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Money and economic growth ☆

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ABSTRACT

The cash in advance and money in utility function models are used to examine whether the nature of fluctuations in economic activities and welfare in three interdependent economies are related to the stocks and growth rate of money. When the money is exogenously introduced in the form of cash in advance, it serves as a medium of exchange and the rate of return in real and nominal assets become equal. Idiosyncratic technological shocks generate fluctuations in the growth rates of capital, output, prices, money, consumption, investment, labour supply and lifetime utilities of households. When households have money endogenously in their utility functions, the stock of money in excess of that required for transactions causes inflation and reduces the amount of capital stock and output in these economies. Both CIA and MIU models support for a steady growth rate of money according to the growth rate of output. While the inflation targeting by manipulating the interest rates for macroeconomic stability is theoretically a prudent policy move, it is impossible for a central bank to eliminate business cycles that arise from shocks to production technology or to other structural features of an economy.

1. Money in growth models

It has been agreed for long that money serves economic purposes as a medium of exchange and unit of standard as well as a standard of differed payment and means of a store (Sproul, 1947). Yet there remains a substantial debate about the neutrality and non-neutrality of money in the long run growth. While Tobin (1965) viewed that money in the form of public debt could be instrumental in channelling savings to investment and hence lead to the higher growth rate, Friedman (1968) opined the growth rate of money should not be greater than that of output for a smooth functioning economy. In theory Sidrauski (1967) showed the role of money in growth, putting money in the utility (MIU) function of an intertemporally optimising representative household and came to the conclusion that money is super neutral, will not have any real impacts and higher rate of growth of money only causes inflation. Similarly Brock (1974) had provided more extensive perfect foresight model to show contribution of money in economic growth. These early views on relations between money and growth are endorsed in subsequent works by Diamond et al. (1983), Hayakawa (1986), Rankin (1992), Gomme (1993), Bank of England (1999, 2001), Balasko (2003), Berentsen, Breu, and Shi (2012) and Aruoba, Waller, and Wright (2011). However there seem to be no explicit numerical analysis on showing fluctuations in macro economic variables under these theoretical exercises. The purpose of this paper is to assess how these theoretical propositions may be brought into numerical analysis

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and whether conclusions reached in those studies are robust enough to the way money is introduced in these models. Growth of money is exogenous in models with cash in advance (CIA) constraints or is endogenous in the models with money in the utility (MIU) functions. Is the super-neutrality proposition of money independent of the way money is introduced in a model? If so super-neutrality should hold in all models whether they have the CIA or the MIU forms. This issue is illustrated with simulations of popular CIA and MIU models discussed in Williamson (2008) and Walsh (1998) to the reasonable set of parameters characterising the three economies. These simulations provide some insights on the role of money in the business cycle and the growth of the model economies.

2. Friedman rule with cash in advance constraint

Friedman is known for his statement that growth rate of the stock of money should equal the growth rate of output. Money is introduced exogenously in a cash in advance monetary economy where a representative household maximises lifetime utility $U(\bullet)$ from consumption (C_t) but experiences disutility from labour efforts put in work, $V(L_t)$. The problem of the economy is to maximise this utility (1) with the technology (2), cash in advance (3) and lifetime budget constraints (4) as:

$$\max \sum_{t=0}^{\infty} \beta^t \left[U(C_t) - V(L_t) \right] \tag{1}$$

subject to a technology constraint:

$$Y_t = zL_t \tag{2}$$

and a cash in advance constraint:

$$P_t C_t + q_t B_{t+1} + P_t s_t X_{t+1} + P_t T_t = M_t + B_t + P_t X_t \tag{3}$$

where $P_t C_t$ is consumption expenditure, P_t a price of goods, C_t a consumption, B_{t+1} is the amount of nominal bonds, q_t is the price of nominal bonds, X_{t+1} real bonds, s_t prices of real bonds, T_t a lump sum tax payment and M_t the stock of money. Budget constraint of the consumer include income from production and allocation of money for the next period.

$$P_t C_t + q_t B_{t+1} + P_t s_t X_{t+1} + P_t T_t + M_{t+1} = M_t + B_t + P_t X_t + P_t z L_t \tag{4}$$

Government controls the money supply and engages itself in an inflationary tax. Its budget constraint for a particular time t is:

$$\overline{M}_{t+1} - \overline{M}_t = -P_t T_t \tag{5}$$

The stock of money grows at a constant rate α, thus $\overline{M}_{t+1} = (1+\alpha)\overline{M}_t$. With this provision, $\alpha \overline{M}_t = -P_t T_t$. Normalising the cash in advance and budget constraint by $\frac{1}{\overline{M}_t}$ and denoting the real values in small case letters, the cash in advance constraint and budget constraints become:

$$p_t C_t + q_t b_{t+1}(1+\alpha) + p_t s_t X_{t+1} + p_t T_t = m_t + b_t + p_t X_t \tag{6}$$

and

$$p_t C_t + q_t b_{t+1}(1+\alpha) + p_t s_t X_{t+1} + p_t T_t + m_{t+1}(1+\alpha) = m_t + b_t + p_t X_t + p_t z L_t \tag{7}$$

The representative agent in the economy chooses C_t, L_t, b_{t+1}, X_{t+1}, m_{t+1} from $t = 0, 1, 2$ to ∞. The Bellman value function for this problem is:

$$v(m_t, b_t, X_t, p_t, q_t, s_t) \max_{C_t, L_t, b_{t+1}, X_{t+1}, m_{t+1}} \left[U(c_t) - V(L_t) \right] + \beta v[m_{t+1}, b_{t+1}, X_{t+1}, p_{t+1}, q_{t+1}, s_{t+1}] \tag{8}$$

3. Dynamic optimisation in CIA model

It is easier to solve the above Bellman problem if it is written in a Lagrangian constrained optimisation problem as:

$$\begin{aligned} \mathcal{L}(C_t, L_t, b_{t+1}, X_{t+1}, m_{t+1}, \lambda_t, \mu_t) = {} & \sum_{t=0}^{\infty} \beta^t \left[U(C_t) - V(L_t) \right] \\ & + \lambda_t \begin{bmatrix} m_t + b_t + p_t X_t - p_t C_t \\ -q_t b_{t+1}(1+\alpha) - p_t s_t X_{t+1} - p_t T_t \end{bmatrix} \\ & + \mu_t \begin{bmatrix} m_t + b_t + p_t X_t + p_t z L_t - p_t C_t \\ -q_t b_{t+1}(1+\alpha) - p_t s_t X_{t+1} - p_t T_t - m_{t+1}(1+\alpha) \end{bmatrix} \end{aligned} \tag{9}$$