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ABSTRACT

We show that if domestic and foreign bonds are imperfect substitutes for each other and the exchange rate is fixed, then, unlike under the perfect substitutability assumption, uncertainty about monetary policy reactions affects the timing of balance-of-payments crises.

1 INTRODUCTION

In the literature on balance-of-payments crises it is shown that an anticipated shift from a fixed exchange rate regime to a floating exchange rate regime is associated with a speculative attack on the currency and that the regime shift occurs without any discrete jump in the exchange rate.[1] Willman (1987a) showed that in a model with uncovered interest parity uncertainty about monetary policy reactions in response to a speculative attack does not affect the results obtained under the assumption of perfect foresight.

In this paper we show that, if the uncovered interest parity assumption is abandoned, then the size and the timing of the speculative attack is no longer insensitive with respect to uncertainty about monetary policy reactions. In addition, the regime shift from the fixed to the floating exchange rate regime, if it is realized, is associated with a discrete jump in the exchange rate.

2 THE MODEL

We employ a full-employment small open economy model with purchasing power parity. Domestic bonds are assumed to be non-tradeable and foreign bonds tradeable. Domestic and foreign bonds are imperfect substitutes for each other in the portfolios of domestic residents.

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[1]See e.g. Krugman (1979), Flood and Garber (1984), Connolly and Taylor (1984), Obstfeld (1984), Calvo (1987) and Willman (1987b).

Foreign reserves are assumed to be in the form of gold or foreign currency.

Following the general convention, we ignore interest receipts as arguments of disposable income and net foreign interest income in the current-account balance. The current account B(t) in real terms can now be expressed as the difference between real domestic output and real private and government expenditure. Government expenditure is assumed to be constant. Under these assumptions the current account balance depends only on the real interest rate as follows:

$$B(t) = a_0 + a_1[r(t) - E_t\dot{p}(t)]; \qquad a_0 < 0,\ a_1 > 0 \tag{1}$$

where r(t) is the domestic nominal interest rate and $\dot{p}(t)$ is the domestic inflation rate. E_t denotes the expectation operator conditional on information available at time t.

We specify the following equations for the net demand for foreign assets and for the transactions demand for money

$$F(t) = b_0 - b_1[r(t) - E_t\dot{p}(t)]; \qquad b_1 > 0 \tag{2}$$

$$r(t) = c_0 - c_1[m(t) - p(t)]; \qquad c_0 \text{ and } c_1 > 0 \tag{3}$$

where F(t) is the real value of the stock of foreign assets held by domestic residents, m(t) the logarithm of nominal money balances and p(t) the logarithm of the domestic price level.

In specifying equation (2) it was assumed that the foreign interest rate stays constant and that the foreign price level equals one. It follows from the latter assumption that the exchange rate can be identified with the domestic price level. Accordingly, in equation (2) the domestic inflation rate $\dot{p}(t)$ measures the rate of depreciation of the domestic currency. The demand-for-money equation (3) has been solved for the domestic nominal interest rate, which depends negatively on the logarithm of the real money balances. The nominal money balances are assumed to be the exogenous control variable of the monetary authority.

After writing the identity for the change in foreign reserves R(t), the model is closed.

$$\dot{R}(t) = B(t) - \dot{F}(t) \tag{4}$$

3 THE CASE OF PERFECT FORESIGHT

In this section our analysis proceeds in three stages. First, the behaviour of foreign reserves is studied in the fixed exchange rate regime. Second, the determination of the exchange rate in the flexible rate regime is examined. Third, the regime shift from the fixed to the floating exchange rate regime is studied. This is done under the assumptions of perfect foresight and that the fixed exchange rate regime is abandoned once the foreign reserves have been depleted to zero.

Assume $p(t) = \bar{p}$ and that the central bank pegs nominal money balances at the level $m(t) = m_0$. Inserting now equation (3) into (1), we obtain

$$B(t) = a_0 + a_1c_0 - a_1c_1(m_0 - \bar{p}) = B_0 \tag{5}$$

As we assume that $m_0 > \bar{p} + (a_0 + a_1c_0)/a_1c_1$, there is a deficit in the current account, i.e. $B_0 < 0$. As also $\dot{F}(t) = 0$, equation (4) implies the following relation for foreign reserves:

$$R(t) = R_0 + B_0t \tag{6}$$

where R_0 is the stock of foreign reserves at t = 0. From (6) we see that the foreign reserves are depleted to zero and a balance-of-payment crisis is inevitable.

In the flexible exchange rate regime, after setting $\dot{R}(t) = 0$, equations (1) - (4) and the money supply rule $m(t) = m_0$ yield the following second order equation for the exchange rate:

$$b_1\ddot{p}(t) + (a_1 - b_1c_1)\dot{p}(t) - a_1c_1p(t) = B_0 - a_1c_1\bar{p} \qquad (7)$$

Assuming that the exchange rate depends only on market fundamentals, equation (7) implies the following solution for the exchange rate:

$$p(t) = ke^{-a_1t/b_1} + \bar{p} - B_0/a_1c_1 \qquad (8)$$

where k is an arbitrary constant multiplying time exponential in the stable root.

Essential from the point of view of the timing of the regime shift is that when it occurs the level of the exchange rate cannot jump discretely. This continuity condition precludes "abnormal" profit or loss opportunities (see Flood & Garber (1984)).

Denote the time of the collapse of the fixed exchange rate regime by T. With $p(T) = \bar{p}$ as an initial condition, the arbitrary constant k can be solved and equation (8) can be written in the form:

$$p(t) = (B_0/a_1c_1)e^{-a_1(t-T)/b_1} + \bar{p} - B_0/a_1c_1; \qquad t > T \qquad (9)$$

Equation (9) states that at t = T the exchange rate starts depreciating from the level $\bar{p}$ towards the level $\bar{p} - B_0/a_1c_1$, which is the level of the exchange rate that brings the current account into balance. Although there is no jump in the exchange rate in connection with the exchange rate regime shift, there is a jump in the rate of depreciation of the exchange rate. At time T the depreciation rate jumps from zero to $\dot{p}(T) = - B_0/b_1c_1 > 0$.

As can be seen from equation (2), the rate of depreciation at t = T also causes a portfolio shift from domestic assets into foreign assets. This shift, which we denote by $\Delta F(T)$, can be identified as a speculative attack and its size is $\Delta F(T) = b_1\dot{p}(T) = - B_0/c_1$.

By definition the size of the speculative attack equals the amount of reserves lost in the attack. Equation (6) defines the pre-attack level of reserves. By setting $R(T) = \Delta F(T)$, the exact timing of the attack can be solved. We obtain

$$T = - (R_0/B_0) - 1/c_1 \qquad (10)$$

We see that in the case of perfect foresight our results support in many respects those obtained under the assumption of uncovered interest parity. The main merit in adopting the portfolio asset model of the balance of payments is that it introduces the current account balance explicitly into the analysis. The exact timing and the size of the speculative attack depend on all factors affecting the current account balance.

4 THE CASE OF UNCERTAIN MONETARY POLICY REACTIONS

The central bank is not, however, forced to abandon the fixed exchange rate regime at the moment the foreign reserves have been exhausted to the critical lower bound. The continuation of the fixed exchange rate regime can be rescued by skrinking the supply of money sufficiently.

In this section we study how this kind of uncertainty changes the results obtained in the preceding section.

Assume that in the pre-attack fixed exchange regime the central bank follows the money supply rule $m(t) = m_0$. However, prior to the moment the foreign reserves have been depleted to zero, there is uncertainty about if the exchange rate will be allowed to float freely with no change in the money supply or if the money supply will be changed consistent with the fixed exchange rate regime, i.e. $m(t) = m_1 < \bar{p} + (a_0 - a_1c_0)/a_1c_1 < m_0$. The former alternative is expected to occur with probability π and the latter alternative with probability $1 - \pi$.

The post-attack expected exchange rate, with expectations formed prior to the speculative attack, is now a weighted average of the freely floating exchange rate determined by equation (8) and the fixed exchange rate $\bar{p}$, i.e.

$$E_t p(\tau) = \pi[ke^{-a_1\tau/b_1} + \bar{p} - B_0/a_1c_1] + (1 - \pi)\bar{p}; \; t < T_1^-, \; \tau > T_1^+ \quad (11)$$

where T_1^- indicates the instant before and T_1^+ the instant after the attack.

By using the continuity condition $E_t p(T_1^+) = \bar{p}$, the constant k can be solved. We obtain $k = (B_0/a_1c_1)\exp(-a_1T_1/b_1)$. Now, by differentiating (11) with respect to time at $t = T_1$, we obtain $E_t\dot{p}(T_1^+) = \pi B_0/b_1c_1$. Proceeding as in preceding section, this implies that the size of the speculative attack $\Delta F(T_1) = -\pi B_0/c_1$ and the exact timing of the attack is

$$T_1 = -(R_0/B_0) - \pi/c_1 \quad (12)$$

We see that, if $\pi < 1$ then $T_1 > T$, and that the closer to zero is π (i.e. the smaller is the probability that the exchange rate regime shift is allowed to take place) the closer to zero is the size of the attack and the later it occurs.

Assume next that the post-attack policy regime chosen by the central bank is the freely floating exchange rate with $m(t) = m_0$. After the choice has been made there is no uncertainty in the model. This implies that the actual exchange rate is determined by equation (8).

As the stock of foreign assets F(t) has changed into a predetermined state variable, information about its size at $t = T_1$ provides us with the initial condition we need in solving k. At $t = T_1$ the post-attack level of the foreign assets $F(T_1) = F_0 + \Delta F(T_1)$, where F_0 is the stock of foreign assets in the pre-attack fixed exchange rate regime equalling $F_0 = b_0 - b_1c_0 + b_1c_1(m_0 - \bar{p})$. On the other hand, equations (2), (3) and (8) imply:

$$F(T_1) = F_0 + b_1B_0/a_1 - (b_1c_1 + a_1)ke^{-a_1T_1/b_1} \quad (13)$$

Now as a solution for k we obtain:

$$k = [(b_1c_1 + \pi a_1)/a_1c_1(b_1c_1 + a_1)]B_0e^{-a_1T_1/b_1} \quad (14)$$

Equations (8) and (14) imply:

$$p(T_1) = \bar{p} + (1 - \pi)a_1/a_1c_1(b_1c_1 + a_1) > \bar{p}, \quad \text{if } \pi < 1 \quad (15)$$

Hence, with $\pi < 1$ there is a jump in the exchange rate at $t = T_1$. This jump is the greater the closer π is to zero.

If, instead, the money supply is changed to be consistent with the fixed exchange rate $p(t) = \bar{p}$, then there is an upward jump in the nominal interest rate at $t = T_1$, the size of which is $\Delta r(T_1) = c_1(m_0 - m_1)$, implying an instantaneous capital inflow and the turning of the current account deficit into surplus.

Hence, the simultaneous risk of discrete depreciation and a discrete rise in the domestic nominal interest rate explains why uncertainty about monetary policy reactions affects the behaviour of investors. Under the assumption of uncovered interest parity this kind of trade-off between risks is lacking.

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