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MONETARY RULES AND COMMODITY SCHEMES UNDER UNCERTAINTY

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ABSTRACT

The paper sets out a simple monetary model and uses it to compare alternative monetary systems. Money may be either fiat or gold. Both gold supply and velocity are uncertain. Asset demands are derived from expected utility maximization. I demonstrate the basic argument against a commodity money -- that it wastes resources, show why the optimal growth rate of money may be zero, and compare the behavior of the economy under constant money stock, constant price level, and constant gold price rules. Expected utility is typically highest under the constant price level rule.

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MONETARY RULES AND COMMODITY MONEY SCHEMES UNDER UNCERTAINTY[1]

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Commodity money schemes appeal to deep historical roots and the legend of a golden age. It is thus inevitable that the call for the gold standard is heard at times of price level instability. But the argument for a commodity money faces two fundamental difficulties: anything that commodity money schemes can accomplish can be done more cheaply in a related fiat money system[2]; and commodity money systems have not met the test of survival.

Changes in the relative price of gold have long been recognized as injecting unnecessary variability into the nominal prices of other commodities in a simple gold standard system that holds the nominal price of gold constant. Irving Fisher in 1920, following several earlier economists whom he credits, proposed that the gold standard be operated with a variable dollar price of gold such that the dollar price of commodities be maintained constant. Robert Hall (1982) resuscitated the Fisher scheme, in addition proposing an alternative commodity standard with few historical antecedents.

In this paper I set out a simple monetary model and use it to analyze the welfare economics of alternative monetary systems. Asset demand functions are obtained from utility maximization, making explicit welfare calculations possible. The set-up is that of an overlapping generations

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[1]Department of Economics, MIT, and NBER. This paper was prepared for a special issue of the Journal of Monetary Economics honoring Karl Brunner. I am grateful to Rudi Dornbusch for helpful discussions. Research support was provided by the National Science Foundation.

[2]See Fischer (1972), Barro (1979) and Black (1981).

model, in which agents can hold gold as as asset and may hold either a gold or a fiat money. I demonstrate the basic argument against a commodity money scheme, show why the optimal growth rate of money may be zero rather than the inverse of the interest rate, and then compare the behavior of the economy under a money stock rule, a constant price level rule, and a monetary policy that stabilizes the nominal price of gold: this last is a gold standard with further discussion of commodity money schemes and monetary rules.

Gerald Nickelsburg (1985) and Thomas Sargent and Neil Wallace (1983) have used overlapping generations models to study the welfare economics of commodity money schemes. Sargent and Wallace concentrate on the asset rather than transactions role of money (McCallum, 1983). Nickelsburg addresss several of the same issues as I do in this paper. Our models differ in that he uses a Clower constraint to generate a demand for money rather than the transactions cost approach I use, and that he does not include uncertainty.

I. A Fiat Money System

In the basic model, individuals of generation t are born at t-1 and receive an endowment, W_{t-1}, and perhaps a transfer payment, $H^1{}_{t-1}$, from the government. They use these resources to invest in physical capital, gold, and money balances. Capital yields a real return R_t, which may be stochastic and which is assumed independent of other disturbances. Gold holding provides returns in the form of both utility and capital gains. Money saves on transactions costs and may yield capital gains or losses.

The utility obtained by generation t is:

$$(1)\quad U(\ ) = (1+a)C_t + \beta \ln G_t - \ln T_t.$$

Utility is linear in consumption and logarithmic in holdings of gold and in time spent transacting. Transactions time in turn is an increasing function of consumption and decreasing in real balances:

$$(2)\ T_t = e^{aC_t} (M_t X_t)^{-\gamma_t}$$

Here X_t is the value of money, the inverse of the price of consumption goods in terms of money:

$$X_t = 1/P_t$$

Strong assumptions such as the functional forms of U( ) and T( ) are made for tractability.[3]

Substitution of (2) in (1) gives the derived utility function:

$$(3)\quad U(\ ) = C_t + \beta \ln G_t + \gamma_t \ln (M_t X_t)$$

The coefficient γ_t may vary over time. Shifts in γ can be regarded as changes in the transactions technology.[4] Whether an increase in γ increases or decreases utility depends on the magnitude of $M_t X_t$, which will itself be a function of γ.

The period t-1 budget constraint is:

$$(4)\quad W_{t-1} + H^1_{t-1} X_{t-1} = K_t + q_{t-1} G_t + X_{t-1} M_t$$

where K_t is purchases of capital, G_t and M_t are demands for gold and nominal balances respectively, H^1_{t-1} is transfer payments in the form of money made to individuals in the first period of life, and q_{t-1} is the real (in terms of goods) price of gold. In period t:

$$(5)\ C_t = R_t K_t + q_t G_t + X_t M_t + H_t^2 X_t$$

H_t^2 are transfer payments in the form of money made to individuals in the

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[3]Linearity of the utility function in consumption ensures that the demand functions for assets are dominated by expected rates of return rather than expectations of the marginal utility of consumption.

[4]Uncertainty about the transactions technology could also affect a. This would have more pervasive effects on portfolio decisions in period t-1 than does uncertainty about γ.

second period of life.

With R_t, q_t and X_t uncertain, the individual maximizes expected utility, First order conditions are:

$$(6) \quad {}_{t-1}[q_t - R_t q_{t-1}] + \frac{\beta}{G_t} = 0$$

$$(7) \quad {}_{t-1}[X_t - R_t X_{t-1}] + \frac{{}_{t-1}\gamma_t}{M_t} = 0$$

where expressions of the form ${}_{t-1}Z_t$ indicate the expectation at (t-1) of Z_t. Rewriting (6) and (7) in the form of demand functions:

$$(6)' \quad G_t = \frac{\beta}{{}_{t-1}R_t q_{t-1} - {}_{t-1}q_t}$$

$$(7)' \quad M_t = \frac{{}_{t-1}\gamma_t}{{}_{t-1}R_t X_{t-1} - {}_{t-1}X_t}$$

The absence of scale effects from the demand function is a result of the constancy of the marginal utility of consumption, in part due to the separability of consumption and real balances in the transactions cost function.

In equilibrium G_t and M_t are each equal to the respective supplies of the assets. Because changes in the net supply of gold are assumed to come from outside the economy, $(G_t - G_{t-1})$ does not appear in the budget constraints (4) and (5). Assuming that R_t is independently and identically distributed, ${}_{t-1}R_t = R$ for all t. Then (6)' and (7)' give the asset pricing relationships:

$$(8) \quad q_{t-1} = \frac{1}{R} \left[\frac{\beta}{G_t} + {}_{t-1}q_t\right]$$

$$(9) \quad X_{t-1} = \frac{1}{R} \left[\frac{{}_{t-1}\gamma_t}{M_t} + {}_{t-1}X_t\right]$$

Hence

$$(10)\quad q_{t-1} = \frac{1}{R} \sum_{o}^{\infty} \frac{1}{R^i}\ {}_{t-1}\left(\frac{\beta}{G_{t+i}} \right)$$

$$(11)\quad X_{t-1} = \frac{1}{R} \sum_{o}^{\infty} \frac{1}{R^i}\ {}_{t-1}\left(\frac{{}_{t+i-1}\gamma_{t+i}}{M_{t+i}} \right)$$

The price of gold will fluctuate over time if the stock of gold fluctuates; the absolute price level fluctuates because of both technological shocks and changes in the stock of money.

Substitution of the demand functions (6)' and (7)', and the budget constraints (4) and (5) in the utility function (3) gives expected utility in the fiat system, as:

$$(12)\quad {}_{t-1}U_F(t) = R(W_{t-1} + H^1_{t-1} X_{t-1}) + {}_{t-1}(H_t^2 X_t) - \beta - {}_{t-1}\gamma_t$$

$$+ \beta \ln G_t + {}_{t-1}\gamma_t \ln M_t + {}_{t-1}(\gamma_t \ln X_t)$$

II. A Commodity Money System

In the pure commodity money system, gold serves instead of fiat money. The maximand is now:

$$(13)\quad E(C_t + \beta \ln G_t^n + \gamma_t \ln (G_t^m q_t))$$

where G_t^n is the non-monetary gold stock and G_t^m the monetary gold stock.

Gold can be transformed costlessly from one form to the other by the young, but monetary gold cannot simultaneously be held in directly utility-yielding form (i.e., as jewelry). Assuming there are no transfer payments, second period consumption is:

(14) $C_t = R_t(W_{t-1} - q_{t-1}\ G_t) + q_t G_t$

with

$$G_t = G_t^{\,n} + G_t^{\,m}$$

Maximization of expected utility gives:

(15) $G_t^{\,n} = \dfrac{\beta}{Rq_{t-1} - {}_{t-1}q_t}$

(16) $G_t^{\,m} = \dfrac{{}_{t-1}\gamma_t}{Rq_{t-1} - {}_{t-1}q_t}$

implying

$$G_t^{\,m} = \frac{{}_{t-1}\gamma_t}{\beta}\, G_t^{\,n} = \frac{{}_{t-1}\gamma_t}{\beta + {}_{t-1}\gamma_t}\, G$$

The price of gold is accordingly:

(17) $q_{t-1} = \frac{1}{R}\left[\sum_{o}^{\infty} \frac{1}{R^i}\ {}_{t-1}\left(\frac{\beta + {}_{t+i-1}\gamma_{t+i}}{G_{t+i}}\right)\right]$

With gold as numeraire, q_t is the inverse of the general price level, which now shifts in accordance with changes in both the supply of gold and the transactions technology.

Expected utility in the commodity money system is:

(18) $${}_{t-1}U_G(t) = RW_{t-1} - \beta - {}_{t-1}\gamma_t + (\beta + {}_{t-1}\gamma_t)\ \ln G_t$$
$$+ \beta \ln \frac{\beta}{\beta + {}_{t-1}\gamma_t} + {}_{t-1}\gamma_t \ln \frac{{}_{t-1}\gamma_t}{\beta + {}_{t-1}\gamma_t} + {}_{t-1}(\gamma_t \ln q_t)$$

In the next section we compare expected utility in the fiat and commodity money systems.

III. The Basic Case Against a Commodity Money

The basic case against a commodity money is that fiat money is cheaper to produce. The point is seen most clearly by assuming the stocks of gold and money are each constant, at G and M respectively. Then in the fiat money system:

$$(19) \quad q_{t-1} = q = \frac{\beta}{Gr}$$

$$(20) \quad X_{t-1} = \frac{1}{RM} \sum_{0}^{\infty} \frac{{}_{t-1}\gamma_{t+i}}{R^i}$$

where $r = R - 1$ is the expected real interest rate. In the absence of technology shocks,

$$_{t-1}\gamma_{t+i} \equiv \gamma$$

and

$$(20') \quad X_{t-1} = \frac{\gamma}{Mr}$$

In the commodity money system, by contrast:

$$(21) \quad q_{t-1} = q = \frac{\beta+\gamma}{rG}$$

The value of the gold stock will be higher in the commodity money system: indeed for the unitary elastic demands generated by the underlying utility function the value of gold in the commodity system is exactly equal to the value of money and gold in the fiat system. But that increase in value is insufficient to compensate for the loss of gold as a commodity. The utility cost of the commodity system is:

$$(22) \quad U_F(t) - U_G(t) = -\beta \ln \frac{\beta}{\beta+\gamma} > 0$$

The loss in utility is higher, the larger the proportion of gold stock that is used as money, that is, the higher is γ. Although costs of production are not formally included in the model, the utility loss from using a commodity money is equivalent to the loss caused by the diversion of factors of production to gold mining.

IV. The Optimum Quantity of Money

Continuing to assume away the presence of uncertainty, we examine the optimum quantity of money argument in the fiat money model. Since gold is in this model entirely separable, we assume for this section that capital and money are the only assets. We consider only constant growth rate rules for money.

Let

(23) $M_t = (1+\mu)^t M_o$

Thus $M_t - M_{t-1} = \mu M_{t-1} = H_{t-1}^{1} + H_{t-1}^{2}$

where H_{t-1}^{1} and H_{t-1}^{2} are nominal transfer payments to the young and old, respectively.

In equilibrium in this stationary economy the value of money will be falling at the same rate as the price level is rising. Accordingly, from the demand function (7)':

$$M_o(1+\mu)^t = \frac{\gamma(1+\mu)^t}{X_o[R(1+\mu)-1]}$$

Thus

(24) $$M_oX_o = M_tX_t = \frac{\gamma}{R(1+\mu)-1}$$

Obviously as the growth rate of money falls, equilibrium holdings of real balances increase. As the growth rate of money approaches the negative of the real interest rate, real balances approach infinity. However, it is not necessarily optimal to drive real balances to infinity, for as real balances rise, capital accumulation is affected (Drazen (1979)).

To see this, assume all transfer payments are made to the young. Then, generation t's utility is:

$$U_t = RW_{t-1} + R\mu M_{t-1}X_{t-1} - \gamma + \gamma \ln M_t X_t$$

and using (24)

$$(25) \quad \frac{\partial U_t}{\partial \mu} = - \frac{\gamma R^2 \mu}{(R(1+\mu)-1)^2}$$

This derivative is zero when the growth rate of money is zero and utility is accordingly at a maximum $(\frac{\partial^2 U_t}{\partial \mu^2}|_{\mu = 0} < 0)$ when μ is zero.

The optimum quantity result does not hold because capital accumulation is reduced by the first period lump sum taxes. Capital accumulation is equal to

$$K_t = W_{t-1} + R\mu M_{t-1}X_{t-1} - M_t X_{t-1}$$

that is, the endowment plus transfer payments minus the amount of endowment used up in purchasing real balances.

Thus,

$$K_t = W_{t-1} + \frac{(R\mu - (1+\mu))\gamma}{R(1+\mu)-1}$$

and

$$\frac{\partial K_t}{\partial \mu} > 0$$

Reductions in the growth rate of money reduce capital accumulation. There is of course the benefit that the value of real balances increases, providing more utility, but in this case the two effects exactly balance when the growth rate of money is zero.

It should accordingly be expected that utility will rise when the growth rate of money is reduced if transfer payments are made to the old. In that case,

$$U_t = RW_{t-1} + \mu M_t X_t - \gamma + \gamma \ln M_t X_t$$

and

$$\frac{\partial U_t}{\partial \mu} = - \frac{\gamma[r[R(1+\mu)-1] + \mu R]}{[R(1+\mu)-1]^2}$$

It is certainly optimal to reduce the growth rate of money below zero. But it is not optimal to go all the way to infinite cash balances, for the optimal growth rate is

$$(26) \qquad \mu^* = -(\frac{r}{R})^2$$

which exceeds the optimum quantity formula

$$\mu = - \frac{r}{R}$$

It is optimal to stop short of satiating the economy with cash balances to ensure that not too much capital is displaced.

V. Stabilizing the Price Level

We now restore uncertainty and examine alternative monetary rules, starting with a price stabilization rule. Whether it is optimal to stabilize the price level depends on the stochastic properties of γ. We continue to omit gold. Now assume first that,

$$(27) \quad \gamma_t = \gamma(1 + \varepsilon_{t-1}) \qquad \varepsilon > -1$$

where ε_t is a white noise process. The specification (27) implies that each generation knows its own technology shock, and thus velocity, when it makes its portfolio decisions.

With γ described by (27), and a constant money stock, M,

(28) $X_{t-1} = \frac{\gamma}{M} (\frac{1}{r} + \frac{\varepsilon_{t-1}}{R})$

The price level is proportional to the money stock and fluctuates inversely with ε_{t-1}. Jensen's inequality implies that the expected price level rises with the variance of ε, but it is clear that the behavior of X, the value of money, is the relevant concern. With the value of money expected to return to its mean, the expected rate of inflation is higher when γ_t is high and vice versa.

With γ_t stochastic, the expected utility of generation t is (again ignoring gold), from (12):

(29) $_{t-1}U_F(t) = RW_{t-1} + (\ln \gamma - 1)\gamma_t + \gamma_t[_{t-1}\ln(\frac{1}{r} + \frac{\varepsilon_t}{R})]$

Uncertainty about the future price level therefore reduces the welfare of generation t compared with a situation in which there are no shocks to γ. Constant M corresponds here to an inactive monetary policy.

Now consider a monetary policy that completely stabilizes the price level. The simplest such policy is

(30) $M_t = {}_{t-1}\gamma_t$

which accomodates the quantity of money to the quantity demanded. Then,

(31) $X_t = \frac{1}{r}$

and the price level is completely stable. Taking into account the transfer payments that have to be made, expected utility for generation t is:

(32) $_{t-1}U_{FP}(t) = RW_{t-1} + \frac{R}{r}(\gamma_t - \gamma_{t-1}) - \gamma_t + \gamma_t \ln\gamma_t - \gamma_t \ln r$

where U_{FP} is utility when prices are fixed.

The difference between utility under a constant price level and a constant money supply is:

$$(33)\quad {}_{t-1}U_{FP}(t) - {}_{t-1}U_F(t) = \frac{\gamma R}{r}(\varepsilon_{t-1} - \varepsilon_{t-2}) + \gamma_t \quad {}_{t-1}\ln\left(\frac{1+\varepsilon_{t-1}}{1+\frac{r\varepsilon_t}{R}}\right)$$

The difference depends on the realizations of ε_{t-1} and ε_{t-2}. As a base case assume $\varepsilon_{t-1} = \varepsilon_{t-2} = 0$. In that case generation t would prefer next period's price level to be stabilized. If the realization of ε_{t-1} is high, then again generation t-1 would prefer the prospect of a stable price level. But if ε_{t-1} is low, this generation suffers negative transfer payments under the fixed price rule and loses its expected capital gains on money because prices are being stabilized. Such a generation would prefer a stable money stock.

Of course, it is only for analytic convenience that each period is assumed to be a generation long. Although not strictly accurate, we may rather think of each individual as living through many periods, with his or her expected utility independent of conditions in any particular period: that would suggest as a welfare criterion the expectation of utility taken sufficiently far back in time that generation t has no special information on which to judge its prospects. For the stochastic technology, (27), that comparison could be made at period t-3. In this case the fixed price rule, which implies zero expected transfers, would be preferred.

The result that uncertainty about γ_t makes individuals worse off is, surprisingly, not robust. Two examples make the point. Suppose first that

$$\gamma_t = \gamma(1 + \varepsilon_t)$$

so that generation t does not know the value of γ_t at the time it makes its portfolio decisions. Then X_t is constant, independent of ε_t (because it is the demand of the young generation that determines the value of money) and expected utility will be unaffected by the uncertainty.

Alternately, suppose that

(34) $\gamma_t = \gamma(1 + \varepsilon_t + \theta\varepsilon_{t-1})$

with ε_t once again i.i.d., which implies

(35) $X_{t-1} = \frac{\gamma}{M}\left(\frac{1}{r} + \frac{\theta\varepsilon_{t-1}}{R}\right)$

Then under the constant money rule we obtain

$$(36)\quad {}_{t-1}U_F(t)' = RW_{t-1} + {}_{t-1}\gamma_t(\ln\gamma - 1) + {}_{t-1}\left(\gamma_t \ln\left(\frac{1}{r} + \frac{\theta\varepsilon_t}{R}\right)\right)$$

$$= RW_{t-1} + {}_{t-1}\gamma_t(\ln\gamma - 1) + {}_{t-1}\left(\gamma(1+\varepsilon_t+\theta\varepsilon_{t-1})\ln\left(\frac{1}{r} + \frac{\theta\varepsilon_t}{R}\right)\right)$$

For discussion purposes suppose $\varepsilon_{t-1} = 0$. Then if θ is positive, uncertainty about ε_t is likely to increase the expected utility of the t'th generation. When ε_t is high, leading the t'th generation to put a high value on real balances, the value of money tends to be high. And because the last expectation in (36) is convex in ε_t for $\theta > 0$, the uncertainty makes individuals better off than they would be if ε_t were identically zero.

Given (35) as the process for γ_t, and once again setting $M_t = {}_{t-1}\gamma_t$, the value of money would be constant at $1/r$, and the difference in utility between the fixed price and fixed money rules is:

$$(37)\quad {}_{t-1}U_{FP}(t)' - {}_{t-1}U_F(t)' = \frac{\theta\gamma}{r}(\varepsilon_{t-1} - \varepsilon_{t-2}) + {}_{t-1}\left[\gamma(1+\varepsilon_t+\theta\varepsilon_{t-1})\ln\left(\frac{1+\theta\varepsilon_{t-1}}{\frac{1+\theta r\varepsilon_t}{R}}\right)\right]$$

For a given value of ε_{t-1}, and with θ positive, this tends to be negative. Thus with θ positive the fixed quantity role outperforms the fixed price rule from the viewpoint of generation t at time t-1. The reason is the convexity of the utility function in ε_t for $\theta > 0$.

Interestingly, though, generation (t-1) might well prefer a fixed price rule before it knows the value of ε_{t-1}. The difference betwen the expected utilities under the two rules taken at t-3 is equal to

$$_{t-3}[\gamma(1+\theta\varepsilon_{t-1})\ln(1+\theta\varepsilon_{t-1}) - \gamma(1+\varepsilon_t)\ln(1+\frac{\theta r\varepsilon_t}{R})]$$

For θ close to or larger than one (θ is not limited to be less than 1) this expression is positive. Thus <u>ex ante</u> a fixed price rule may be preferred, but once some uncertainty has been resolved, the fixed money rule may appear preferable.

At this stage of course it would be desirable to have in the model more pervasive effects of monetary uncertainty than merely on the demand for money. In particular, price level variability induces variability in both the level of output and its allocation, because of the slow adjustment of prices.[5] A heavier penalty on price level variability, equivalent in this model to ex ante uncertainty about prices, would of course make the fixed price rule more attractive relative to the fixed money rule. Despite the above interesting result that price level uncertainty may increase expected utility under certain conditions, the presumption should still be in the opposite direction.

VI. Stabilizing the Nominal Price of Gold

Section II showed why the use of a commodity as money is typically dominated by use of a fiat money. The nominal price of gold can be stabilized by using it as money or by manipulating the money stock for that purpose. This is what Black (1981) means by a gold standard with zero reserves. We now return to the full model with gold and fiat money, starting, by describing the behavior of the gold stock.

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[5]Such effects are discussed in Brunner and Meltzer (1971).

(38) $G_t = \frac{G_{t-1}}{1+u_t}$

where u_t is a white noise process $u_t > -1$. The gold stock follows approximately a logarithmic random walk.

From the pricing equation for gold, (10), we obtain

(39) $q_{t-1} = \frac{\beta}{rG_t}$

The price of gold in terms of commodities thus varies over time with the supply. From equation (3) it is clear that the uncertainty in the supply of gold reduces expected utility; the price uncertainty when gold is merely a commodity is derivative of the quantity uncertainty and exerts no independent effects on utility.

Suppose now that monetary policy instead of being passive or stabilizing the aggregate price level aims to stabilize the exchange rate between money and gold, the nominal price of gold. Let Q_t be the nominal price of gold:

$$Q_t = \frac{q_t}{X_t}$$

Monetary policy now has to stabilize Q_t at Q, or to set

(40) $X_t = \frac{q_t}{Q}$

For convenience we set Q = 1. We thus want the monetary policy such that $X_t = q_t$. Note that no gold is being used for monetary purposes.

The policy will have to depend on the stochastic structure of both G_t and γ_t. Assume that γ_t is given by (27). We require

$$\frac{\beta}{rG_t} = \frac{1}{R} \sum_{o}^{\infty} \frac{1}{R^i} \, {}_{t-1}\left(\frac{{}_{t+i-1}\gamma_{t+i}}{M_{t+i}}\right)$$

The rule

(41) $M_t = \frac{{}_{t-1}\gamma_t}{\beta} G_t$

for all t will produce constancy in the nominal price of gold.[6]

The rule is to expand the money stock with the gold stock, the proportion depending on the technology parameter ${}_{t-1}\gamma_t$. When the demand for money at any given expected rate of inflation is high (i.e. when ${}_{t-1}\gamma_t$ is large) the money stock is larger. Essentially (41) is a simple accommodating policy, combining rule (30) that stabilizes the price level with a policy that mimics the movements in the gold stock.

Under this gold standard rule (with zero reserves), expected utility for generation t is:

$$(42) \quad {}_{t-1}U_{GS}(t) = RW_{t-1} + \frac{R\gamma}{r}[(1+\varepsilon_{t-1}) - (1+\varepsilon_{t-2})(1+u_t)] + \beta(\ln G_{t-1}) - \gamma_t$$
$$+ \gamma_t \ln \gamma_t + \gamma_t \; {}_{t-1}\ln(\frac{1+u_{t+1}}{r})$$

Comparing (42) with (29), adjusting for the omission of terms in β in (29), the gold standard policy appears preferable for $\varepsilon_{t-1} = 0 = \varepsilon_{t-2} = u_t$ so long as the variance of u is small compared with that of ε.[7] Further comparison with (32), however, shows that a policy of stabilizing the price level is likely to produce greater expected utility than gold price stabilization. Viewed at least three periods ahead, price level stabilization dominates gold price stabilization.

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[6]An essential assumption in deriving (41) is that u_t in (38) is not serially correlated.

[7]Between (29) and (42), note that (ε_t/R) in the former is replaced by (u_{t+1}/r) in the latter. The difference results from the fact that shocks to G are permanent and those to γ are transitory.

This analysis provides no support for the gold standard rule - keep the nominal price of gold constant - for monetary policy. It is possible though that correlation between u_{t+1} and ε_{t-1} could make a case for the gold standard. If the gold stock was expected to be high when γ_t was high, then following the gold standard rule would be utility increasing. However, there is no reason to expect such a correlation.

VII. OMITTED FACTORS.

One benefit of commodity reserve money schemes not included in the above analysis is that they operate automatically. In this paper the monetary authority is able to fix the price level exactly. It can also determine the price of gold exactly by changing the stock of money. Of course these feats are not possible in practice.

The inability of the monetary authority to achieve its targets exactly could be included in the above model by assuming that the money stock deviates randomly from the level of the base set by the monetary authority. This would not materially affect the comparison among the different fiat money schemes, including the constant growth rate rule.

It would however affect the comparison between schemes that involve fixing the quantity of money and those that endogenize money, such as interest rate fixing or commodity reserve schemes. There are three issues in the commodity reserve schemes. Beyond the resource costs of such schemes and the problem of changing relative prices of the commodities and goods in general - both analyzed above - a full comparison would have to include the possible breakdown of the scheme. As Flood and Garber (1985) have emphasized, a scheme that produces intermittent absolute stability punctuated by breakdowns may be worse than one that produces less short run stability but is more likely to survive.

The Irving Fisher gold standard with variable nominal price of gold is a commodity money scheme that attempts to stabilize the price level. It would thus achieve the same price level behavior as the monetary policy of Section V. As a commodity money system, the Fisher plan has the advantage over the normal gold standard of being much less likely to break down because of secular changes in the relative price of gold. It has the disadvantage that lags in price data collection make it less automatic -- and more likely to be the subject of speculative attacks --than a pure gold standard scheme. Further, as Section V shows, the price level can be stabilized through monetary policy without having to hold reserves of gold. The benefits of the Fisher scheme would then result from its automaticity and the possibility -- though not the likelihood -- that its operation is easier to enforce than that of a monetary policy not tied to a commodity reserve that is given the goal of price level stabilization.[8]

VIII. Summary

Commodity money systems are dominated by related fiat money systems. The positive case for a genuine commodity money would have to be constructed by arguing that their automaticity ensures better implementation of the goals of policy than would be achieved under the superior fiat system. That issue has not been analyzed in this paper, but it is doubtful the case can be made once it is recognized that commodity schemes have always broken down.

The paper also addresses the issue of the choice between fixed money stock and fixed price level rules, is an equilibrium economy. The former is typically though not always less desirable than the latter. A fixed money

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[8]Nickelsburg (1985) is skeptical about the viability of the Fisher scheme.

(growth) rule does in practice have the benefit that it is relatively easy to monitor and that blame for inevitable divergences from targets can be assigned. Since the monetary authority has less control over the price level, it can more easily escape detection if it misbehaves under a price level rule. That is one of several reasons many economists have given for preference, a money stock rule. But it is an extremely poor reason.

Academics, Karl Brunner among them, have analyzed central banks as maximizing institutions, whose preference for obscurity of purpose and methods maximizes the easy life. The academic analysis of policy that insists on simple criteria for policy evaluation may also be seen as a maximizing choice, which minimizes the amount of time that academics have to spend evaluating policy and the small details of institutional change that central bankers use to justify their actions.

In this regard Karl Brunner has set an example, in both analyzing general principles of monetary policy and -- through the Shadow Open Market Committee, his own research, and in advising United States and European policymakers -- willingly immersing himself in the details of policy implementation. For him economics has been both intellectual stimulation and a tool to try to improve the world.

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