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Some Not So Unpleasant Monetarist Arithmetic

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SOME NOT SO UNPLEASANT

MONETARIST ARITHMETIC

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ABSTRACT

This paper analyzes the quantitative significance of Sargent and Wallace's (1981) "Some Unpleasant Monetarist Arithmetic" in a model that is parameterized to correspond with U.S. data. The major result is that the monetarist arithmetic is not overly unpleasant and that the nominal side of the economy is not very sensitive to whether money growth does or does not respond to government debt.

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I. INTRODUCTION

The motivation for this paper is the well known controversial work of Sargent and Wallace (1981). In their paper they show the potential importance of the government's budget constraint for the behavior of nominal variables. The government's lifetime budget constraint can place restrictions on the behavior of future money and thus influence current economic magnitudes through expectational channels. Some of their results are indeed striking and indicate that current tight monetary policy can lead to the unpleasant result of both higher expected future inflation and higher current inflation. Theoretically they highlight important intertemporal considerations, but one wonders if these considerations are quantitatively meaningful in a dynamic stochastic environment that might reasonably approximate an actual economy.

In order to investigate the quantitative significance of unpleasant monetarist arithmetic in a dynamic stochastic model in which the government's budget constraint has nontrivial importance, the methodology of Dotsey (1994a) and Dotsey and Mao (1994b) is used. Here both money growth and distortionary tax rates are stochastic, but one or both must endogenously respond to debt if the government is to maintain budget balance. The primary focus of the analysis is the behavior of nominal variables and a comparison of their behavior when the monetary authority does and does not respond to the government's budget constraint. A basic result is that for reasonable parameterizations it is very difficult to satisfy the government's budget constraint solely through monetary policy. For debt to remain bounded, fiscal policy must respond to government indebtedness. With a responsive fiscal policy, the underlying nominal behavior of the economy does not significantly depend upon whether or not the monetary authority reacts to government financing considerations. In this sense the monetarist arithmetic is not overly unpleasant.

The considerations addressed in this paper are similar to those in Leeper (1991) who extended the Sargent and Wallace work to a linear rational expectations environment. Leeper's model is, however, somewhat different in that the monetary authority uses an interest rate instrument and reacts (in some cases) to inflation. With this modeling of policy, unique solutions only obtain when either--but not both--the monetary authority or the fiscal authority respond to the government's budget. When money is the policy instrument, as it is in this analysis, both authorities can respond to debt.[1] This modeling is more directly related to Sargent and Wallace, and since it potentially allows both the Treasury and the monetary authority to respond to debt it is more likely to be consistent with actual practice. For example, Bohn (1991) shows that for the U.S. both spending and tax revenues are important means of achieving budget balance.

The paper proceeds as follows. In section II, both the behavior of the government and the underlying technology are described. In section III the behavior of an economy that is characterized by a low interest sensitivity of money demand is investigated. In particular, the differences between an economy in which the monetary authority does and does not react to government debt are examined. Only minor differences are found. Section IV concludes.

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[1]One could always make the money supply rule more realistic by including elements of interest rate smoothing.

II. TECHNOLOGY AND GOVERNMENT BUDGET BALANCE

This section depicts the technology and the fiscal and monetary policy processes that characterize the economic environment under consideration.

a. Technology

Firms produce output via a Romer (1986) technology in which a production externality allows for endogenous growth. Specifically, output, y_t, is given by

(1) $y_t = Ak_t^{\alpha} n_t^{1-\alpha} K_t^{\chi}$

where k is the firms capital stock, n is the labor hours, and K is the aggregate per capita capital stock. The firm maximizes profits $p_t[y_t - r_t k_t - w_t n_t]$, where p is the price level, r is the rental rate on capital, and w is the real wage rate, subject to (1). Using the parameterization $\alpha+\chi = 1$ and the equilibrium condition that $k_t = K_t$, in equilibrium one observes that

(2) $r_t = \alpha A n_t^{1-\alpha}$

and

(3) $w_t = (1-\alpha) A K_t n_t^{-\alpha}$.

In the model that follows, money has no direct effect on real economic activity. Thus the choice of endogenous or exogenous growth is not crucial to the underlying results. Endogenous growth is chosen, soley, for computational reasons.

b. Government Budget Balance

A novel feature of the exercises undertaken in this paper is the modeling of endogenous fiscal and monetary policies that are: (a) stochastic, (b) do not violate the government's budget constraint, and (c) do not rely on lump sum transfers. Monetary policy is defined over changes in base growth rather than the setting of nominal interest rates. This depiction of policy is more directly analogous to previous literature relating deficit finance and inflation.[2] It also allows one to investigate the consequences of money growth's dependence on debt while incorporating the empirically relevant behavior of taxes responding to debt (Bohn 1991). Interest rate smoothing concerns could easily be incorporated by allowing the monetary authority to respond to unexpected movements in the nominal interest without affecting the existence or the uniqueness of the solutions (see Boyd and Dotsey (1993)).

Money, M_t, is introduced through open market operations, and money behaves according to

(4) $M_t = M_{t-1}(1+\eta_t)$

where η_t is the stochastic rate of money growth.

Taxes are distortionary and are levied on both the returns from capital and labor.[3] Thus tax revenues, T_t, are given by

(5) $T_t = \tau_t(r_tK_t + w_tN_t)$

where K and N refer to aggregate quantities of the per capita capital stock and labor hours. The government's nominal debt B_{t+1}, therefore, follows

(6) $Q_tB_{t+1} = G + TR + B_t - T_t - \eta_tM_{t-1}$

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[2]For example see Sargent and Wallace (1981), Drazen (1985), Liviatan (1984), and McCallum (1984).

[3]To greatly ease the computational burden imposed by monetary and fiscal policy processes government bonds are untaxed.

where G is "useless" government spending, TR are fixed transfer payments, and Q_t is the price of a bond at time t that pays one dollar at t+1. The real value of the debt relative to output, $B_{t+1}/(P_{t+1}y_{t+1}) = b_{t+1}$, can be written as

$$(7) \quad b_{t+1} = R_t\,[g+tr+b_t-\tau_t-(\eta_t/(1+\eta_t))\,\frac{M_t}{p_t y_t}]\,\frac{p_t y_t}{p_{t+1}y_{t+1}}$$

where R_t is the gross nominal interest rate.

A sufficient condition for the government to obey its lifetime budget constraint is for tax and money growth processes to behave so that the debt to gnp ratio is bounded. For that to happen either one or both must respond to b_t. When these processes respond to debt they are modeled as two-state markov processes with endogenous transition probabilities. Thus the processes are time varying. In particular let the transition probabilities for taxes be

$$(8a) \quad \text{prob}\ (\tau_{t+1} = \tau_\ell | \tau_t = \tau_\ell) = \min\ \{\max\ [(1-\phi b_t)^{1/\nu}, 0],\ 1\}$$

$$(8b) \quad \text{prob}\ (\tau_{t+1} = \tau_h | \tau_t = \tau_h) = \max\ \{\min\ [\phi b_t^{1/\nu},\ 1],\ 0\},$$

and these for money growth be

$$(9a) \quad \text{prob}\ (\eta_{t+1} = \eta_\ell | \eta_t = \eta_\ell) = \min\ \{\max\ [(1-\phi b_t)^{1/\psi},\ 0],\ 1\}$$

$$(9b) \quad \text{prob}\ (\eta_{t+1} = \eta_h | \eta_t = \eta_h) = \max\ \{\min\ [\phi b_t^{1/\psi},\ 1],\ 0\}$$

where the subscripts ℓ and h refer to low and high.

As long as the debt rises when both tax rates and money growth rates are low and falls when tax rates and money growth rates are high, the debt to gnp ratio is bounded and only rarely lies outside the interval [0, $1/\phi$]. As b_t approaches $1/\phi$ both taxes and money growth will be high with probability one. Similarly as b_t approaches 0 both taxes and money growth will be low.[4] The parameters ν and ψ control the persistence of the two processes. For any given debt to gnp ratio as ν and ψ increase the probability of remaining in the current state increases. Thus, the above specifications imply that current realizations of policy have implications for the entire future path of policy realizations through their direct effect on debt.

It is important to note that both the unconditional mean and the persistence of money growth do not depend on the debt to gnp ratio. If instead the monetary authority had no control over unconditional means or persistence it would be a trivial exercise to show that the nominal behavior of the economy crucially depended on fiscal policy. Instead the more difficult question of whether conditional dependence of monetary policy on debt affects nominal magnitudes is explored.

Alternatively, cases where one of the processes are invariant to the debt to gnp ratio can be investigated. We will see that it is difficult to bound the debt to gnp ratio by relying solely on monetary policy, and that fiscal policy, therefore, must respond to debt. A monetary policy that is independent of debt is feasible and such a policy will be compared to that given by (9a) and (9b).

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[4]The debt to gnp ratio can temporarily move outside $[0, 1/\phi]$ because next periods taxes and money growth depend on todays debt. If, for example $b_t = 1/\phi - \varepsilon$ and $\tau_t = \tau_\ell$ and $\eta_t = \eta_\ell$ then b_{t+1} could be larger than $1/\phi$. Furthermore, with low probability $\tau_{t+1} = \tau_\ell$ and $\eta_{t+1} = \eta_\ell$ implying $b_{t+2} > b_{t+1}$. At this point, however, the debt to gnp ratio must decline since τ_{t+2} and η_{t+2} must equal τ_h and η_h, respectively.

III. A MODEL WITH A LOW INTEREST ELASTICITY OF MONEY DEMAND

This section compares economic outcomes when monetary policy responds to debt and when monetary policy is independent. Since the primary goal is to quantify the nominal consequences arising from a lack of central bank independence, a low interest elasticity of money demand is modeled. To lighten the computational burden, a cash-in-advance model in which the interest elasticity of zero is used. The results of the exercise would not be substantially different if the interest elasticity was small, as it empirically appears to be,[5] but would change for unrealistically high values.

For interest elasticities in excess of one (see Drazen (1985)), it is possible to obtain the spectacular case of Sargent and Wallace where both current and expected inflation increase when the current money growth rate declines.[6] Since the interest elasticity of money demand appears to be quite a bit less than one, this case is not an economically meaningful one. It is, therefore, not pursued.

Money is also neutral in this model and the inflation tax, therefore, has no direct effect on real magnitudes. This purposeful omission of real-nominal interactions is done to avoid confounding real effects with the nominal effects generated by the path of expected future money. This allows one to highlight the implications that government budget balance has

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[5]See Dotsey (1988) for evidence that currency is not very interest sensitive.

[6]Furthermore, to achieve to the spectacular case with a model of monetary policy given by (9a) and (9b) would require a high interest elasticity at high debt levels in which expected future money growth is high no matter what the current state. High expected future money growth implies high nominal interest rates and the interest elasticity of money demand would need to be insensitive to the level of interest rates.

for nominal magnitudes and concentrate on the main point raised by Sargent and Wallace.

a. Individuals Optimization

The individuals optimization problem is to

$$\underset{\{c_t\},\{k_t\},\{n_t\},\{M_t\},\{B_t\}}{\text{maximize}} \quad \sum_{t=0}^{\infty} \beta^t [\log c_t + \gamma(1-n_t)]$$

subject to

$$M_t + p_t k_{t+1} + Q_t B_{t+1} \le p_t(1-\tau_t)(r_t k_t + w_t n_t) + p_t k_t(1-\delta) + B_t + M_{t-1} - \theta p_{t-1} c_{t-1} + TR_t$$

and

$$\theta p_t c_t \le M_t.$$

The parameter θ determines the portion of consumption that is subject to the cash-in-advance constraint. Because agents can use current wages to finance current consumption, there is no direct inflation tax.[7]

b. Equilibrium

The relevant first-order conditions for this problem are

$$\text{(10a)} \quad \gamma = \frac{w_t(1-\tau_t)}{\theta c_t}$$

$$\text{(10b)} \quad 1/c_t = \beta E_t \frac{r_{t+1}(1-\tau_{t+1}) + (1-\delta)}{c_{t+1}}$$

[7]In the specification employed above agents are allowed to spend each dollar once per period (i.e. there is a unitary velocity constraint). This specification, although somewhat nonstandard makes computation easier, and serves to eliminate the inflation tax, thus divorcing nominal and real sides of the model. This dichotomy makes interpretation easier without affecting the main results of the paper.

(10c) $Q_t = \beta E_t \dfrac{p_t c_t}{p_{t+1} c_{t+1}}$

(10d) $P_t = M_t/(\theta c_t)$

As these equations stand, the system is nonstationary since the model admits endogenous growth. Defining the following variables m=M/P, ζ = c/y, and μ = m/c. Using (2) and (3) the first-order conditons can be rewritten as

(11a) $n_t = \dfrac{(1-\alpha)(1-\tau_{t+1})}{\gamma \zeta_t}$

(11b) $1/\zeta_t = \beta E_t\,(1/\zeta_{t+1})\,\dfrac{n_t^{1-\alpha} K_t}{n_{t+1}^{1-\alpha} K_{t+1}}\,[1-\delta+\alpha\ A n_{t+1}^{1-\alpha}(1-\tau_{t+1})]$

(11c) $\mu_t = \theta$

A solution to this problem involves finding the policy function $K_{t+1} = \tilde{h}(b_t, \tau_t, \eta_t, K_t)$, where $\tilde{h}$ satisfies

(12) $K_{t+1} = h(b_t, \tau_t, \eta_t)\,[A n_t^{1-\alpha} + (1-\delta)]\, K_t$

This is particularly convenient since it implies that the capital stock can be eliminated as a state variable. The problem is reduced to solving the functional equations for ζ (b, τ, η), h(b, τ, η), and μ(b, τ, η) along with the transtion equation for government debt.

Once the function ζ, μ, and h are found, the various pricing relationship can also be derived. These are

(13) $R_t = (1/\beta)[1/E_t(1/(1+\eta_{t+1}))]$,

(14) $E_t \dfrac{p_{t+1}}{p_t} = \zeta_t n_t^{1-\alpha}\ E_t \{\dfrac{1+\eta_{t+1}}{n_{t+1}^{1-\alpha}[A n_t^{1-\alpha} + (1-\delta)]}\}$,

and

$$(15)\quad \rho_t = 1/[\beta E_t\{\frac{\zeta_t}{\zeta_{t+1}}\ \frac{n_t^{1-\alpha}}{n_{t+1}^{1-\alpha}(An_t^{1-\alpha} + (1-\delta))}\}]$$

where ρ_t is the gross rate of interest paid on a bond promising to deliver one unit of consumption next period.

c. Parameterization

For the most part parameter values are consistent with those used in other studies in dynamic stochastic macroeconomics. The stochastic process for taxes is calibrated to roughly conform with the Barro and Sahasakul (1986) series. Thus the mean of τ is .27. Government spendings mean is .17 and is taken from Christiano and Eichenbaum (1992) while transfers are set equal to .10. Given these values for fiscal policy choosing A=2.0, β=.98, $\gamma\theta$=4.0, δ=.10 and α=.30 yields steady state real output growth of 1.02, a real after-tax interest rate of 1.04, a fraction of time worked equal to .20, and consumption's share of gnp equal to .64. The parameter θ is set so that the ratio of consumption on nondurables and services to the monetary base is .10 (which is approximately equal to its actual 1991 value of .09). This implies θ=.10.

With no interest elasticity of money demand, the tax base for inflation is independent of the inflation rate and there is not a problem in using monetary policy to bound the debt from above. However, if tax rates are allowed to take on values somewhat greater than the sum of government spending plus transfers, it is impossible to counteract the resulting declines in the debt to gnp ratio through the open market sale of securities. Debt will be unbounded below.

In this model the revenue from open market operations is

$(\eta_t/(1+\eta_t))(M_t/y_t) = (\eta_t/(1+\eta_t))\theta\zeta_t$. Because η_t must be greater than -.02 to assure positive nominal interest rates, the debt to gnp ratio can only be increased by .0013 (when θ=.10) through open market operations. Hence a realistic fiscal policy process requires the responsiveness of tax rates to debt.

d. Results

The experiments below will contrast two different monetary policies one exogenous and the other responding endogenously to debt. Both the tax process and money growth rates will be highly persistent with ν=16 and either ψ=2 or the transition probability of money growth remaining in the same state equal to .85. With these parameters the autocorrelation coefficient for taxes is .83, which is very close to the value of .78 displayed by the Barro and Sahasakul (1986) series, while the autocorrelation coefficient for money growth is approximately is .63 when money is endogenous and .67 when money is exogenous. These values are also fairly close to the actual autocorrelation coefficient of .67 for base growth from 1960-1993. Tax rates take on the values .23 and .31 while money growth rates take on the values .02 and .08. This leads to a standard deviation for taxes of .04, which is almost exactly the value of .039 exhibited by the Barro-Sahasakul series. The mean of taxes is .273 again replicating the .278 mean of the actual data. Money growth has a mean of .063 in the exogenous case and .067 in the endogenous case while the standard deviations are .024 and .025, respectively. This compares with actual data on base growth from 1959-1993 which has a mean of .065 and a standard deviation of .023.

The policy functions for the case of exogenous monetary policy are displayed in figures (1a)-(1f), while those for endogenous money are shown in figures (2a)-(2f). One immediately notices that there is little to distinguish the basic shapes of the various policy and equilibrium pricing functions. For example, consider the policy functions for labor hours depicted in (1a) and (2a). In both economies individuals work harder when taxes are low. As debt rises the chances of staying in the low tax state decrease and individuals take greater advantage of lower taxes by more aggressively substituting labor for leisure. Similarly when taxes are high, rising debt makes it more likely that taxes will remain high and there is less intertemporal substitution out of labor and into leisure. High money growth reduces debt levels increasing the probability that tax rates will either fall in the future or remain low. Thus in both the high and low tax states high money growth reduces effort, but the response is so small that it is barely noticeable in the figures.[8]

Consumption behaves just like leisure with individuals consuming more goods when they consume more leisure. With effort greater when taxes are low and less consumption, real interest rates must be lower in order to induce a market clearing level of investment. One notes from the policy functions for investment and the real interest rate that increasing debt crowds in investment and lowers the real rate, a decidedly non-Keynesian result.

While money growth rates have only small effects on the policy functions for real variables, they do, alter, somewhat, the equilibrium policy functions for expected inflation and the nominal rate of interest. Under both

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[8]For a larger dispersion of tax rates the differences between high and low money growth states becomes more significant.

types of monetary policy, higher money growth rates imply higher nominal rates and higher expected inflation. When money is exogenous debt levels have no effect on either the nominal rate or expected inflation where as both the nominal rate and expected inflation are increasing in debt when money is endogenous. The intuition for these results follows directly from (13) and (14). When money is endogenous, higher debt implies a greater probability of high money growth and thus higher nominal rates and expected inflation.

Whether money is exogenous or endogenous does not significantly affect the behavior of the nominal side of the economy, as shown in figures 4 and 5. When money is exogenous money growth oscillates somewhat less than when monetary policy reacts endogenously (compare figures 3b and 4b). The oscillatory behavior in (4b) can be dampened somewhat by constructing a hybrid example in which money only responds to debt at the upper and lower bounds of the debt to gnp ratio.

The oscillatory behavior of endogenous money imparts similar oscillations in the other nominal variables. Although the means of the series are almost identical under the two types of policy, the standard deviations of the series are somewhat higher when money is endogenous (see Table 1). In comparing the model's generated data with actual data on after-tax nominal interest rates and inflation (measured using the gdp deflator) the data generated using exogenous money seems to conform better. The standard deviation for after-tax nominal rates (1970-1993) is .014 and inflation has a standard deviation of .024 over the period 1960-1993.

The correlation coefficients also show some differences between the two economies. While the correlations between nominal variables is quite similar across monetary regimes, the correlations between real variables and the nominal interest rate is quite different (see Table 2). The reason for this is the behavior of money and its correlation with tax rates. When money growth is endogenous it follows a stochastic process similar to tax rates (see figures 5a and 5b). This correlation drives the significant correlation between money and real variables which was not present under a regime of exogenous money growth. The correlations of money with real variables in turn drives the significant correlations between other nominal variables and the real side of the economy.

One then sees that apart from a slight increase in the standard deviations of nominal variables that a regime of endogenous money growth induces only minor differences in the behavior of nominal magnitudes. Thus from the standpoint of unpleasant arithmetic there is really nothing very unpleasant. The major differences across regimes occurs in the correlations between real variables and the nominal interest rate. These correlations do not occur because of any major causality running from monetary policy to real magnitudes, but occur because money growth is correlated with tax policy.

We have just seen that nominal behavior does not depend critically on whether the monetary authority responds to debt. However, for the two cases considered an econometrician could easily uncover whether or not the monetary authority responds to debt by running a regression of money growth on lagged money growth and lagged debt.[9] The results of such an exercise when money is endogenous is

$$\eta_t = \alpha_\eta + \underset{(.14)}{.33}\,\eta_{t-1} + \underset{(.016)}{.066}\,b_{t-1}$$

[9]Regression coefficients are an average of 250 simulated regressions.

However, if the monetary authority were only required to respond to debt at its upper bound a simple regression would not be sufficient for uncovering the link between money growth rates and debt. In this case the estimated regression would be

$$\eta_t = \alpha_\eta + \underset{(.11)}{.58}\ \eta_{t-1} + \underset{(.015)}{.020}\ b_{t-1},$$

and the coefficient on lagged debt would be insignificantly different from zero. Thus, if the monetary authority is independent in all but fiscal policy crises, establishing a link between fiscal and monetary policy could be a fairly subtle exercise.

V. CONCLUSION

This paper has analyzed the quantitative significance that lifetime government budget balance has for monetary policy and economic variables. While explicit consideration of the government's budget constraint has interesting implications for the effects of fiscal policy--for example, crowding in of investment and somewhat lower real interest rates--these consideration have only marginal and not very significant effects on nominal variables.[10] As long as the monetary authority can control the essential features of monetary policy, money growth rates and their dispersion, whether policy responds to debt or not is of little consequence. Since the responsiveness of fiscal policy to debt appears to be critical for the existence of a well defined equilibrium, and that money policy is at best of limited practical use in bounding debt, it may be that societies with well developed taxing technologies place little importance on using a central bank

[10]For a more detailed analysis of fiscal policy see Dotsey (1994a) and Dotsey and Mao (1994b).

as an agent of fiscal policy. Thus empirical results such as those in King and Plosser (1985) and Plosser (1982) that indicate that seignorage and other nominal magnitudes are independent of debt are not very surprising.

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TABLE 1

Summary Statistics for Model Generated Data*

money exogenous

	means	s.d	rho
τ	.273	.040	.827
η	.063	.024	.682
b	.286	.173	.968
n	.198	.017	.801
ζ	.645	.020	.757
i	.185	.020	.757
r	1.040	.015	.799
R	1.085	.017	.682
π^e	1.044	.022	.719
π	1.043	.030	.657

money endogenous

	means	s.d	rho
τ	.273	.040	.825
η	.067	.025	.630
b	.282	.172	.967
n	.198	.017	.798
ζ	.644	.020	.753
i	.186	.020	.753
r	1.040	.015	.799
R	1.089	.018	.886
π^e	1.047	.027	.873
π	1.047	.034	.700

*100 simulations of 60 periods

TABLE 2

Correlation Coefficients

(a) money exogenous

	τ	η	b	n	ζ	i	r	R	π^e	π
τ	1.0									
η	-.016	1.0								
b	.221	-.120	1.0							
n	-.992	-.003	-.118	1.0						
ζ	.938	.018	-.070	-.974	1.0					
i	-.938	-.018	.070	.974	-1.0	1.0				
r	-.915	-.022	-.312	.881	-.788	.788	1.0			
R	-.016	1.0	-.120	-.003	.018	-.018	.022	1.0		
π^e	.608	.721	.113	-.595	.551	-.551	-.663	.721	1.0	
π	.592	.765	-.021	-.608	.611	-.611	-.513	.765	.926	1.0

(b) money endogenous

	τ	η	b	n	ζ	i	r	R	π^e	π
τ	1.0									
η	.307	1.0								
b	.207	.600	1.0							
n	-.991	-.239	-.101	1.0						
ζ	.936	.112	-.089	-.973	1.0					
i	-.936	-.112	.089	.973	-1.0	1.0				
r	-.912	-.361	-.304	.875	-.777	.777	1.0			
R	.257	.864	.903	-.155	-.027	.027	-.343	1.0		
π^e	.687	.765	.759	-.600	.426	-.426	-.794	.842	1.0	
π	.771	.823	.488	-.727	.621	-.621	-.740	.696	.875	1.0

Figure 1: Policy Functions for Low Interest Elasticity (Money Exogenous)

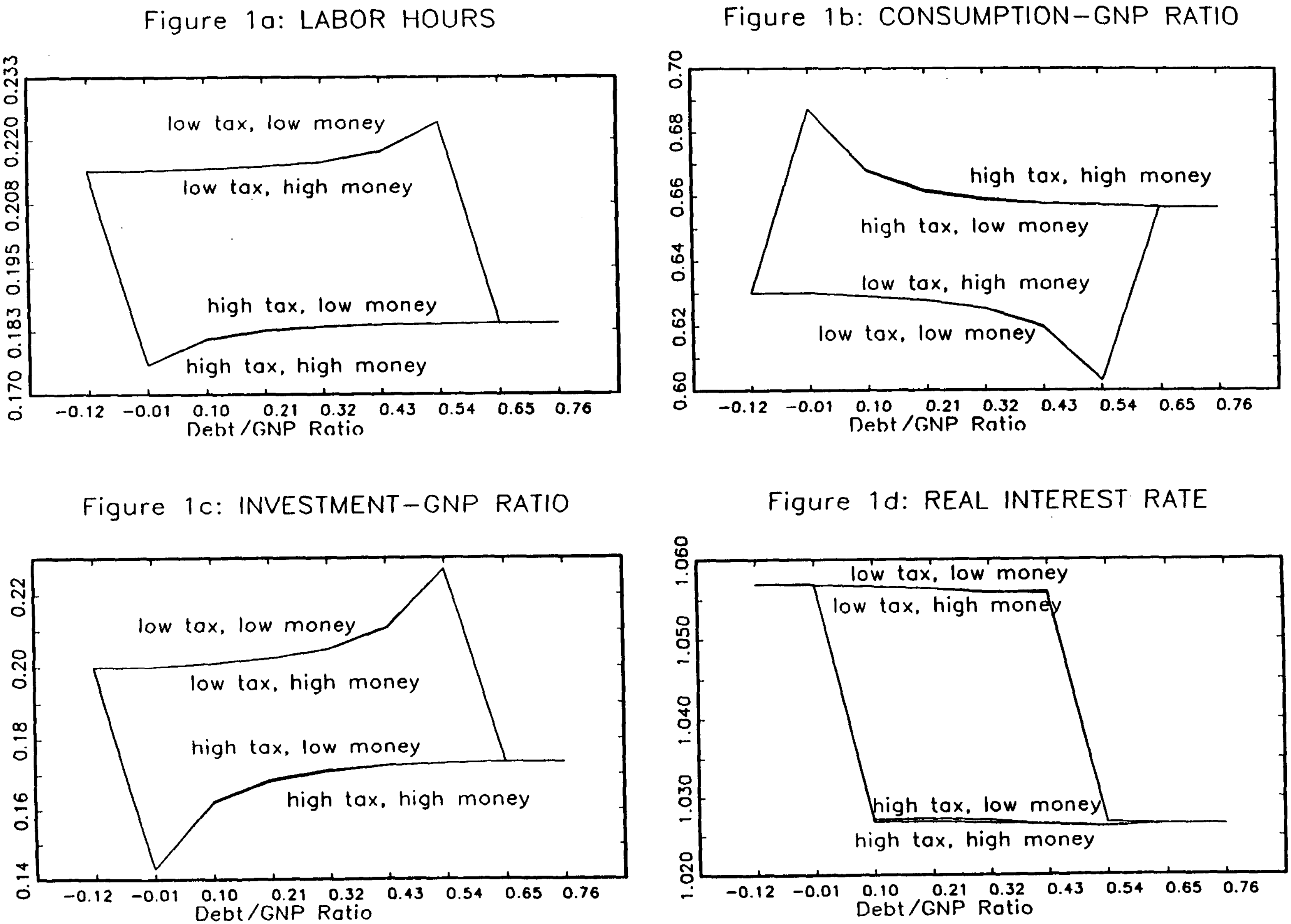

Figure 1e: NOMINAL INTEREST RATE

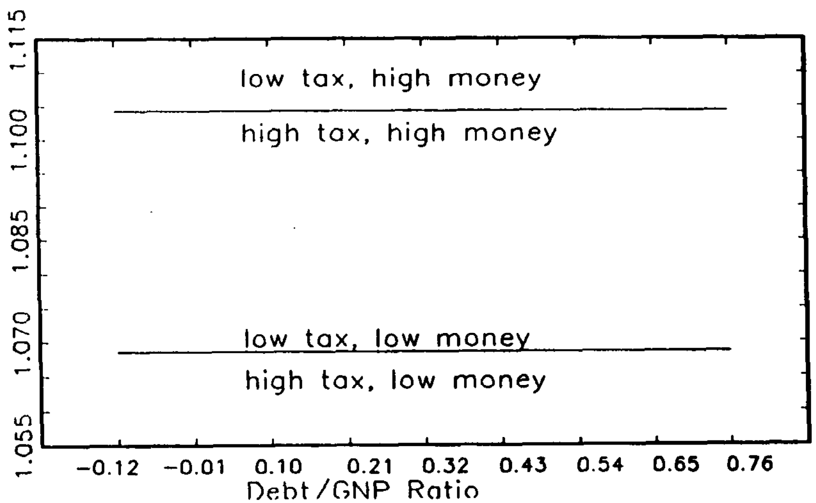

Figure 1f: EXPECTED INFLATION

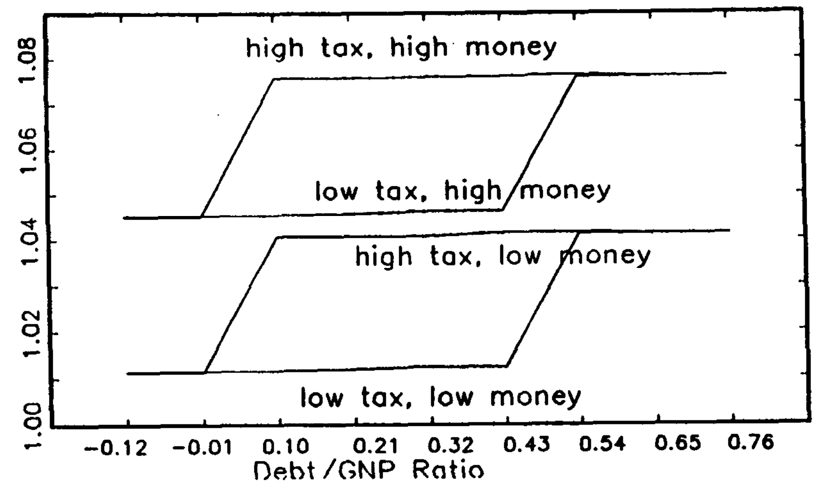

Figure 2: Policy Functions for Low Interest Elasticity (Money Endogenous)

Figure 2a: LABOR HOURS

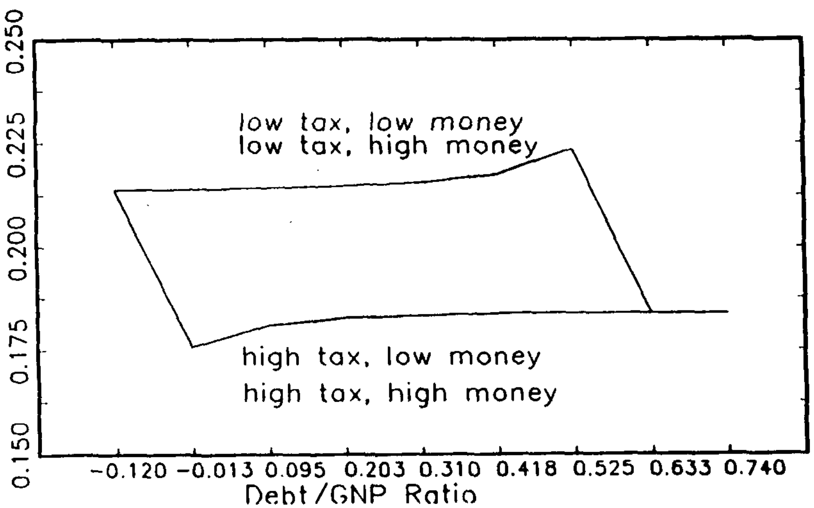

Figure 2b: CONSUMPTION-GNP RATIO

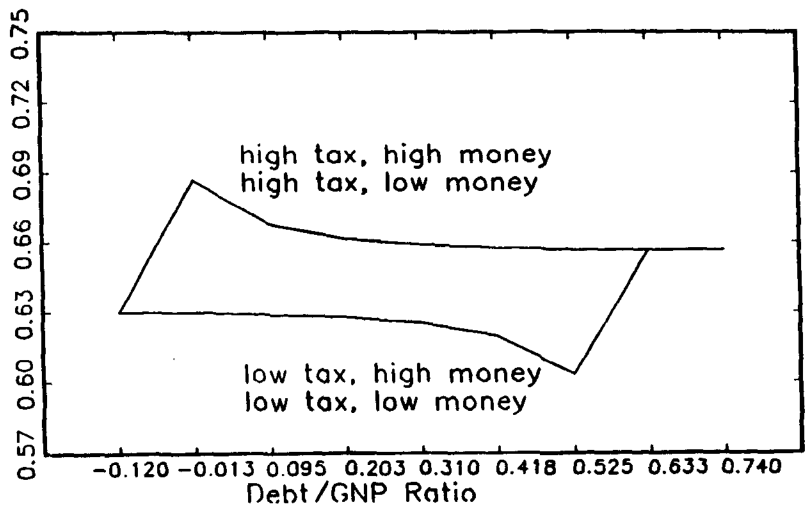

Figure 2c: INVESTMENT-GNP RATIO

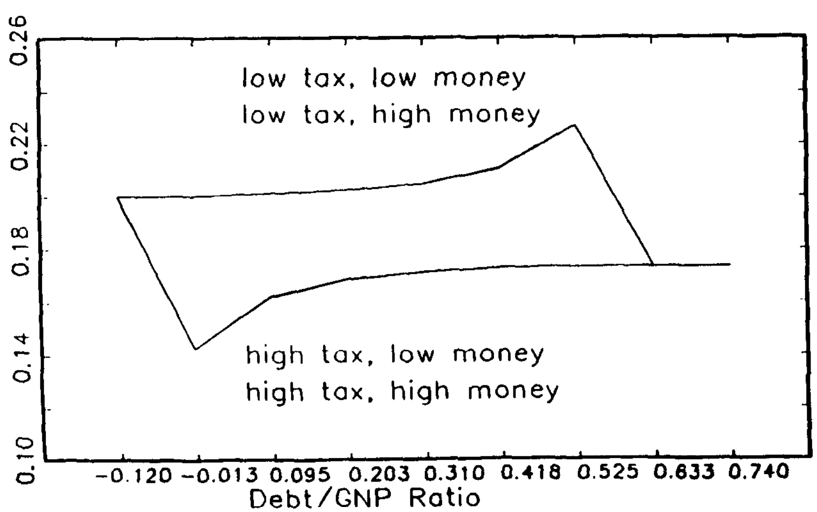

Figure 2d: REAL INTEREST RATE

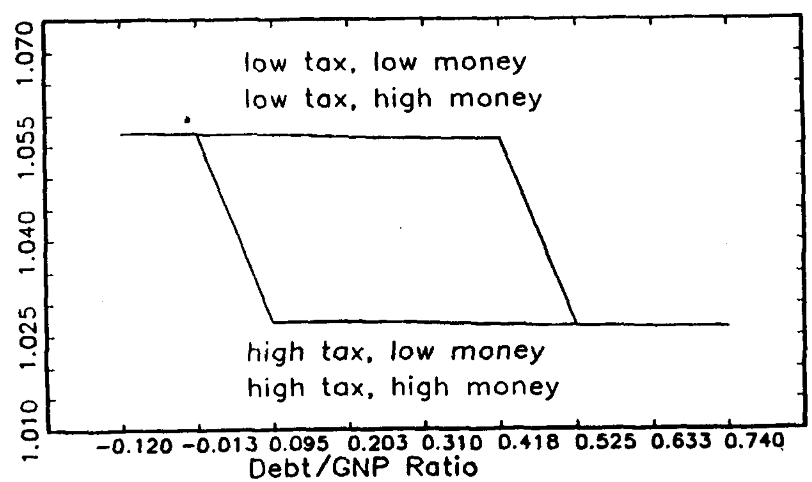

Figure 2e: NOMINAL INTEREST RATE

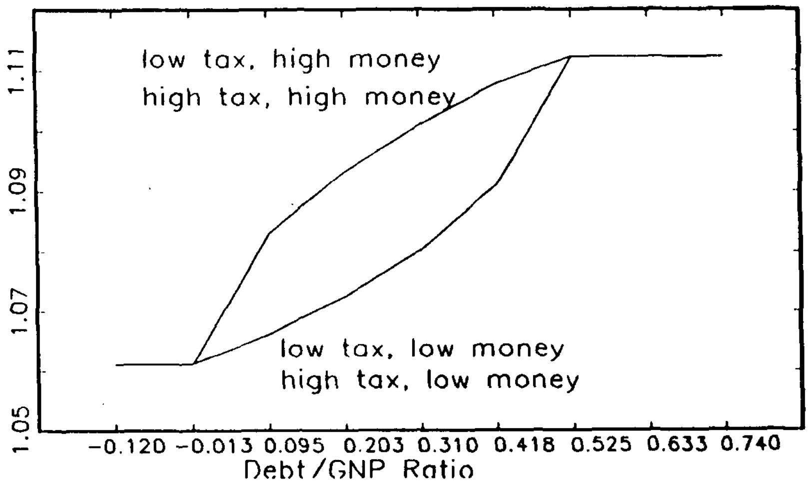

Figure 2f: EXPECTED INFLATION

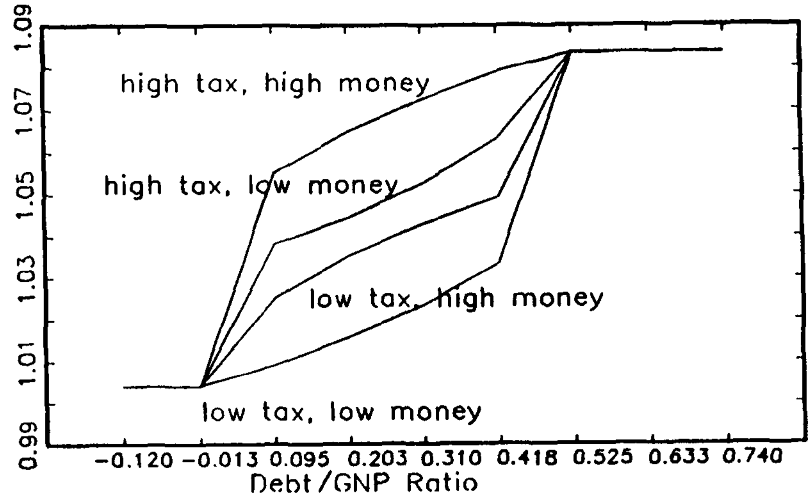

Figure 3: Simulations for Money Exogenous

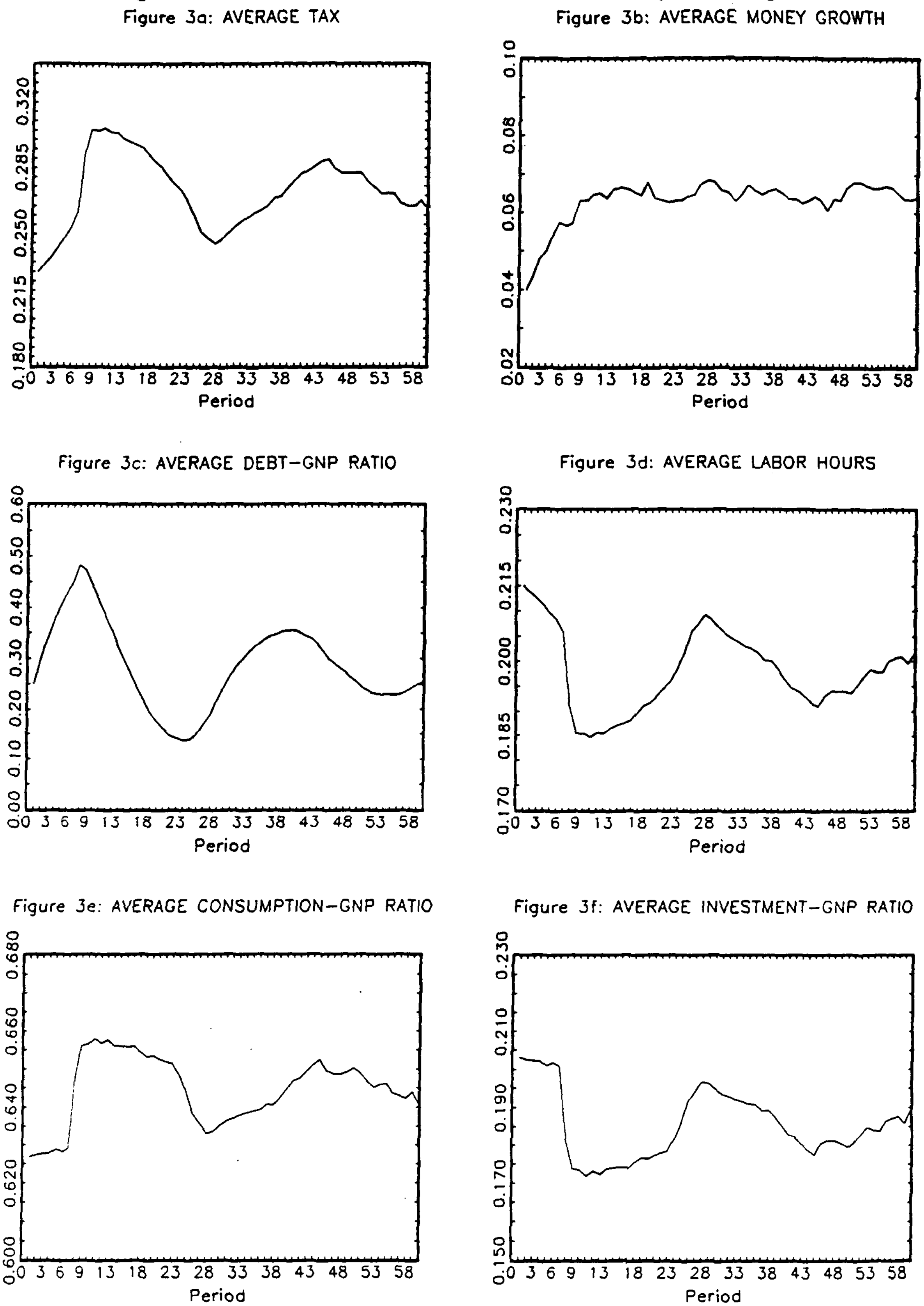

Figure 3g: AVERAGE REAL INTEREST RATE

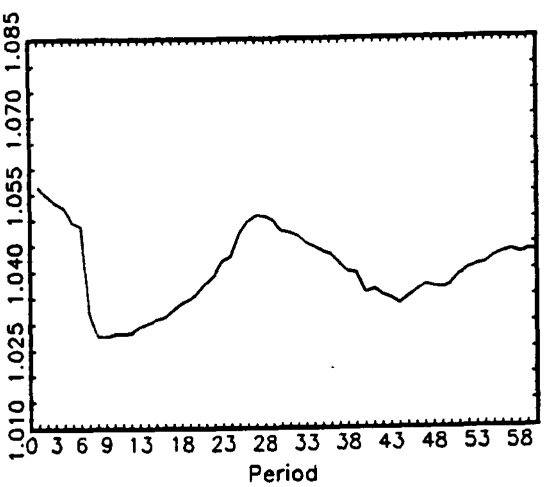

Figure 3h: AVERAGE NOMINAL INTEREST RATE

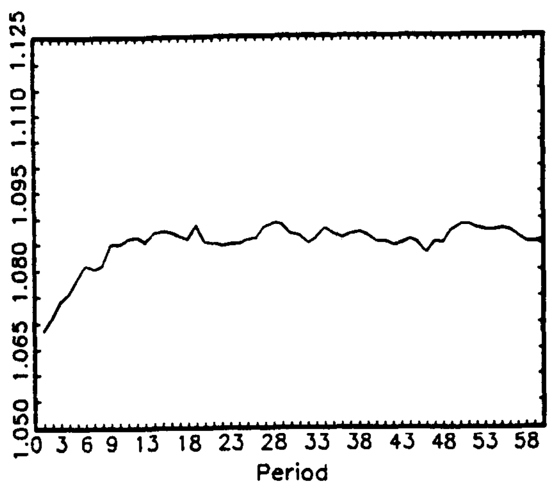

Figure 3i: AVERAGE EXPECTED INFLATION

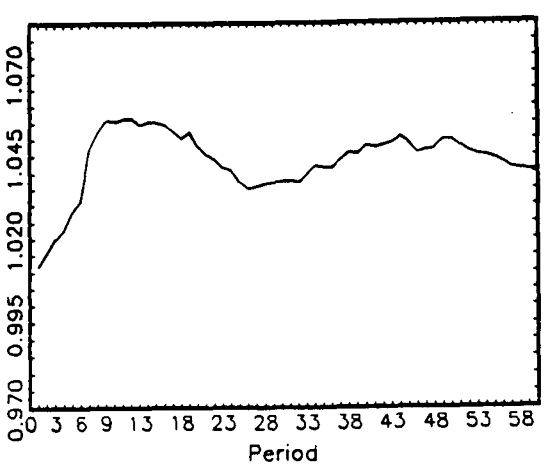

Figure 3j: AVERAGE ACTUAL INFLATION

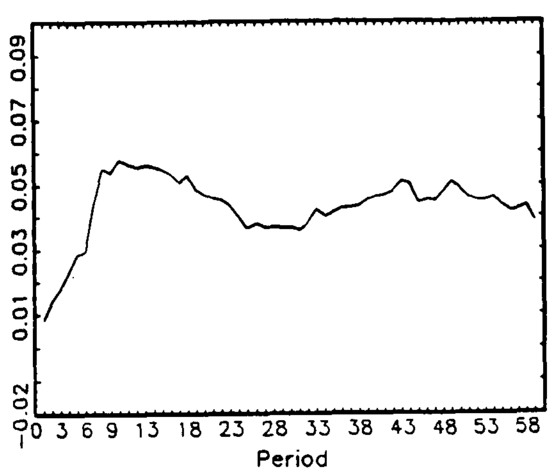

Figure 4: Simulations for Money Endogenous

Figure 4a: AVERAGE TAX

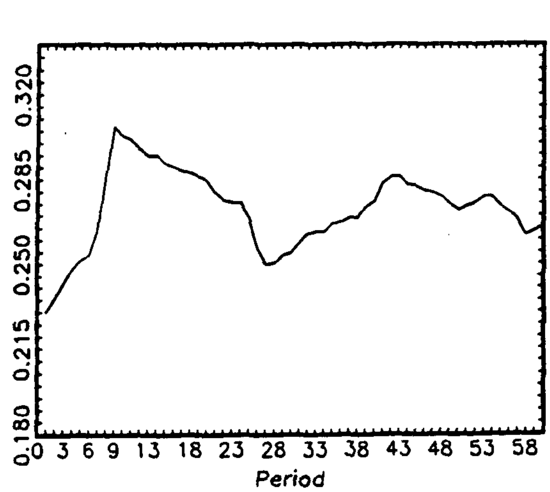

Figure 4b: AVERAGE MONEY GROWTH

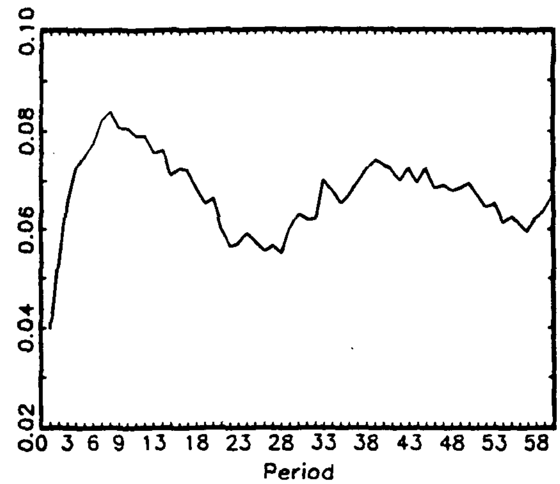

Figure 4c: AVERAGE DEBT-GNP RATIO

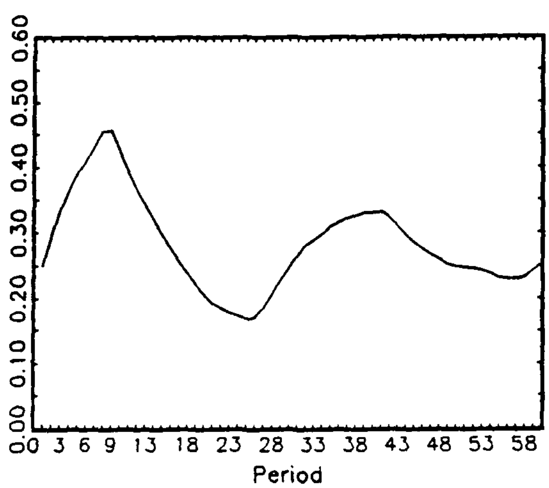

Figure 4d: AVERAGE LABOR HOURS

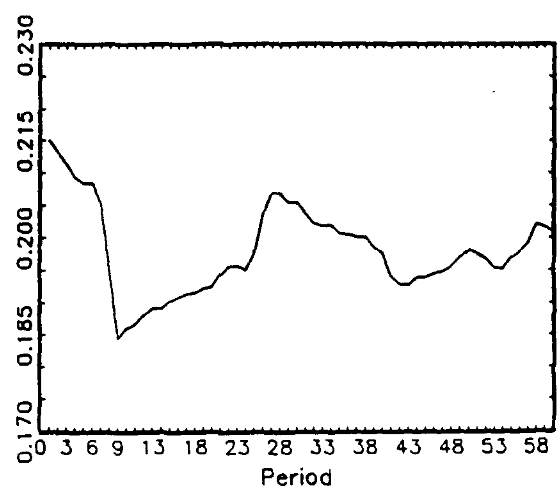

Figure 4e: AVERAGE CONSUMPTION-GNP RATIO

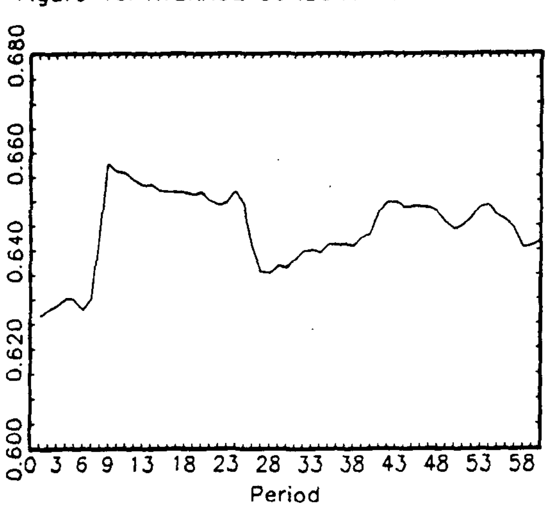

Figure 4f: AVERAGE INVESTMENT-GNP RATIO

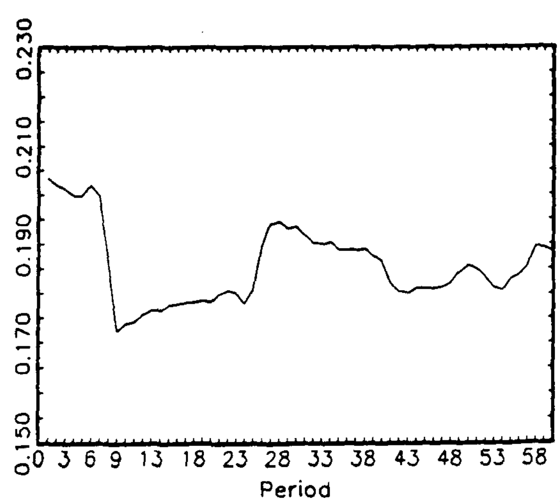

Figure 4g: AVERAGE REAL INTEREST RATE

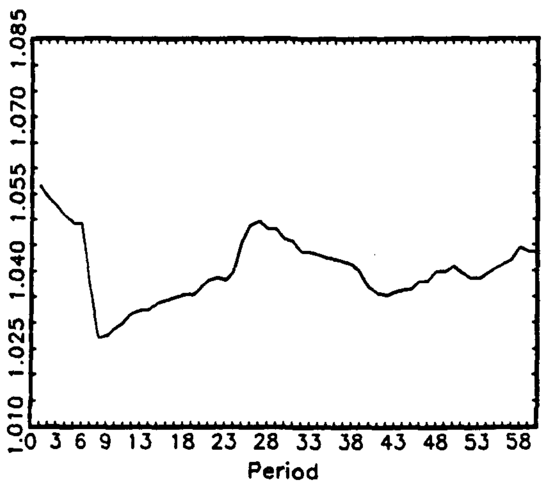

Figure 4h: AVERAGE NOMINAL INTEREST RATE

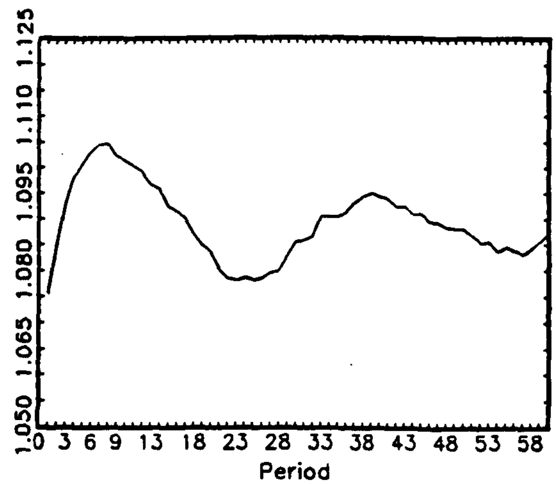

Figure 4i: AVERAGE EXPECTED INFLATION

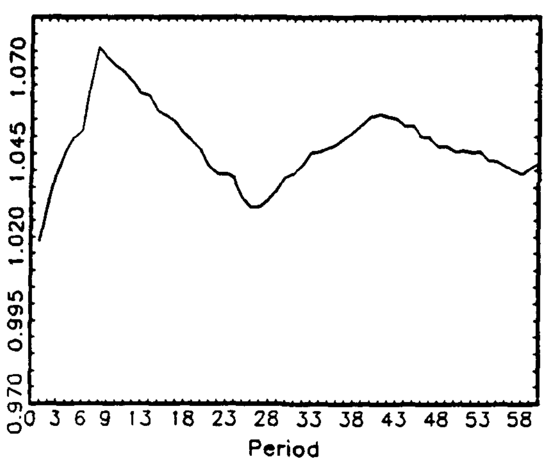

Figure 4j: AVERAGE ACTUAL INFLATION