\phi\delta}{\phi\delta+V(-r_1)}(p_0-\bar{p}),$$

[16] The solution to the characteristic equation associated with equation (8.3), $r^2+(-tr(a))r+det(a)=0$, is $r_1,r_2=\left\{tr(a)\pm\left((-tr(a))^2-4det(a)\right)^{1/2}\right\}/2$, where $tr(a)=r_1+r_2=(\phi\delta-\pi(\lambda+\beta)\delta)/V$ and $det(a)=r_1r_2=-\pi\delta/V<0$.

[17] This condition requires that the coefficient k_2 associated with the unstable root r_2 be zero: $k_2=0=\left((\phi\delta/V+(-r_1))/(r_2-r_1)\right)(e_0-\bar{e})+\left(((1-\gamma)-\phi\delta/V+(-r_1))/(r_2-r_1)\right)(p_0-\bar{p})$.

where $-\left(\left(1-\gamma\right)-\phi\delta\right)/\left(\phi\delta+V\left(-r_1\right)\right)$ is the slope of the saddle path, and e_0 and p_0 are the values of the exchange rate and the price level following some disturbance.[18]

Now consider a monetary expansion. In the long run [see (7.1) to (7.3)], money is neutral, i.e., it affects nominal variables, equiproportionately $\left(d\bar{e}/dm = d\bar{p}\ dm = 1\right)$, but does not affect real variables. In the short-run, money is not neutral; specifically, the impact effects [see (8.1), (8.2), (9.1) and (7.1) to (7.3)] are $dp_0/dm = 0, d\left(p_0 - d\bar{p}/dm\right) = -dp/dm = -1$, and

(10.1) $$\frac{dy_0}{dm} = \frac{d\left(y_0-\bar{y}\right)}{dm} = \frac{(\lambda+\beta)\delta}{V}\left(1+\frac{\left(1-\gamma\right)-\phi\delta}{\phi\delta+V\left(-r_1\right)}\right) > 0,$$

(10.2) $$\frac{di_0}{dm} = \frac{d\left(i_0-\bar{i}\right)}{dm} = -\frac{\left(1-\gamma\right)}{V} + \frac{\phi\delta}{V}\left(1+\frac{\left(1-\gamma\right)-\phi\delta}{\phi\delta+V\left(-r_1\right)}\right) \lesseqgtr 0,$$

(10.3.*i*) $$\frac{de_0}{dm} = \frac{d\bar{e}}{dm} + \frac{\left(1-\gamma\right)-\phi\delta}{\phi\delta+V\left(-r_1\right)}\left(\frac{d\bar{p}}{dm}\right) = 1 + \frac{\left(1-\gamma\right)-\phi\delta}{\phi\delta+V\left(-r_1\right)} > 0,$$

(10.3.*ii*) $$\frac{d\left(e_0-\bar{e}\right)}{dm} = \frac{\left(1-\gamma\right)-\phi\delta}{\phi\delta+V\left(-r_1\right)} \lesseqgtr 0,$$

where $de_0/dm > 0$, since $1+\left(\left(1-\gamma\right)-\phi\delta\right)/\left(\phi\delta+V\left(-r_1\right)\right) > 0$, implying that the initial response to a monetary expansion is always a depreciation, but $d\left(e_0-\bar{e}\right)/dm \gtreqless 0$ as the marginal propensity to save out of income $(1-\gamma)$ is greater, equal to, or less than the product of the income elasticity of money demand and the real exchange rate elasticity of net exports $(\phi\delta)$, implying that the exchange rate may overshoot, neither overshoot nor undershoot, or undershoot its new long-run equilibrium value.

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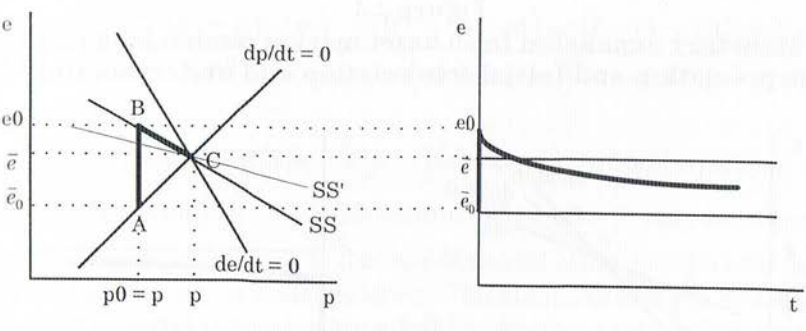
[18] After the jump, the system moves along the stable path where $de/dt = r_1(e_t - \bar{e})$, $e_t - \bar{e} = -\left(\left(\left(1-\gamma\right)-\phi\delta\right)/\phi\delta+V\left(-r_1\right)\right)\left(p_t-\bar{p}\right)$, and $-r_1 > 0$ is the system's speed of adjustment.

With instantaneous output adjustment, a monetary expansion will cause a nominal depreciation and a real depreciation as well since the price level is sticky and the foreign price level is fixed. A real depreciation, in turn, will cause exports and therefore output to increase [(10.1)]. In the money market, money demand will increase as output increases; if at the initial interest rate there is an excess supply (equilibrium; excess demand), i.e., $(1 - \gamma) - \phi\delta > 0$ ($= 0$; < 0), then the interest rate must fall (remain the same; rise) to re-equilibrate the money market [(10.2)]. Since the foreign interest rate is exogenously fixed and if the interest rate declines (remains the same; rises), asset market equilibrium requires that there must be an expectation of a subsequent appreciation (constant exchange rate; depreciation), i.e., that $E(de/dt)$ be negative (zero; positive), which will hold only if initially the exchange rate overshoots (neither overshoots nor undershoots; undershoots) its new long run equilibrium value [(10.3.*i*) and (10.3.*ii*)].[19]

Figure 2.1

Monetary expansion in an asset market model: long run depreciation and initial depreciation and overshooting



[19] In the $e - p$ space, as m increases, the $de/dt = 0$ locus shifts vertically by an amount equal to $(1 - \gamma)/\phi\delta > 0$, the $dp/dt = 0$ locus remains the same, and the SS curve shifts vertically by an amount equal to the exchange rate jump. As β increases, the slope of the de/dt=0 locus, $(de/dp)_{|de/dt=0} = -((1 - \gamma) - \phi\delta)/\phi\delta \lessgtr 0$, and the slope of the $dp/dt = 0$ locus, $(de/dp)_{|dp/dt=0} = 1$, remain the same, and since the slope of the SS curve is $(de/dp)_{|SS} - ((1-\gamma)-\phi\delta)/(\phi\delta + V(-r_1)) \lessgtr 0$, the SS curve becomes flatter when downward sloping (downward sloping instead of horizontal; steeper when upward sloping), as shown in Figure 2.1 (2.2; 2.3). Consequently, $d(-r_1)/d\beta = 0^{-1/2}(\lambda + \beta)^{-1}((\phi\delta/V)(-r_1) - (\pi\delta/V)) \lessgtr 0$.

Figure 2.2
Monetary expansion in an asset market model: long run depreciation and initial depreciation and neither overshooting nor undershooting

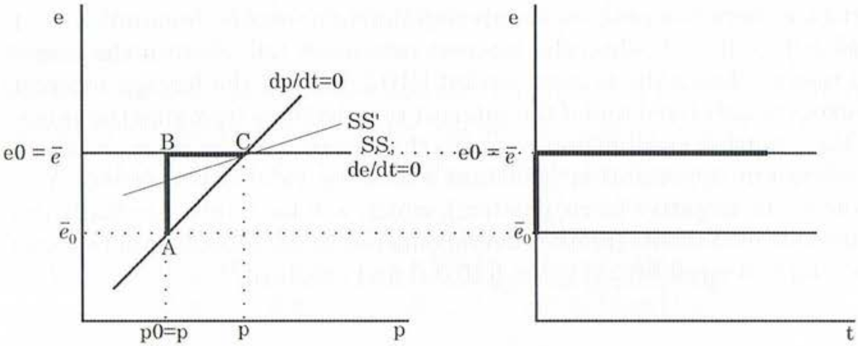
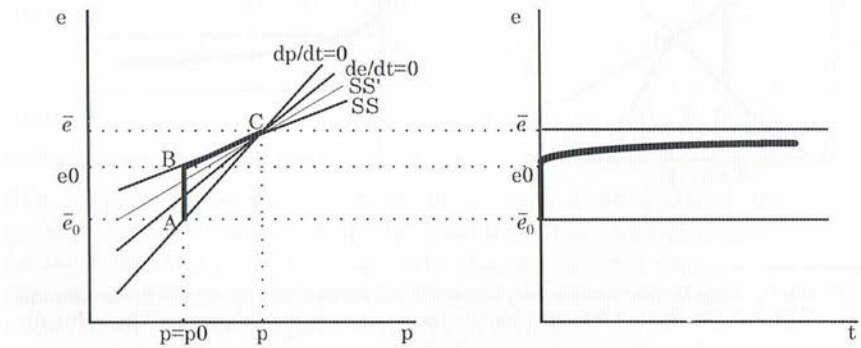


Figure 2.3
Monetary expansion in an asset market model: long run depreciation and initial depreciation and undershooting



In real terms, the domestic currency also depreciates initially:

(10.4.*i*)

$$\frac{d\left(\left(e_0 - p_0 + p_f\right) - \left(\bar{e} - \bar{p} + p_f\right)\right)}{dm} = \frac{d\left(e_0 - p_0 - p_f\right)}{dm} = \frac{de_0}{dm} = 1 + \frac{\left(1-\gamma\right) - \phi\delta}{\phi\delta + V\left(-r_1\right)} > 0,$$

where nominal and real depreciation arising from monetary expansion are the same, $de_0/dm = d\left(e_0 - p_0 - p_f\right)/dm$, since p cannot jump and p_f is exogenously fixed, and real depreciation and extent of real overshooting are also the same, $d\left(e_0 - p_0 + p_f\right)/dm = d\left(\left(e_0 - p_0 + p_f\right) - \left(\bar{e} - \bar{p} + p_f\right)\right)/dm$, since $\left(\bar{e} - \bar{p} + p_f\right)$ remains the same.

The effect of increased currency substitution on exchange rate volatility is given by:

(10.4.*ii*)

$$\frac{d\left(de_0/dm\right)}{d\beta} = \frac{d\left(d\left(e_0 - \bar{e}\right)/dm\right)}{d\beta} = \frac{-\left(\left(1-\gamma\right) - \phi\delta\right)\pi\delta\left(1 + \left(\lambda+\beta\right)\left(-r_1\right)\right)}{\left(\phi\delta + V\left(-r_1\right)\right)^2\left(\lambda+\beta\right)V\left(\right)^{1/2}} \lesseqgtr 0,$$

where $d\left(de_0/dm\right)/d\beta = d\left(d\left(e_0 - \bar{e}\right)/dm\right)/d\beta$, since $d\left(d\bar{e}/dm\right)/d\beta = 0$, and $\left(\right)^{1/2} = \left(\left(-tr(a)\right)^2 - 4\,det(a)\right)^{1/2} > 0$. The term $((1-\gamma) - \phi\delta > 0)$ may be negative, zero, or positive corresponding to the case of overshooting, neither overshooting nor undershooting, or undershooting. This means that if, for some given value of β, the initial responses are a fall (no change; a rise) in the interest rate, an expectation of a subsequent appreciation (constant exchange rate; depreciation), and a depreciation and overshooting (neither overshooting nor undershooting; undershooting), then an increase in the value of β will, initially, cause the interest rate to fall by a smaller amount (rise; rise by a larger amount) and, hence, the domestic currency to depreciate and overshoot by a smaller amount (undershoot; undershoot by a larger amount) so as to create an expectation of a subsequent smaller appreciation (depreciation; larger depreciation).

The implication is that increased currency substitution will moderate (reinforce) the initial fall (rise) in the interest rate and, thus, will dampen the extent of initial depreciation and reduce (increase) the extent of overshooting (undershooting) resulting from a monetary expansion.[20] This is so because increased currency substitution makes the downward sloping (horizontal; upward sloping) saddle path flatter (downward sloping instead of horizontal; steeper), as shown in Figures 1.1, 1.2, and 1.3.

On the other hand, if output is fixed, then effectively, $\gamma = \phi = 0$ in the short run, and as a result of either a monetary expansion, unambiguously, the interest rate will decline, and the domestic currency will depreciate and overshoot its new long run equilibrium value.[21] Increased currency substitution will also tend to dampen the interest rate decline and both the depreciation and overshooting of the exchange rate.[22]

Finally, consider a fiscal expansion and assume again that $u = u_0 + u_1 g$. Because a change in government spending does not affect $\bar{p}\left(dp_0/dg = d\bar{p}/dg = 0\right)$, there are no dynamic effects, i.e., the steady state and impact effects are the same, and therefore the degree of currency substitution does not matter. Furthermore, fiscal expansion leaves the interest rate unaffected $\left(di_0/dg = d\bar{i}/dg = 0\right)$ and causes nominal and real appreciation $\left(de_0/dg = d\bar{e}/dg = -(1/\delta)u_1 = d\left(e_0 - p_0 - p_f\right)/dg = d\left(\bar{e} - \bar{p} + p_f\right)/dg\right)$ and a full crowding out of net exports $\left(dT_0/dg = d\bar{T}/dg = (\delta/a_2)(-1/\delta)u_1\right)$, and thus output remains the same $\left(dy_0/dg = dy_0^d = 0 = d\bar{y}/dg = d\bar{y}^d/dg\right)$. As in the Mundell-Fleming model, fiscal policy is ineffective in influencing output under flexible exchange rates and perfect capital mobility and substitutability.

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[20] Given equations (10.4) and (10.5.*iii*), it follows that both real exchange rate depreciation and overshooting will be dampened.

[21] The effects are $di_0/dm = d\left(i_0 - \bar{i}\right)/dm = -1/(\lambda + \beta) < 0$, $de_0/dm = d\left(e_0 - p_0 + p_f\right)/dm = d\left(\left(e_0 - p_0 + p_f\right) - \left(\bar{e} - \bar{p} + p_f\right)\right)/dm = 1 + \left(1/(\lambda+\beta)(-r_1')\right) > 1$, and $d\left(e_0 - \bar{e}\right)/dm = 1/(\lambda+\beta)(-r_1') > 0$. The domestic currency also unambiguously depreciates in real terms and "rises" above its unchanged long run equilibrium value.

[22] $d\left(de_0/dm\right)/d\beta = -\left((\lambda+\beta)(-r_1')\right)^{-2}(\lambda+\beta)^{-1}0^{-1/2}\pi\delta\left(1+(\lambda+\beta)(-r_1')\right) = d\left(d\left(e_0 - \bar{e}\right)\right)/dm/d\beta$, and $d\left(-r_1'\right)/d\beta = -0^{-1/2}(\lambda+\beta)^{-2}\pi\delta < 0$.

Thus, in this model, it is monetary policy, and not fiscal policy as in the portfolio balance model, which can be a source of exchange rate volatility, and increased currency substitution will dampen the extent of depreciation and hence moderate (reinforce) undershooting resulting from a monetary expansion.

5. Conclusion

This paper has employed two small, open economy macro models of exchange rate determination—a portfolio balance model and an asset market model—to examine the implications of endogenous currency substitution on exchange rate volatility arising from monetary and fiscal policies. It is shown that the degree of currency substitution affects the response of the exchange rate and hence the extent of exchange rate overshooting and undershooting.

In the portfolio balance model, monetary policy has no dynamic effects, and it is fiscal policy which can be a source of exchange rate volatility. As a result of a fiscal expansion and if the wealth elasticity of money demand and the real exchange rate elasticity of net exports are both sufficiently small (large) and the elasticity of net exports with respect to wealth is sufficiently large (small), the domestic currency will appreciate (depreciate) in the long run but initially, since the interest rate rises unambiguously, there must be an expectation of a subsequent depreciation and hence the domestic currency must also appreciate (depreciate) and overshoot (undershoot) its new long run equilibrium value. Increased currency substitution makes the downward sloping saddle path flatter and hence reduces (increases) the extent of depreciation and dampens the extent of overshooting (undershooting).

In contrast, in the asset market model, it is monetary policy, and not fiscal policy, which can be a source of exchange rate volatility. Specifically, as a result of a monetary expansion and if the income elasticity of money demand and the real exchange rate elasticity of net exports are both sufficiently small (large) and the marginal propensity to save out of income is sufficiently large (small), the domestic currency unambiguously depreciates in the long run but initially the interest rate falls (rises) and hence the domestic currency must also depreciate but overshoot (undershoot) its new long run equilibrium value. Here, increased currency substitution makes the downward (upward) sloping saddle path flatter (steeper) and hence reduces the extent of depreciation and dampens (reinforces) the extent of overshooting (undershooting).

In the portfolio balance (asset market) model, whether the exchange rate will overshoot or undershoot in response to a fiscal (monetary) expansion depends on the marginal propensity to import out of wealth (to save out of income) relative to the product of the wealth (income) elasticity of money demand and the real exchange rate elasticity of net exports. Thus, whether fiscal or monetary policy will cause excessive exchange rate volatility is an empirical question. Overshooting is definitely not desirable because the exchange rate becomes volatile in the sense that the initial depreciation is followed by an appreciation. Since exchange rate changes have pervasive effects on the economy and, for given values of the wealth (income) elasticity of money demand and the marginal propensity to import (save) out of wealth (income), policies should be directed toward increasing the responsiveness of net exports to real exchange rate changes such that the extent of overshooting is minimized.

On the other hand, in the portfolio balance (asset market) model, when the response to a fiscal (monetary) expansion is undershooting, increased degree of currency substitution tends to increase (reduce) the extent of initial depreciation and hence dampen (reinforce) the extent of undershooting and reduce (increase) the extent of subsequent depreciations. This means that increased currency substitution makes the initial depreciation larger (smaller) and the subsequent depreciations smaller (larger). There is a trade-off between initial adjustment and subsequent adjustments or the economy's speed of adjustment during transition. Whether the trade-off and hence the degree of undershooting will matter will depend on, among many other factors, the economy's ability and need to buy time, and its ability to exploit time to its advantage.

In both models, increased currency substitution tends to dampen overshooting; however, in the portfolio balance (asset market) model, increased currency substitution tends to reduce (reinforce) the extent of undershooting.

Currency substitution has been claimed as a source of increased exchange rate volatility and policy interdependence. In contrast, the result of this paper for both models—that currency substitution reduces exchange rate volatility by reducing the degree of overshooting—suggests that currency substitution is not necessarily destabilizing.

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