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ACTIVE PEGGING, RATIONAL EXPECTATIONS, AND AUTONOMY OF MONETARY POLICY*

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A simple stochastic model of an open economy is used to analyze the effects of exchange rate policies and variability in the money supply process on monetary autonomy. With deterministic exchange rate policies (active pegging), and assuming serially uncorrelated expectations monetary autonomy can be increased although not without limit.

1. INTRODUCTION

Many recent stochastic models of the open economy assume that the exchange rate is perfectly flexible and that expectations are formed rationally. One of the questions addressed in the framework of these models is the variability of the exchange rate with respect to various stochastic shocks and the degree of capital mobility.[1] However, these models are not suitable for analyzing those especially small economies pegging their currencies either to a major currency or to a basket of currencies.

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1 For recent contributions, see Barro (1978), Driskill and McCafferty (1980a, 1980b), Turnovsky and Bhandari (1982) and Eaton and Turnovsky (1984).

Under completely fixed exchange rates and perfect capital mobility, a small country cannot conduct an independent monetary policy. With the presence of exchange rate risk and risk aversion, capital mobility is less than perfect and monetary policy gains autonomy. The exchange risk can arise from discrete adjustments of the domestic currency or from active pegging. Since the degree of capital mobility is inversely related to exchange rate risk, one policy option to acquire greater monetary autonomy is to increase exchange risk.

The aim of this paper is to examine the effects of domestic exchange rate policies on exchange risk and the autonomy of domestic monetary policy. Section 2 presents a simple stochastic model of the monetary sector of an open economy with fixed but adjustable exchange rates, rational expectations and exogenous exchange rate risk. In section 3 the concept of consistent exchange rate risk is introduced.

2. THE MODEL

The model is a simple version of the monetary model developed by Kouri and Porter (1974). It is assumed that domestic agents can allocate their wealth between domestic money and one-period domestic and foreign bonds, while foreigners hold neither domestic money nor bonds. For simplicity, income and prices are assumed to be exogenous. With demand for money defined as $M^d = M(r)$, $M_r < 0$, where r is domestic interest rate, the equilibrium condition in the domestic money market is

$$M(r) = M_r \Delta r = \Delta L - \Delta F + X. \qquad (1)$$

The right-hand side of (1), the money supply, is derived from the consolidated balance sheet of the banking sector, L being domestic credit creation, F the stock of foreign securities and X the current account.

Assuming only exchange rate risk and risk aversion, the net demand for foreign securities is derived in the mean-variance framework [Dornbusch (1983)] as

$$F = \frac{1}{\delta^2 A}(r^f + \tilde{e} - r), \qquad (2)$$

where r^f is the foreign interest rate, A (A > 0) is a measure of absolute risk aversion, $\tilde{e}$ is the difference between the currently expected and current exchange rate expressed in logarithmic form being a first order approximation of the expected relative exchange rate change, and δ^2 is the variance of the one-period exchange rate forecast. In the case of perfect capital mobility with either risk neutrality of absence of exchange risk uncovered interest parity prevails.

Taking the difference of (2) and solving with (1), the following reduced form is obtained [Tarkka (1984)]

$$\Delta F = \alpha[-M_r \Delta r^f + \Delta L + X - M_r \Delta\tilde{e}] \qquad (3)$$

$$\Delta r = \alpha[\Delta r^f + \delta^2 A(-\Delta L - X) + \Delta\tilde{e}] . \qquad (4)$$

In the model (3) - (4) α is the offset coefficient expressed in terms of the structural parameters as $\alpha = 1/(1 - \delta^2 AM_r)$ with $0 \leq \alpha \leq 1$. In the following it is assumed that both risk aversion A and the interest rate response of money demand M_r are constants. The offset coefficient is equal to unity in the absence of exchange rate risk and there is no monetary autonomy. In the other polar case $\alpha = 0$ when $\delta^2 \to \infty$ and monetary autonomy is complete.

The offset coefficient in the model is thus an important parameter determining the degree of monetary autonomy. Clearly, with a completely fixed exchange rate $\alpha = 1$ and the issue is then whether the monetary authority can increase policy autonomy by active pegging. To address this question the following policy rule is added to the model

$$e_t - e_{t-1} = a\Delta F \ , \ a > 0 \ . \tag{5}$$

The rational expectations solution of the model is obtained by substituting (3) into (5) and applying conditional expectations held at time t-1. Thus

$$b[E_{t-1}e_{t+1} - \frac{2b-1}{b}E_{t-1}e_t + \frac{b-1}{b}\ e_{t-1}] = a\alpha E_{t-1}J_t \ , \tag{6}$$

where $b = a\alpha M_r < 0$ and $J_t = \Delta L_t + X_t$ and it is assumed that $\Delta r_t^f = 0$ and $E_{t-1}e_{t-1} = e_{t-1}$.

Equation (6) can be written as a stochastic second order difference equation

$$b[1 - \frac{2b-1}{b}\ B + \frac{b-1}{b}\ B^2]E_{t-1}e_t = a\alpha E_{t-1}J_{t-1}, \tag{7}$$

where the operator B is defined as $BE_te_{t+1} = E_te_t$.

Equation (7) is factorized as

$$b(1 - \lambda_1 B)(1 - \lambda_2 B)E_{t-1}e_t = a\alpha E_{t-1}J_{t-1} \ , \tag{8}$$

where $\lambda_1 = 1$ and $\lambda_2 = (b-1)/b > 1$ are the characteristic roots. To satisfy the transversality condition equation (8) is solved by dividing by the unstable factor $1-\lambda_2 B$ [see Sargent (1979)]. Thus

$$E_{t-1}e_t = e_{t-1} + \frac{1}{1-b}\sum_{i=0}^{\infty}(\frac{1}{b-1})^i\ a\alpha E_{t-1}J_{t+i}. \tag{9}$$

Leading (9) one period forwards it can be seen that the conditional expectation of the exchange rate in period t for t+1 depends on future expectations held at t of the process J_{t+1+i} , i = 0, 1, ... For example, expectations of future cuts in domestic credit creation or of deficits in the current account induce expectations of revaluation.[2]

Next, monetary autonomy is considered in the case of some simple expectations mechanisms assuming that exchange risk is evaluated independently of expectations. If expectations are uniform so that $E_t L_{t+1+i} = 0$, for all t and i, the offset coefficient calculated from (3) is $\alpha_o = \alpha/(1-b)$ since $\Delta\tilde{e}=[a\alpha/(b-1)]\Delta L_t$. In this case monetary autonomy can be strengthened by increasing the coefficient a.

If expectations are uniform with $E_t J_{t+1+i} = \Delta L_{t+1}$, $i = 0$ and $E_t J_{t+1+i} = 0$, i = 1, 2, ... , the coefficients for the periods t and t+1 are $\alpha_t^1 = \alpha_o$ and $\alpha_{t+1}^1=\alpha(-b)/(1-b)=\alpha_o(-b)$. As a limiting case consider $E_t J_{t+1+i} = \Delta L_{t+1}$, i = 0, 1, ..., giving $\alpha_t^2 = \alpha(1+b)$ and $\alpha_{t+1}^2=\alpha(-b)$

Thus in the last two cases it can be seen that with increasingly forward looking expections, monetary autonomy in period t also decreases. However, the total offset coefficients for periods t and t+1 are

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2 This result is due to the simple policy rule (5). Alternatively, assuming a rule of the form

$$e_t - e_{t-1} = a'\Delta R = a'(X - \Delta F) , a' < 0, \qquad (5')$$

where R is the foreign exchange reserves of the central bank, expectations of current account deficits, assuming $0 < \alpha < 1$, would induce expectations of devaluation. In this case, the direct effect of the deficit expectation dominates the indirect effect of capital imports increasing reserves. For simplicity, the general propositions of the paper are derived only in the case of rule (5). Analoguous results could be derived using rule (5').

constant and equal to α, implying a corresponding increase in autonomy in period t+1 for sufficient active pegging.

3 CONSISTENT EXCHANGE RATE RISK

Above it was assumed that in spite of rational expectations exchange rate risk was parametrically given. Since the exchange rate risk is not policy invariant according to model (9), it is now assumed that agents' expectations of exchange rate risk are consistent with the full model solution.

The rational expectations equilibrium solution of the model is obtained by substituting (9) into (5) and assuming that the process J_{t+1+i} is serially uncorrelated with zero mean and finite variance δ_{ε}^2. This gives

$$e_{t+1} = e_t + \frac{a\,\alpha}{1-b}\,\Delta L_{t+1} = e_t + H_{t+1}\,. \qquad (10)$$

From (10) consistent exchange rate risk is obtained as a conditional one-period variance of e_{t+1};[3] $\delta^2 = \text{var}(e_{t+1}) = \text{var}(H_{t+1})$. The solution is

$$\delta^2 = \left(\frac{a\alpha}{1-b}\right)^2 \delta_{\varepsilon}^2 = \frac{a^2}{(1+a+\delta^2)^2}\,\delta_{\varepsilon}^2 \quad . \qquad (11)$$

In the last expression it is assumed that A = 1 and $M_r = -1$. It can be seen that δ^2 depends on a and but since equation (11) is third degree in δ^2 it cannot be solved explicitly. However, as the right-hand side of (11) is a decreasing function of δ^2 for $\delta^2 \geq 0$, there exists exactly one positive solution:

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[3] Note that because $\lambda_1 = 1$ in (9) the asymptotic variance of the exchange rate is unbounded.

$\delta^2 = \delta^2(a, \delta_\varepsilon^2)$. It is easily seen that $\partial\delta^2/\partial a > 0$. Thus, with more active pegging the monetary authority can increase monetary autonomy. In the case where $a = 0$, also $\delta^2 = 0$ and autonomy cannot be increased without limit since the right hand side of (11) is bounded for all $\delta^2, a \geq 0$. This is due to deterministic pegging. Obviously with a stochastic floating rule the limit disappears. Also, $\partial\delta^2/\partial\delta_\varepsilon^2 > 0$ and $\delta^2 = 0$, when $\delta_\varepsilon^2 = 0$. In this case, however, more uncertainty in expectations, i.e. a rise in δ_ε^2, increases monetary autonomy without limit.[4]

As a conclusion it can be noted that, according to the model, monetary policy is more autonomous the more active exchange rate policies are pursued and/or the more variability there is in expectations concerning the money supply process and the less these expectations are discounted to the present. With deterministic exchange rate policies (5) or (5') and assuming serially uncorrelated expectations, monetary autonomy can be increased only in a limited way. If expectations are serially correlated or if the exchange rate policy rule is stochastic, autonomy can be further enhanced.

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4 Assuming more generally that J_{t+1+i} is a Markov process, $E_{t+1}J_{t+1+i} = \mu^i \phi_{t+1}$, $|\mu| < (b-1)/b$, gives

$$\delta^2 = \frac{a^2\delta_\phi^2}{[1 + (1-\mu)a + \delta^2]^2} \quad . \qquad (11')$$

Again it is seen that $\partial\delta^2/\partial a, \partial\delta^2/\partial\delta_\phi^2 > 0$. In this case, however, monetary autonomy can be increased without limit by setting $\mu = 1$.

REFERENCES

Barro, R., 1978, A stochastic equilibrium model of an open economy under flexible exchange rates, Quarterly Journal of Economics 92, 149 - 164.

Dornbush, R., 1983, Exchange rate risk and the macroeconomics of exchange rate determination, in: R. Hawkins, R. Levich and C. Wihlborg, eds., The internationalization of financial markets and national economic policy (JAI Press, Greenwich).

Driskill, R. and S. McCafferty, 1980a, Speculation, rational expectations, and stability of the foreign exchange market, Journal of International Economics 10, 91 - 102.

Driskill, R. and S. McCafferty, 1980b, Exchange-rate variability, real and monetary shocks, and the degree of capital mobility under rational expectations, Quarterly Journal of Economics 94, 577 - 587.

Eaton, J. and S. Turnovsky, 1984, The forward exchange market, speculation, and exchange market intervention. Quarterly Journal of Economics 98, 43 - 69.

Kouri, P. and M. Porter, 1974, International capital flows and portfolio equilibrium, Journal of Political Economy 82, 443 - 467.

Sargent, T., 1979, Macroeconomic theory (Academic Press, New York).

Tarkka, J., 1984, Independence of monetary policy (in Finnish), Bank of Finland Research Department, Research Papers 10/84.

Turnovsky, S. and J. Bhandari, 1982, The degree of capital mobility and the stability of an open economy under rational expectations, Journal of Money, Credit and banking 14, 303 - 326.