Preliminary

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A NOTE ON THE NEUTRALITY OF TEMPORARY MONETARY DISTURBANCES

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In the classical macroeconomic models constructed by Lucas (1972, 1975) and Barro (1976), monetary aggregates are assumed to be generated by a logarithmic random walk. This specification implies that all monetary growth is (a) unanticipated and (b) permanent.

As the primary analytical focus of these studies was the construction of expectationally consistent models of the contemporaneous relationship between unobservable monetary shocks, prices and output, this specification was presumably chosen for technical convenience. However, within this type of model, relaxing the random walk specification potentially leads to real effects of temporary monetary disturbances, a result widely believed to be generally inconsistent with models incorporating rational expectations, on the basis of the discussion of Sargent and Wallace (1975).

For the purposes of the present note, we shall be working within a classical macroeconomic model closely resembling Barro (1976) with the following characteristics: (1) money is the only store of value and bears a fixed (zero) nominal rate of return, (2) output depends positively on the anticipated real rate of return on money, i.e., the expected deflation rate, (3) markets clear, (4) agents form anticipations rationally in the sense of Muth (1961).

Within this framework, temporary monetary disturbances potentially can alter real output by changing the real yields relevant to agents' decisions. However, the extent to which movements in real yields are induced by a temporary monetary disturbance depends on specification of the real balance effect in commodity demand and supply schedules.

The organization of the discussion is as follows. In section I, we make the notion of a temporary monetary disturbance precise, by means of three alternative money supply specifications. Subsequently, in section II, we derive a rational expectations solution for a version of the model in which commodity demand and supply depend on current money balances. In this case, temporary monetary disturbances cause temporary movements in commodity production, while permanent monetary disturbances do not have real effects. By contrast, in section III, we break the strict link between money and prices, working from Friedman's (1957) permanent income perspective. Under this specification, in which only permanent monetary magnitudes are relevant to supply and demand functions, monetary aggregates do not alter real quantities--irrespective of the temporary or permanent character of the disturbances. In section IV we discuss some theoretical interpretations of the alternative behavioral specifications. Section V contains some concluding remarks.

I. Money Supply Specifications

Three alternative specifications of exogenous policy behavior will be considered in the discussion below.[1] The impulse to these stochastic processes for the natural logarithm of the money stock (m_t) is a serially independent normal random variable, ξ_t, with constant variance σ^2_ξ. Specification (1a) is the random walk process, as in Lucas (1972, 1975) and Barro (1976). Specifications (1b) and (1c) are first order autoregressive processes in the level and first difference of the money stock, respectively, where ρ and λ are positive constants less than unity.

(1a) $m_t = \xi_t + m_{t-1}$

(1b) $m_t - \bar{m} = \rho(m_{t-1} - \bar{m}) + \xi_t$ $\quad 0<\rho<1$

(1c) $m_t - m_{t-1} = \lambda(m_{t-1} - m_{t-2}) + \xi_t$ $\quad 0<\lambda<1$

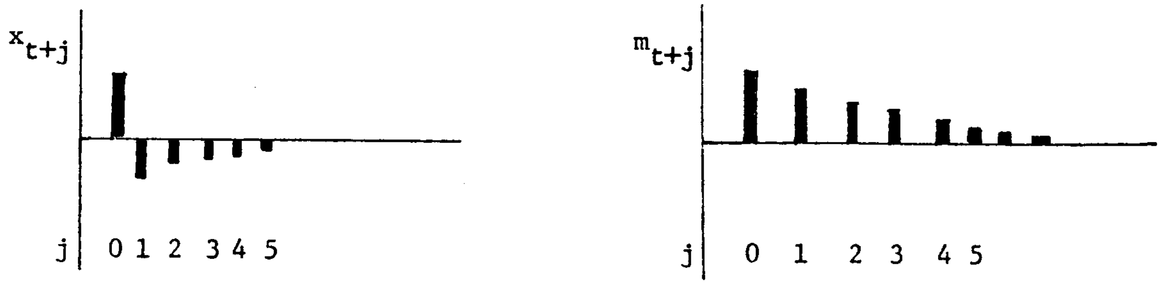
In specification (1b), $\bar{m}$ is the long run level of the money stock. Defining the growth rate $x_t = m_t - m_{t-1}$, these rules imply

(2a) $x_t = \xi_t$

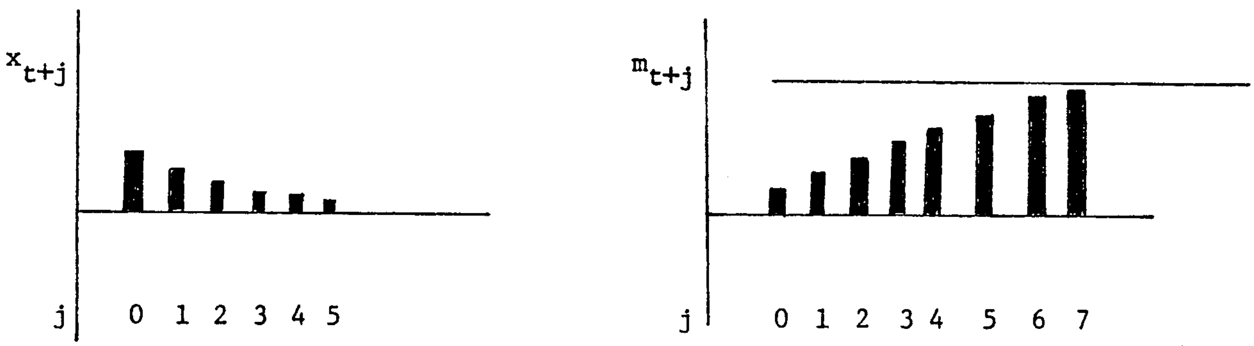
(2b) $x_t = (1 - \rho)(\bar{m} - m_{t-1}) + \xi_t$

(2c) $x_t = \lambda x_{t-1} + \xi_t$

Under the random walk specification, money shocks are permanent and serially independent: at any point in time, expected future money growth is zero.[2] Specification (2b) implies a fixed target money stock ($\bar{m}$) with ρ measuring the rapidity at which deviations from the target are corrected by the authorities. The third specification implies positive serial correlation of money growth from average, with a fraction of abnormal growth being anticipated: however, like the random walk specification, random shocks imply a permanent change in the expected level of money (the process is nonstationary). Figure 1 shows the response of money and money growth to a positive shock, $\xi_t>0$, when all other shocks are assumed zero ($\xi_{t\pm j} = 0$, j = 1, 2, 3...), for the monetary policy specifications 2b and 2c.[3]



$$x_t = (1 - \rho)(\bar{m} - m_{t-1}) + \xi_t$$



$$x_t = \lambda(x_{t-1}) + \xi_t$$

Figure 1

II. A Basic Equilibrium Model

The present section introduces a log-linear model closely related to that constructed by Barro (1976). The main elements are commodity supply and demand schedules, a market clearing condition, and the hypothesis of rational expectations. The supply and demand for the single, nonstorable good y depends on the anticipated one period real return to money and on current real balances.[4] The normal level of output is denoted $\bar{y}$ and the money price of the good y is p.

$$(3)\quad y^s_t = \bar{y} + \alpha_s(p_t - Ep_{t+1}) - \beta_s(m_t - p_t)$$

$$(4)\quad y^d_t = \bar{y} - \alpha_d(p_t - Ep_{t+1}) + \beta_d(m_t - p_t)$$

where following Barro all parameters are treated as positive.[5] Solution of the market clearing condition yields the following price and output equations:

$$(5)\quad p_t = \frac{\alpha}{\alpha+\beta}Ep_{t+1} + \frac{\beta}{\alpha+\beta}m_t$$

$$(6)\quad y_t = \bar{y} - \frac{H}{\alpha+\beta}Ep_{t+1} + \frac{H}{\alpha+\beta}m_t$$

where following compound parameters have been defined: $\alpha \equiv \alpha_s + \alpha_d$, $\beta \equiv \beta_s + \beta_d$, and $H \equiv \alpha_s\beta_d - \alpha_d\beta_s$. In the discussion that follows, the case $H>0$ will be treated for concreteness.

A rational expectations solution for prices may be obtained by the recursive substitution technique. The result is

$$(7)\quad p_t = \left(\frac{\beta}{\alpha+\beta}\right) \sum_{j=0}^{\infty} \left(\frac{\alpha}{\alpha+\beta}\right)^j Em_{t+j}$$ [6]

with the corresponding solution for output being

$$(8)\quad y_t = \frac{H}{\alpha+\beta}\left[m_t - \frac{\beta}{\alpha+\beta} \sum_{j=0}^{\infty} \left(\frac{\alpha}{\alpha+\beta}\right)^j Em_{t+j+1}\right] + \bar{y}$$

Case 1.

Consider first the behavior of prices and output under the random walk specification (1a). In this case, given the assumption of complete contemporaneous information, $Em_{t+j} = m_t$ for all j. Thus, prices and output exhibit a neutral solution

$$(9)\quad p_t = m_t;\quad y_t = \bar{y}$$

and the expected real yield on money is zero, as the expected price level is also equal to m_t

$$(10) \quad Ep_{t+1} = Em_{t+1} = m_t = p_t$$

Thus, the present model reproduces the characteristic result of Lucas and Barro.

Case 2

By contrast, under the alternative specification of monetary behavior (1b) in which deviations from a target money stock are gradually eliminated, the jth period prediction for money is

$$(11) \quad Em_{t+j} = \bar{m} + \rho^j (m_t - \bar{m})$$

Substituting from (11) into (7) and (8), the implied behavior of prices and output is[7]

$$(12) \quad p_t = \bar{m} + \frac{\beta}{\beta+\alpha(1-\rho)} (m_t - \bar{m})$$

$$(13) \quad Ep_{t+j} = \bar{m} + \frac{\beta}{\beta+\alpha(1-\rho)} \rho^j (m_t - \bar{m})$$

$$(14) \quad y_t = \frac{H(1-\rho)}{\beta+\alpha(1-\rho)} (m_t - \bar{m}) + \bar{y}$$

$$(15) \quad Ey_{t+j} = \frac{H(1-\rho)}{\beta+\alpha(1-\rho)} \rho^j (m_t - \bar{m}) + \bar{y}$$

and the expected real return on money is given by

$$(16) \quad Er_{m,t} \equiv p_t - Ep_{t+1} = \frac{\beta(1-\rho)}{\beta+\alpha(1-\rho)} (m_t - \bar{m})$$

A positive monetary shock is illustrated in Figure 2. The operating characteristics of the model may be illustrated by examining the determination of the period "o" price level.

Suppose the price level remains unchanged. This means that, on impact, real balances rise, and an incipient excess demand for goods exists in period "o" at output $\bar{y}$. Therefore, the price level must rise on impact to bring current real balances back down and thereby eliminate the excess demand for goods.

But a rise in the current price level implies anticipated future deflation in this case. If an agent believes that the price level is going to fall, he has incentive to substitute future for current leisure, raise goods supply to the market above normal, and hoard some of his additional income. Carrying this additional money into the next period and taking a capital gain enables him to buy more goods in sum over the two periods for a given total amount of goods supplied to the market.[8]

Now if the price level rises equiproportionately with the money supply on impact, then real goods demand and supply is not affected by the current nominal money supply increase. However, due to the anticipated future deflation, desired current goods supply is increased. The goods market exhibits incipient excess supply. Since we assume market clearing, the price level must rise, but by less than the current money stock. This is shown in the left frame of Figure 2.

The right frame shows the path of real output. It is greatest on impact because the anticipated rate of deflation is at its maximum there. Notice that as $\rho \longrightarrow 1$, monetary shocks become more permanent in character, the solutions approach those of the previous case.

Case 2

Behavior of Prices and Output under (1b)

Response to $\xi_t > 0 \quad \xi_{t\pm j} = 0$, all $j > 0$

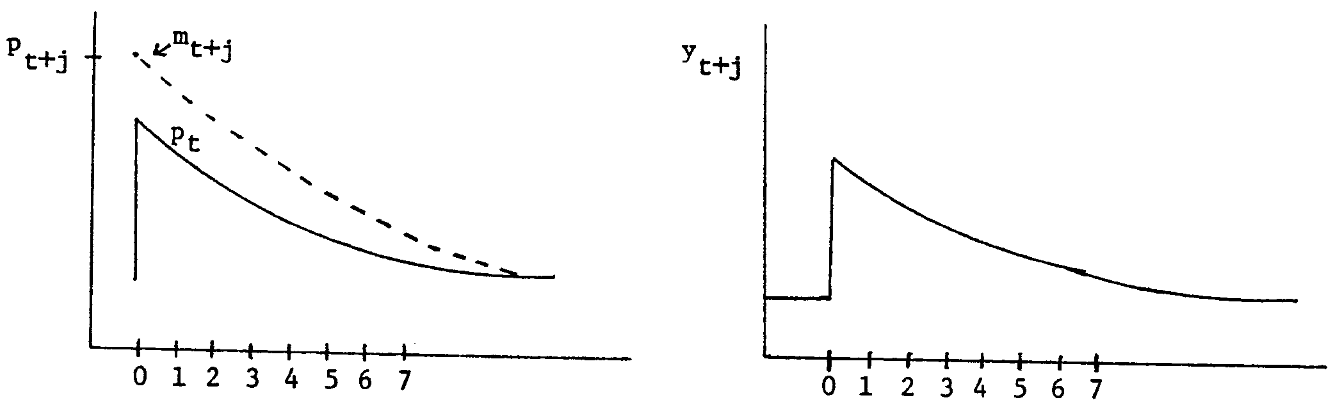


Figure 2

Case 3

The third monetary specification contains elements of each of these solutions, as a given innovation yields both a change in the long run expected value of the money stock and a serially correlated pattern of money growth. The relevant jth period prediction may be written as[9]

$$(17)\quad Em_{t+j} = m_{t-1} + \frac{1}{1-\lambda}(m_t - m_{t-1}) - \frac{\lambda^{j+1}}{1-\lambda}(m_t - m_{t-1})$$

where the first two terms represent the expected new long run level and the latter term is the jth period's discrepancy from the expected long run level.[10]

Substituting from (17) into (7) and (8), the rational expectations solutions for price and expected price are:

$$(18)\quad p_t = [m_{t-1} + \frac{1}{1-\lambda}(m_t - m_{t-1})] - \frac{\beta}{\beta+\alpha(1-\lambda)}(\frac{\lambda}{1-\lambda})(m_t - m_{t-1})$$

$$= m_{t-1} + \frac{\alpha(1-\lambda)}{\beta+\alpha(1-\lambda)}(\frac{\lambda}{1-\lambda})(m_t - m_{t-1})$$

$$(19)\quad Ep_{t+j} = [m_{t-1} + \frac{1}{1-\lambda}(m_t - m_{t-1})] - \frac{\beta}{\beta+\alpha(1-\lambda)}\lambda^{j}(\frac{\lambda}{1-\lambda})(m_t - m_{t-1})$$

and the corresponding solution for output is

$$(20)\quad y_t = \bar{y} - \frac{H(1-\lambda)}{\beta+\alpha(1-\lambda)}(\frac{\lambda}{1-\lambda})(m_t - m_{t-1})$$

$$(21)\quad Ey_{t+j} = \bar{y} - \frac{H(1-\lambda)}{\beta+\alpha(1-\lambda)}(\frac{\lambda}{1-\lambda})\lambda^{j}(m_t - m_{t-1})$$

with the one period real return on money in period t

$$(22)\quad r_{m,t} = p_t - Ep_{t+1} = \frac{-\beta(1-\lambda)}{\beta+\alpha(1-\lambda)}(\frac{\lambda}{1-\lambda})(m_t - m_{t-1})$$

In interpreting these solutions, notice first that only the anticipated future monetary increments, operating through the real yield mechanism, are relevant to the determination of output. Specifically, a current monetary shock implies a movement in money j periods in the future equal to $\frac{\lambda^j}{1-\lambda}$ times the current movement, and this fraction works just as the serially correlated movements in case 2.

In addition, permanent changes in money as captured by the first two terms in (18) are reflected in prices on a one-to-one basis and are irrelevant to output and the real yield on money.

The effect of a positive monetary shock is illustrated in Figure 3. In this case, a current increase in money implies further increases in the future. In the new long run equilibrium, the money stock is <u>not</u> brought back to its original level. The money stock increases in the short run and continues to increase as it converges to its new higher long run level. Again, operation of the model is illustrated by a verbal discussion of the determination of the period "o" price level.

Suppose the price level remains unchanged. This means that real balances rise, but this implies an excess demand for goods in period "o," at output $\bar{y}$. Therefore the price level must rise on impact to limit the rise of current real balances and eliminate the incipient excess demand for goods.

Suppose the price level rises on impact equiproportionally with the current money stock. Current real balances are unchanged, but this cannot be the end of the story because the money stock and prices will rise further in the future. The anticipated inflation induces agents to reduce current goods supply below normal and raise current goods demand

Case 3

Behavior of Prices and Output under (1c)

Response to $\xi_t > 0 \quad \xi_{t+j} = 0$, all $j > 0$

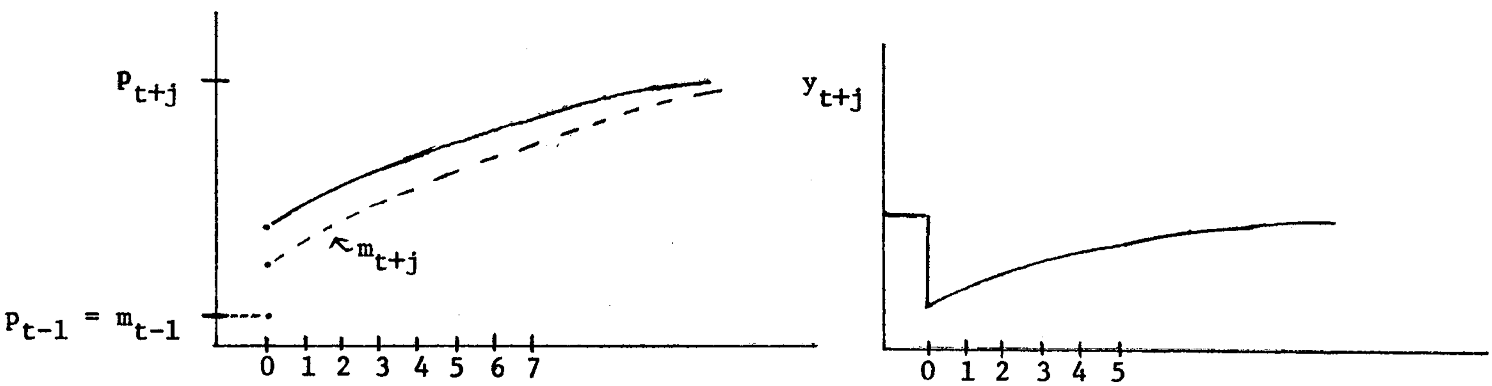


Figure 3

above normal. But this implies an incipient excess demand for goods. Therefore the current price level rise must exceed the current money stock increase. Note the rise in the current price level is bounded above by the new long run price level as is evident by reasoning along the above lines. The money stock and price level paths are shown in the left frame of Figure 3. The right frame shows the path of real output.[11]

III. The Permanent Balance Model

The alternative specification considered in the present section is that only permanent monetary magnitudes appear in the commodity supply and demand schedules.[12] Denoting permanent money balances as m^*_t, this respecification implies

$$(23)\quad y^s_t = \bar{y} + \alpha_s(p_t - Ep_{t+1}) - \beta_s(m^*_t - p_t)$$

$$(24)\quad y^d_t = \bar{y} - \alpha_d(p_t - Ep_{t+1}) + \beta_d(m^*_t - p_t)$$

where all parameters are assumed positive. The market clearing condition implies

$$(25)\quad p_t = \frac{\alpha}{\alpha+\beta}Ep_{t+1} + \frac{\beta}{\alpha+\beta}m^*_t$$

$$(26)\quad y_t = \bar{y} + \frac{H}{\alpha+\beta}(m^*_t - Ep_{t+1})$$

A rational expectation solution for prices then has the form

$$(27)\quad p_t = \frac{\beta}{\alpha+\beta}\sum_{j=0}^{\infty}\left(\frac{\alpha}{\alpha+\beta}\right)^j Em^*_{t+j}$$

Consistency in the formation of expectations requires, in the absence of trend growth in the money supply, that $Em^*_{t+j} = m^*_t$. Thus, the behavior of prices reduces to

$$(28) \quad p_t = m^*_t$$

Further, the expected yield on money is simply zero and, correspondingly, output is equal to $\bar{y}$.

The relevant permanent monetary values for the three alternative policy specifications are obtained by letting j go to infinity for the forecasts in the previous section.

$$(29a) \quad m^*_t = m_t$$

$$(29b) \quad m^*_t = \bar{m}$$

$$(29c) \quad m^*_t = m_{t-1} + \frac{\lambda}{1-\lambda}(m_t - m_{t-1})$$

Thus, in this behavioral specification, measured real balances, $m_t - p_t$, adjust to accommodate transitory monetary movements without affecting real output or consumption. The expected behavior of measured real balances then is[13]

$$(30a) \quad Em_{t+j} - p_t = 0$$

$$(30b) \quad Em_{t+j} - p_t = \rho^j(m_t - \bar{m})$$

$$(30c) \quad Em_{t+j} - p_t = -\frac{\lambda^{j+1}}{1-\lambda}(m_t - m_{t-1})$$

The consequence of the permanent balance specification is to make a large class of policy rules equivalent to the random walk rule with respect to their effect on real output. This is because permanent balances--as an optimal limit forecast--must exhibit a serial independence of increments.[14] Hence, money will be neutral under all three rules in this case if accurate contemporaneous information is available.

The economics of the solution may be described briefly as follows. The short run monetary disturbances and policy responses are assumed not to change any of the underlying long run behavior functions. Therefore, long run demand for real balances is unaffected by short run monetary disturbances. Consequently, the long run relation between the money stock and the price level is invariant to short run effects. Agents are assumed to know this. Agents realize, therefore, that short run changes in their real money balances do not create permanent excess supplies or demands for real money wealth.[15] If real balances affect goods supply and demand only through a wealth effect, and agents realize there is no permanent real wealth effect, then they will not allow changes in current or measured real balances to affect their real goods supply or demand.

Given this behavior, the only price level time path consistent with short run equilibrium, perfect foresight, and convergence to the long run equilibrium price level conditional on the anticipated long run money stock is one where the price level jumps immediately to its long run level and stays there. This is seen by eliminating the last two terms from (23) and (24) and solving for p_t. The only solution consistent with goods market equilibrium in this case is zero anticipated change in the price level.

IV. Money

The models of section II and III differ only in the specification of the real balance effect in commodity demand and supply schedules. The purpose of the present section is to relate these alternative specifications to the economic functions of money.

If money is held purely as an asset, then current real flow decisions should respond only to changes in real balances anticipated to be permanent.[16] If agents have diminishing marginal utility of consumption and lengthy planning horizons, a real response to an anticipated temporary monetary movement cannot be optimal, as it necessitates a countervailing response in the future, to satisfy an unchanged lifetime budget constraint.

When money is held for the services it renders as a medium of exchange, then it becomes plausible that current balances could be relevant to real flow decisions. For example, suppose that money reduces the transactions costs associated with the purchase of commodities. Then, for a given wealth, an individual who suffers an anticipated temporary reduction in measured real balances might shift expenditure from present to future periods, in order to take advantage of the lower net costs of transactions in these periods. Alternatively, to the extent that money is a factor of production, a reduction in current balances could lead to a reduction in current supply.[17]

In our view, the models of the previous sections invite interpretation along these lines. The permanent balance specification of section III is essentially a purely asset theoretic view of money, while the current balance specification of section II is consistent with the interpretation of money as a medium of exchange.

V. Conclusions

The present analysis demonstrates that the classical invariance proposition--the independence of real magnitudes from perceived variations in monetary aggregates--depends in a critical manner on the specification of the real balance effect, in a basic framework that incorporates rational expectations.

In the present single store-of-value context, a key element of the nonneutrality of transitory monetary disturbances is the fixed nominal return on money, which enters as an argument in the commodity demand and supply schedules. It is important to stress that in a model with alternative stores of value, such as Barro (1978) or King (1978), where the relevant marginal yield for labor supply and commodity decisions is assumed to be that of an asset with a variable nominal yield, this distinction between money as wealth and money as a medium of exchange retains its importance for the hypothesis of the invariance of real magnitudes.

In a critique of the money and growth literature, Robert Clower (1968) pointedly remarked that "it is no good to assert that money serves as a medium of exchange, if in our theoretical analysis we are unable to assign a formal interpretation to this assertion."[18] To the limited extent possible in a descriptive (nonoptimizing) analysis, we have tried to do this for the classical, rational expectations model. In particular, the relationship between policy rules and the effect of temporary monetary disturbances on output depends on whether we interpret money as an asset or as a medium of exchange.

FOOTNOTES

[1] Alternatively, we could have concocted feedback rules from money to observed serially correlated variables, with no difference in the conclusions of this paper.

[2] This is popularly called a simple "base drift" policy rule because the level of money stock at any point in time is irrelevant for intended future money growth. In effect the level of the money stock is allowed to wander or drift over time, with no affinity for a mean level. Intended money growth is always zero in this case.

Our second policy may be thought of as a version of Milton Friedman's proposed constant growth rule. Here, the long run chosen growth rate is zero and the monetary authority is committed to removing any deviations of the money stock from its chosen long run level gradually over time.

Our third policy allows "base drift" with additional autocorrelated money growth.

[3] These figures are correlograms of money and money growth under policy specifications (1b) and (1c).

[4] A more general specification would allow for a longer horizon for interest rate effects on commodity demand and supply, as for example, $y^s_t = \sum_{j=0}^{n} \alpha_j (Ep_{t+j} - Ep_{t+j+1}) - \beta_s (m_t - p_t)$. We treat the present case for expositional simplicity, since the qualitative effects would seem to be the same if $\sum_{j=0}^{n} \alpha_j \rho^j > 0$. Such a formulation allows for larger effects of changes in interest rates that are perceived to be temporary. In general, one would anticipate that the supply response to transitory occurrences would be larger because of the greater range of substitution possibilities, as Robert Lucas has stressed.

[5] See Section IV and footnote 16 below for a discussion of parameter sign specifications.

[6] We are assuming here that $Ep_{t+j+1} - m_{t+j} \rightarrow 0$ as $j \rightarrow \infty$.

This constraint guarantees an equiproportional movement of the price level and money supply in the long run.

[7] The steps involved in deriving p_t and y_t are summarized as follows:

$$p_t = \frac{\beta}{\alpha+\beta} \sum_{j=0}^{\infty} \left(\frac{\alpha}{\alpha+\beta}\right)^j Em_{t+j} \quad ; \quad \Theta \equiv \frac{\alpha}{\alpha+\beta}$$

$$= (1-\Theta) \sum_{j=0}^{\infty} \Theta^j [\bar{m} + \rho^j (m_t - \bar{m})]$$

$$= (1-\Theta)\left(\bar{m}\frac{1}{1-\Theta} + (m_t - \bar{m})\frac{1}{1-\Theta\rho}\right) = \bar{m} + \frac{1-\Theta}{1-\Theta\rho}(m_t - \bar{m}) \quad ; \quad \frac{1-\Theta}{1-\Theta\rho} = \frac{\beta}{\beta + \alpha(1-\rho)}$$

$$y_t = \frac{H}{\alpha+\beta}\left(m_t - \frac{\beta}{\alpha+\beta} \sum_{j=0}^{\infty} \left(\frac{\alpha}{\alpha+\beta}\right)^j Em_{t+j+1}\right) + \bar{y}$$

$$= \frac{H}{\alpha+\beta}\left(m_t - (1-\Theta)\sum_{j=0}^{\infty} \Theta^j \left(\bar{m} + \rho^{j+1}(m_t - \bar{m})\right)\right) + \bar{y}$$

$$= \frac{H}{\alpha+\beta}\left(m_t - \bar{m} - \rho(1-\Theta)\frac{1}{1-\Theta\rho}(m_t - \bar{m})\right) + \bar{y}$$

$$= \frac{H}{\alpha+\beta}\left(\frac{(\beta+\alpha)(1-\rho)}{\beta + \alpha(1-\rho)}(m_t - \bar{m})\right) + \bar{y}$$

[8] If agents are taken to be identical, then since goods markets are assumed to clear, individual money hoarding must be zero each period. Within the context of this model the possibility of individual "current account imbalance" can be rationalized by taking (3) and (4) as the representative agent's demand and supply functions.

If real balances are excluded from the supply function, then agents have incentive to allow current good supply to respond to anticipated deflation only if money can be hoarded or dishoarded to take advantage of an anticipated capital gain or loss. In this case, goods market equilibrium must allow a voluntary transfer of money balances from one subset of agents to another for good supply to be affected by anticipated deflation. Note that this requires a reverse transfer to occur in the future, before a full long run equilibrium is reached. However, it is beyond the scope of this paper to pursue this line of thought further.

[9] The new long run level is found as an infinite sum of changes. Suppose $m_t - m_{t-1} > 0$, then

$$m_t - m_{t-1} + \lambda(m_t - m_{t-1}) + \lambda^2(m_t - m_{t-1}) + \ldots = \frac{1}{1-\lambda}(m_t - m_{t-1}) = \bar{m} - m_{t-1}$$

So $\bar{m} = m_{t-1} + \frac{1}{1-\lambda}(m_t - m_{t-1})$.

[10] For example, the difference between m_t and $\bar{m}$ is λ^1[the new infinite series in $m_t - m_{t-1}$ starting at t+1].

The derivations are summarized as follows:

$$p_t = \frac{\beta}{\alpha+\beta} \sum_{j=0}^{\infty} \left(\frac{\alpha}{\alpha+\beta}\right)^j Em_{t+j}$$

$$= (1-\Theta) \sum_{j=0}^{\infty} \Theta^j \left(m_{t-1} + \frac{1}{1-\lambda}(m_t - m_{t-1}) - \frac{\lambda^{j+1}}{(1-\lambda)}(m_t - m_{t-1})\right) \quad ; \; \Theta \equiv \frac{\alpha}{\alpha+\beta}$$

$$= m_{t-1} + \frac{1}{1-\lambda}(m_t - m_{t-1}) - \frac{\beta}{\beta + \alpha(1-\lambda)}\left(\frac{\lambda}{1-\lambda}\right)(m_t - m_{t-1})$$

$$y_t = \frac{H}{\alpha+\beta}\left(m_t - \left(\frac{\beta}{\alpha+\beta}\right) \sum_{j=0}^{\infty} \left(\frac{\alpha}{\alpha \ \beta}\right)^j Em_{t+j+1}\right) + \bar{y}$$

$$= \frac{H}{\alpha+\beta}\left(m_t - (1-\Theta) \sum_{j=0}^{\infty} \Theta^j \left(m_{t-1} + \frac{1}{1-\lambda}(m_t - m_{t-1}) - \frac{\lambda^{j+2}}{1-\lambda}(m_t - m_{t-1})\right)\right)$$

$$= \frac{H}{\alpha+\beta}\left(\frac{-\lambda}{1-\lambda}(m_t - m_{t-1}) + \left(\frac{\lambda}{1-\lambda}\right)\frac{\lambda(1-\Theta)}{1-\Theta\lambda}(m_t - m_{t-1})\right)$$

$$= -\frac{H}{\alpha+\beta}\left(\frac{\lambda}{1-\lambda}\right)\left(1 - \frac{\lambda(1-\Theta)}{1-\Theta\lambda}\right)(m_t - m_{t-1})$$

$$= \frac{-H\lambda}{\beta + \alpha(1-\lambda)}(m_t - m_{t-1}) + \bar{y}$$

Remember that in the period of unanticipated money growth there is no tendency for output to rise since we assume complete contemporaneous information.

[11] The results for output hold throughout this section so long as either $p_t - Ep_t$ or $m_t - p_t$ is in the supply function and they each appear at least once in either function.

[12] By permanent monetary magnitudes we mean anticipated long run nominal money balances. Note that the results are no different if long run nominal balances are deflated by the anticipated long run price level in (23) and (24).

[13] For (30b) substitute from (11) and (29b), and for (30c) substitute from (17) and (29c).

[14] In particular, this conclusion holds for

$$A(L)(m_t-\bar{m}) = B(L)\xi_t$$

$$A(L)(x_t) = B(L)\xi_t$$

where A(L) is a stationary autoregressive process.

[15] We are of course assuming money is initially distributed evenly among agents.

[16] We make no attempt to rationalize a pure asset motive for holding money. This is not our point. We have doubts as to whether this can be done. Our discussion is meant to be taken conditionally. Our point is to demonstrate that the effectiveness of systematic monetary policy depends on the predominant motive for which money is held.

[17] If real balances are interpreted as a factor of production, then the coefficient in the supply function could be positive. On the other hand real balances appearing in the supply function as wealth, should have a negative coefficient.

[18] See Clower, p. 875.

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