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ON THE MONETIZATION OF DEFICITS

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ABSTRACT

Whether or not a deficit is monetized is often thought to have important macroeconomic ramifications. This paper is organized around two questions. The first is: Does monetization matter?, or more specifically, For a given budget deficit, do nominal or real variables behave differently depending on whether deficits are monetized or not? Virtually all macro models give an affirmative answer. After sorting out some theoretical issues that arise in a dynamic context, I present some new time series evidence which suggests that monetization matters mostly for nominal variables.

The second question is: What factors determine how much monetization the Federal Reserve will do? After discussing some normative rules, I offer a game-theoretic argument to explain why a central bank may choose not to monetize deficits at all and may even contract bank reserves when the government raises its deficit. The empirical work turns up a surprisingly systematic link between budget deficits and growth in reserves. This relationship suggests that the Federal Reserve monetizes deficits less when inflation is high and when government purchases are growing rapidly.

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A government deficit is said to be "monetized" when the central bank purchases the bonds that the government issues to cover its deficit. Because of the central bank's balance sheet identity, such purchases increase bank reserves unless offset by other transactions. By contrast, new government debt purchased by private parties does not increase bank reserves. Because of this difference, whether or not a deficit is monetized is often thought to have important macro- economic ramifications. And there is considerable evidence that this supposition is correct.

This paper is organized around two questions: Does monetization matter? and, What factors determine how much monetization the Federal Reserve will do? Both of these questions have been asked before, and my answers will be less than startling. My aims are more modest: to bring a bit more evidence to bear on the issues and to add a few new thoughts to the discussion.

Section I takes up the first question: For a given budget deficit, will nominal or real variables behave differently depending on whether the new bonds are purchased by the central bank or by the public? Notice that this is basically the same as asking: Do open-market operations matter? Virtually all macro models give an affirmative answer. But some recent theoretical developments, which I review, suggest that the issue is a good deal more complicated than indicated by simple models like the quantity theory or IS-LM. After sorting out some theoretical issues that arise in a dynamic context, I present some new time series evidence which supports the old idea that monetization matters.

Section II addresses the second issue: How does the Fed decide how much of each deficit to monetize? First, some normative rules dictating how the Fed should make this decision are presented and briefly evaluated. Then a game-theoretic argument is offered to explain why a central bank with discretionary authority may choose not to monetize deficits at all and may instead do the opposite, i.e., contract bank reserves when the government raises its deficit. Finally, I offer some empirical evidence suggesting that there is a systematic link between budget deficits and growth in reserves. This relationship suggests that the Federal Reserve monetizes deficits less when inflation is high and when government purchases are growing rapidly.

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I. DOES MONETIZATION MATTER?

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Elementary macro models, including both the quantity theory and IS-LM, suggest that budget deficits have a greater effect on aggregate demand if they are monetized.

This difference is extreme under the crude quantity theory. Obviously, if Py=MV and V is a constant, then deficits increase nominal demand if and only if they are monetized. <1> A slightly more sophisticated quantity theory, which recognizes that nonmonetized deficits raise velocity by raising interest rates, allows for an effect of deficits on aggregate demand. But the supposition that the effect of money is greater is maintained.

Essentially the same conclusion emerges from the fix-price IS-LM model. Figure 1 shows an initial IS-LM equilibrium at point A. Higher government spending or a cut in taxes raises the IS curve to I_1S_1. If the deficit is not monetized, the LM curve is unchanged and equilibrium moves to point B; output rises. But if the deficit is monetized, the LM curve shifts as well (to L_1M_1) and output increases even more (point C).

This is all very simple, but it leaves out much. Among the important omissions are:

(1) wealth effects on the IS and/or LM curves and the resulting dynamics that are implied by the government budget

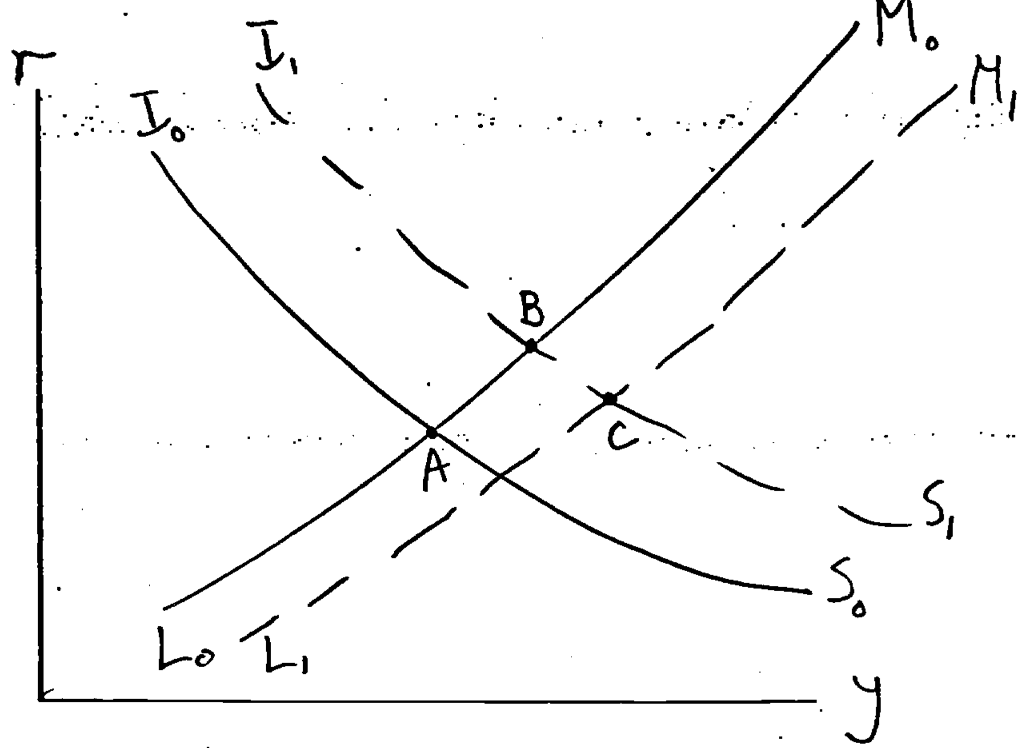


Figure 1

constraint;

(2) changes on the supply side of the economy as higher or lower interest rates affect investment;

(3) expectational effects set up by the government's financing decision (which, among other things, intervene between the real interest rate and the nominal interest rate).

The next three subsections take up each of these in turn.

1. WEALTH EFFECTS AND THE GOVERNMENT BUDGET CONSTRAINT

The government budget constraint states that any excess of total expenditures over total receipts must be financed by selling bonds either to the Federal Reserve (and hence creating high- powered money) or to the public:

$$(1) \quad dH/dt + dB/dt = G + rB - T(Y)$$

where H is high- powered money, B is publicly-held bonds (here taken to have zero maturity), G is nominal government purchases, r is the nominal interest rate, and T is nominal receipts, written as a function of nominal income.

As Solow and I (1973) showed almost a decade ago, if there are wealth effects on the IS and LM curves, then the dynamics set up by (1) lead to results that seem paradoxical from the viewpoint of static macro models. In particular, if the model remains stable under bond financing of deficits (which is by no means a sure thing), then the long-run effects of a deficit on aggregate demand are greater if it is not monetized.

How can this be true in view of Figure 1? Suppose we add wealth effects to the analysis and assume that government bonds are net wealth. <2> Start with the case of bond financing (point B). The additional wealth represented by the new bonds augments consumer spending and pushes the IS curve further to the right. At the same time, however, the LM curve shifts leftward if there is a wealth effect on the demand for money. <3> The net result of these two wealth effects is clearly to increase r. But the net effect on Y seems to be ambiguous. However, Solow and I showed (as is obvious) that in a stable system the net impact of the two wealth effects must increase income.

The dynamic adjustment proceeds as follows. Each injection of bonds increases income, and the process continues (in a stable system) until the induced tax receipts bring the budget into balance. The dynamics are similar under money financing, except that each dollar of newly- created money has an additional liquidity effect on the LM curve which makes Y rise even faster.

Why, then, do bond-financed deficits have larger effects in the long run? The reason, loosely speaking, is that bond-financed deficits "last longer." More precisely, bond-financed deficits raise the government's interest expenses whereas money- financed deficits reduce them. Thus, while each $1 billion bond issue expands Y by less than a $1 billion issue of high-powered money, the total amount of new paper assets that must be created before the deficit is closed is greater under bond financing.

How do we know that the net result is that Y expands more under bond financing? Set (1) equal to zero and take the (long-run) total derivative with respect to G, including the wealth effects of the creation of new paper assets. Under bond financing, a rise in G leads to a rise in B so:

$$(2) \quad dY/dG = (1/T'(Y))(1 + d(rB)/dG).$$

Under money financing, a rise in G leaves B unchanged but raises M, so:

$$(3) \quad dY/dG = (1/T'(Y))(1 + B(dr/dG)).$$

In (2), both r and B are driven up by the increase in B. In (3), r is driven down by the increase in M. It follows that the multiplier in (2) exceeds the multiplier in (3).

Of course, all this assumes that the economy is stable under both methods of financing, a matter to which I will return. It also ignores expectations, the behavior of prices, and changes in the capital stock, items which I take up next.

2. CAPITAL ACCUMULATION AND THE LONG RUN

The original paper by Solow and myself allowed for capital accumulation and showed that, apart from modifications in the stability conditions, this wrinkle did not affect the basic results. However, the model we used maintained the (inappropriate) assumption of a fixed price level.

Fortunately, subsequent work established very similar conclusions in models which deal more satisfactorily with the price level. <4>

If the labor force and technology are more or less exogenous, then the long-run effects of monetization depend on how the capital stock reacts. Neoclassical growth models lead to the supposition that money financing of deficits is better for capital formation than bond financing, <5> but adding even a minimal amount of complexity to standard macro models introduces enough ambiguity so that even this intuitive conclusion cannot be derived.

The ambiguities arise from the interaction of wealth effects and interest elasticities, neither one of which can be ignored without assuming away the problem. Consider, as an example, the following simple IS-LM model augmented to include wealth effects:

$$(4)\quad y = c(y-t(y),\ a) + i(r-\pi,K) + g$$

$$(5)\quad M/P = L(r,\ y,\ a)$$

$$(6)\quad a = K + M/P + B/P$$

$$(7)\quad dM/dt + dB/dt = P(g - t(y)) + rB$$

$$(8)\quad (1/P)(dP/dt) = \pi + h(y - F(K))$$

$$(9)\quad dK/dt = i(r-\pi,K)$$

Equations (4) and (5) are IS and LM curves augmented to include real wealth, a, which is defined in (6). Here r denotes the nominal interest rate and π the expected rate of inflation. The difference between M and H is ignored. Equations (7)-(9)

give the dynamics of the three state variables: P, K, and either M or B. Equation (7) is the government budget constraint; equation (8) is an expectational Phillips curve; and equation (9) updates the capital stock.

The signs of most of the short- run comparative static multipliers implicit in (4)-(6) can be determined with only the usual qualitative assumptions. An important exception, however, is dr/dM which, even ignoring possible effects of M on expected inflation (about which more later), has the sign of:

$$C_a L_y - (1-L_a)[1-C_y(1-t')]$$

an expression which is negative in the absence of wealth effects, but ambiguous in their presence. The economics behind this ambiguity is quite simple. Normally, an increase in M lowers interest rates by shifting the LM curve to the right. But the wealth effects of an injection of money shift the LM curve to the left and the IS curve to the right, thereby pushing up interest rates. These wealth effects could conceivably be strong enough to offset the original effect of M on the LM curve.

As might be surmised, this ambiguity is devastating to long-run analysis where primary attention focuses on the behavior of the capital stock. If we do not know in which direction M pushes r, then we certainly will not be able to tell in which direction it pushes K. In fact, none of the long-run comparative static derivatives (obtained from equations (4)-(6) and from equations (7)-(9) set equal to zero) are of determinate sign unless wealth effects are assumed away. But this is not a legitimate way out of the indeterminacy because Solow and I (1973) showed years ago that wealth effects are intimately involved in the stability conditions. <6>

The conclusion, unfortunately, seems to be that theory will tell us little about the long-run consequences of the monetization decision. Econometric estimation and simulation of quantitative models seem to be the only ways out.

3. THE GOVERNMENT BUDGET CONSTRAINT AND EXPECTATIONS

The dynamic constraints across choices of policy mixes set up by the government budget constraint bring expectational issues to the fore. The identity points out that today's deficit and monetization decisions have implications for the feasible set of fiscal-monetary combinations in future periods.

For example, suppose an expansionary fiscal policy today leads to a large deficit that is not monetized. Future government budgets will therefore inherit a larger burden of interest payments, so the same time paths of G, M, and tax rates will lead to larger deficits. What will the government do about this? That depends on its reaction function. For example, large deficits and high interest rates might induce greater monetary expansion in the future (the possibility emphasized by Sargent and Wallace (1981)). Alternatively, it might induce future tax increases (the case stressed by Barro

(1974)), or cuts in government spending (the apparent hope of Reaganomics). Yet another possibility is that the government will simply finance the burgeoning deficits by issuing more and more bonds. <7>

All of these are live options, and have different implications for the long-run evolution of the economy. In fact, under rational expectations, they may have different implications for the state of the economy today.

As an example of a nonmonetized deficit, consider a tax cut financed by issuing new bonds. Such a tax cut today enlarges current and prospective future budget deficits, thereby requiring some combination of the following policy adjustments:

(1) increases in future taxes;

(2) decreases in future government expenditures;

(3) increases in future money creation;

(4) increases in future issues of interest- bearing national debt.

To the extent that the current decisions made by individuals and firms are influenced by their expectations about the future, each of these alternatives may have different implications for the effects of the tax cut today.

For example, if people believe that a tax cut financed by bonds simply reduces today's taxes and raises future taxes in order to pay the interest on the bonds, then consumption may not be affected. This is essentially Barro's (1974) argument.

Alternatively, people may believe that the policy will eventually lead to greater money creation. If so, the inflationary expectations thereby engendered may affect their current decisions in ways that are not captured by standard behavioral functions. This is essentially the point made by Sargent and Wallace (1981) in arguing that tight money may be inflationary.

Still different reactions would be expected if people thought the current deficit would lead to lower government spending or to more bond issues in the future. The theoretical possibilities are numerous, limited only by the imagination of the theorist. <8>

Rational expectations interact with the government budget constraint in an obvious way. People's beliefs about the future consequences of current monetary and fiscal decisions are conditioned by their views of the policy rules that the authorities will follow. To the extent that these beliefs affect their current behavior, different perceived policy rules actually imply different short-run policy multipliers under rational expectations.

This is easily illustrated in the context of the preceding IS-LM model. Consider the short-run multiplier dy/dg, allowing for a possible effect of g on inflationary expectations via the mechanisms just discussed. It follows directly from (4)-(6) that:

$$\left.\frac{\partial y}{\partial g}\right|_{\pi\ \text{const.}} = \frac{1}{1-C_y(1-t')+\frac{i_r}{L_r}L_y} \equiv \mu\ ; \quad \text{and} \quad \left.\frac{\partial y}{\partial \pi}\right|_{g\ \text{const.}} = -i_r\mu\ ,$$

and from the chain rule that:

$$dy/dg = \left.\frac{\partial y}{\partial g}\right|_{\pi} + (d\pi/dg)\left(\left.\frac{\partial y}{\partial \pi}\right|_{g}\right)$$

The first term is the standard (positive) government spending multiplier in IS-LM analysis. The second term is the product of a positive effect of inflationary expectations on output and an effect of g on π which depends on the factors enumerated above. If it is positive, as seems likely, then expectational effects make the short-run multiplier larger. But it is conceivable that $d\pi/dg$ could be zero or even negative.

A key question for policy formulation is: how important are these expectational effects in practice? This seems to depend principally on how forward-looking urrent economic decisions really are.

Take the tax cut example again. Under the pure permanent income hypothesis (PIH) only the present discounted value of lifetime after-tax income flows affects current consumption. <9> So expectations about future budget policy should have important effects on current consumption. But if short-sightedness, extremely high discount rates, or capital market imperfections effectively break many of the links between the future and the present, then current consumption may be rather insensitive to these expectations and rather sensitive to current income. Even under fully rational expectations and the pure PIH, consumption may depend largely on current income if the stochastic process generating income is highly serially correlated. These are issues about which knowledge is accumulating; but much remains to be learned. The evidence to date does not lead to the conclusion that long-term expectations rule the roost. <10>

The other two places where expectations about future fiscal and monetary policies might have significant effects on current behavior are wage and price setting and investment.

Investment, of course, is the quintessential example of an economic decision which is strongly conditioned by expectations about the future. Even Keynes knew this! But, once again, there are some real-world considerations that interfere with the strictly neoclassical view of investment as the unconstrained solution to an intertemporal optimization problem. One is that capital rationing may interfere with a firm's ability to run current losses on the expectation of future profits. A second is that management may use ad hoc rules such as the payback period criterion in appraising investment projects. A third is the emerging "business school" view that managers are more shortsighted than they "should be" because they face the wrong incentives. A fourth is that there may be a strong accelerator element in investment spending, which ties the current investment decision much more tightly to the current state of the economy than neoclassical economics recognizes. As in the consumption example, each of these things diminishes the importance of the future to current decision making and thereby renders expectational effects less important.

Wage and price setting is another important example. Ad hoc rules which adjust wages or prices in accordance with "the law of supply and demand," or which are mainly backward looking, render expectational effects rather unimportant. But rules which are based on forward- looking considerations (such as expected future excess demand) make expectational effects crucial. Again, this is an area where we must learn much more before we can make any definitive judgments. <11>

A word on uncertainty seems appropriate before leaving this topic. It seems to me that people probably attach great uncertainty to their beliefs about what future government policies will be. If so, the means of their subjective probability distributions may have far less influence on their current decisions than the contemporary preoccupation with rational expectations would suggest. For example, how much influence does the two-week-ahead weather forecast have on your decision about whether or not to plan a picnic on a given date?

Similarly, the importance of expectations for macroeconomic aggregates is diminished by the likelihood that different people hold different expectations about what future government policies are likely to be. <12> If some people believe today's tax cuts signal higher future taxes, some believe they signal higher future money creation, and some believe they signal lower future government spending, then expectations about the future may have meager current effects in the aggregate.

The conclusion seems to be that, while we should not forget about expectational effects operating through the government budget constraint, neither should we get carried away by them. There is no reason to believe that they are the whole show.

4. NEW TIME SERIES EVIDENCE

The two preceding sections showed that capital accumulation and expectations considerably complicate theoretical discussion of the monetization issue. The former creates complexities that can be handled in principle, but not in practice. The latter opens up so many possibilities that it may be intractable even in principle. Can we let the data speak for themselves? This is hazardous in the absence of a reliable structural model embodying many of the effects just enumerated. What I offer in this section is far less ambitious: some simple time series evidence on whether or not knowledge of the monetization decision helps predict movements in nominal GNP, real GNP, and the price level.

The framework for such an analysis has been well established by Granger (1969) and Sims (1972), and will not be repeated here. Two points are worth making, however:

(1) Granger-causation has nothing to do with

causation in the usual sense. Since it is quite possible, especially once expectational influences are accounted for, that the "effect" might precede the "cause," learning that X Granger-causes Y tells us nothing about whether or not Y moved "because of" X. It means that X adds to the ability to predict Y, no more and no less.

(2) Whether or not X contributes to the ability to predict Y may depend on what other information is considered. Thus, for example, it is perfectly possible that X might Granger- cause Y when some other variable, Z, is excluded from the regression, but fail to Granger-cause Y when Z is included. In this context, I will interpret the question "Does monetization matter?" as asking whether or not changes in bank reserves Granger-cause nominal GNP growth (or inflation) once we control for growth of the national debt.

Letting Y denote nominal GNP, R denote bank reserves, D denote the outstanding stock of government bonds (including the portion owned by the Fed), and denote the first-difference operator, regressions of the following form were run:

$$(13) \quad \Delta Y/Y = a(L)(\Delta Y/Y) + b(L)(\Delta R/R) + c(L)(\Delta D/D),$$

These were estimated on annual fiscal year data, with the maximum lag extending back either two or three years. <13>

Monetization "does not matter," that is, fails to help predict growth in Y, if the b coefficients are jointly insignificant. Analogously, debt policy "does not matter" (given monetary policy) if the c coefficients are jointly insignificant. Notice that the crude quantity theory suggests a unitary long-run elasticity for bank reserves and a zero long-run elasticity for the non-monetized debt, that is:

$$\Sigma a + \Sigma b = 1 \quad \text{and} \quad \Sigma c = 0.$$

These hypotheses are all testable by standard F tests.

In estimating (13), ΔD was defined as the increase in government indebtedness to the public during fiscal year t. Fiscal, rather than calendar, years were used so as to get a more accurate measure of the deficit. Budget numbers in the national income and product accounts (NIPA) differ in several ways from those in the unified budget, and the deficit series I used differs further from the unified budget owing to the activities of off-budget agencies. This suggests a potentially large slippage between, say, quarterly NIPA deficit numbers and the true government borrowing requirement.

In order to use the fiscal year as the unit of time, quarterly data on adjusted bank reserves, R, <14> and nominal GNP, Y, were put on a fiscal year basis. <15> Results from estimating equation (13) by ordinary least squares over the period 1952-1981 appear as regressions (1) and (2) in Table 1. Roughly speaking, the regressions make it look as if only the first lag of each variable matters. But, in keeping with the spirit of this sort of work, the "insignificant" variables were not dropped.

Table 1

Regressions for Nominal GNP Growth, Fiscal Years 1952-1981

Variable	(1)	(2)
Constant	.068 (.015)	.052 (.012)
$(\Delta Y/Y)_{t-1}$	-.536 (.196)	-.515 (.187)
$(\Delta Y/Y)_{t-2}$	-.082 (.203)	.093 (.125)
$(\Delta Y/Y)_{t-3}$	-.174 (.133)	--
$(\Delta R/R)_{t-1}$	.675 (.150)	.715 (.146)
$(\Delta R/R)_{t-2}$	.186 (.212)	.116 (.199)
$(\Delta R/R)_{t-3}$	.149 (.197)	--
$(\Delta D/D)_{t-1}$	.349 (.091)	.328 (.080)
$(\Delta D/D)_{t-2}$	.125 (.114)	.177 (.104)
$(\Delta D/D)_{t-3}$	.161 (.108)	--
R^2	.80	.78
DW	2.16	2.25
$\frac{\Sigma b_j}{1-\Sigma a_j}$	.56	.58
$\frac{\Sigma c_j}{1-\Sigma a_j}$	.35	.36

	(1)	(2)
F Test for		
1) All $b_i = 0$	6.93**	9.18**
2) $\Sigma b_i = 0$	7.92*	9.96**
3) All $c_i = 0$	10.48**	14.58**
4) $\Sigma c_i = 0$	23.02**	24.33**
5) $\Sigma a + \Sigma b = 1$	12.14**	12.01**
6) $\Sigma a + \Sigma b = 1$ and $\Sigma c = 0$	12.01**	13.16**

Notes: Standard errors in parentheses.

*denotes significant at 5% level.

**denotes significant at 1% level.

The first question to be addressed is: Once growth of national debt is controlled for, does growth of reserves help to predict nominal GNP growth? The point estimates certainly suggest an affirmative answer, since in each regression the lagged change in reserves has a large and significant coefficient. More formally, F test number 1, reported at the bottom of the table, decisively rejects the null hypothesis that $\Delta R/R$ does not Granger-cause $\Delta Y/Y$.

A weaker hypothesis is that the sum of the b coefficients is zero, that is, that reserves have no long-run effect. Once again, the point estimates are unfavorable to this hypothesis since the estimated elasticity of Y with respect to R, controlling for D, is about .57. And, as can be seen in the table (F test number 2), the appropriate F-test confirms that this elasticity is significantly different from zero. Thus monetization does matter.

We can, of course, turn the tables and ask whether growth in national debt helps to predict nominal GNP growth once we control for growth in bank reserves. Hard-core monetarism suggests a negative answer. However, as can be seen in F-test number 3, the null hypothesis that all the c coefficients are zero is decisively rejected. Even the weaker hypothesis that, while deficits matter in the short run, they do not matter in the long run, to wit:

$$\Sigma c = 0,$$

is easily rejected by the data. Deficits certainly seem to matter.

What about the characteristic quantity-theory implication that the long-run elasticity of Y with respect to R is unity? As the table shows (in F test number 5), the null hypothesis that this elasticity is unity, i.e. that $\Sigma a + \Sigma b = 1$, is clearly rejected. The quantity theory fares no better if it is extended to include the implication $\Sigma c = 0$ (F test number 6).

The overall conclusion from these regressions is clear: both monetized and nonmonetized deficits are significant predictors of subsequent GNP growth.

An obvious question is whether the debt and reserves variables used in Table 1 are mainly predicting movements of prices or movements of real output. To address this question, Table 2 reports the results from regressions analogous to equation (13), but using the GNP deflator in place of nominal GNP.

The results differ from those obtained with nominal GNP in a number of ways, and are far more favorable to the quantity-theoretic approach. Unfortunately, in contrast to the case of nominal GNP, some of the results depend on whether we use the regression with three lags (column 1) or the regression with two lags (column 2).

First, the null hypothesis that growth in reserves does contribute to the explanation of inflation can be rejected in the equation using three lags -- but only at the 5% level of

Table 2

Regressions for Inflation, Fiscal Years 1952-1981

Variable	(1)	(2)
Constant	-.005 (.006)	-.000 (.006)
$(\Delta P/P)_{t-1}$	.432 (.179)	.508 (.173)
$(\Delta P/P)_{t-2}$	-.009 (.207)	.318 (.182)
$(\Delta P/P)_{t-3}$	.209 (.178)	--
$(\Delta R/R)_{t-1}$	.219 (.096)	.239 (.107)
$(\Delta R/R)_{t-2}$	-.009 (.102)	-.099 (.100)
$(\Delta R/R)_{t-3}$	.189 (.096)	--
$(\Delta D/D)_{t-1}$	-.071 (.077)	-.087 (.075)
$(\Delta D/D)_{t-2}$	.135 (.069)	.182 (.063)
$(\Delta D/D)_{t-3}$	.086 (.064)	--
R^2	.87	.81
DW	1.50	1.54
$\frac{\Sigma b_j}{1-\Sigma a_j}$	1.08	.81
$\frac{\Sigma c_j}{1-\Sigma a_j}$	.79	.55

	(1)	(2)
F Test for		
1) All $b_i = 0$	3.47*	2.82
2) $\Sigma b_i = 0$	6.55*	1.02
3) All $c_i = 0$	3.47*	4.23*
4) $\Sigma c_i = 0$	2.10	1.57
5) $\Sigma a + \Sigma b = 1$	.02	.04
6) $\Sigma a + \Sigma b = 1$ and $\Sigma c = 0$	3.25	1.08

Notes: Standard errors in parentheses.

*denotes significant at 5% level.

significance, not at the 1% level. In the equation using two lags, it cannot be rejected at all. (See F test number 1 at the bottom of Table 2.)

Second, in the two-lag equation we cannot even reject the hypothesis that the long-run elasticity of P with respect to R is zero -- an hypothesis that almost no one would seriously entertain. However, we can easily reject it in the three-lag equation. (See F test number 2.)

Fortunately, the other results do not depend on whether we use two or three lags of the variables. For example, growth in national debt helps to predict inflation (once growth in reserves are controlled for) at the 5%, but not the 1%, level. (F test number 3.) However, the null hypothesis that the long-run elasticity of P with respect to D is zero cannot be rejected. (F test number 4.) The implications that we associate with the strict quantity theory (see F tests 5 and 6) also cannot be rejected.

Table 3 reports the analogous regressions and F tests using real GNP in place of nominal GNP. Naturally, the explanatory power is much lower since we are using nominal reserves and nominal debt to explain a real variable. In general, very few significant effects are found.

For example, the hypothesis that growth in reserves does not help predict real GNP growth can be rejected at the 5% level in the regression using two lags of each variable. But it cannot be rejected at the 1% level; and it cannot be

Table 3

Regressions for Real GNP Growth, Fiscal Years 1952-1981

Variable	(1)	(2)
Constant	.033 (.015)	.022 (.013)
$(\Delta y/y)_{t-1}$	-.019 (.209)	.147 (.184)
$(\Delta y/y)_{t-2}$	.427 (.256)	.296 (.213)
$(\Delta y/y)_{t-3}$	-.120 (.227)	--
$(\Delta R/R)_{t-1}$	.262 (.187)	.258 (.188)
$(\Delta R/R)_{t-2}$	-.393 (.169)	-.450 (.172)
$(\Delta R/R)_{t-3}$	-.198 (.208)	--
$(\Delta D/D)_{t-1}$	.374 (.152)	.291 (.138)
$(\Delta D/D)_{t-2}$	-.203 (.156)	-.218 (.124)
$(\Delta D/D)_{t-3}$	-.126 (.135)	--
R^2	.48	.36
DW	2.35	2.24
$\frac{\Sigma b_j}{1-\Sigma a_j}$	-.46	-.35
$\frac{\Sigma c_j}{1-\Sigma a_j}$	.06	.13

F Test for	(1)	(2)
1) All $b_i = 0$	2.56	4.01*
2) $\Sigma b_i = 0$	1.11	0.64
3) All $c_i = 0$	2.57	2.35
4) $\Sigma c_i = 0$	0.11	0.43

Notes: Standard errors in parentheses.

*denotes significant at 5% level.

rejected at all in the regression using three lags of each variable.

The hypothesis that growth in debt does not help predict real GNP growth cannot be rejected in either regression.

While the point estimates of the long-run elasticity of y with respect to R are sizeable and negative (-.46 and -.35 in the two versions), neither differs significantly from the quantity-theoretic value of zero (see F text number 2). The estimated long-run elasticity of y with respect to D is a small positive number (.06 and .13 in the two versions), but is nowhere near significant (see F test number 4).

In sum, neither growth in bank reserves nor growth in national debt carries much information that is useful in predicting future <u>real</u> GNP growth according to these equations. The fact that both variables were significant predictors of future growth in <u>nominal</u> GNP seems to stem mainly from their value in predicting inflation.

II. THE DETERMINANTS OF MONETIZATION

The government budget constraint, by pointing out that there are two ways to finance a deficit, creates a presumption that a blend of the two will normally be used; that is, it creates a presumption that some fraction of the deficit will be monetized. Let δ_t denote the nominal deficit in fiscal year t and write (1) as:

$$(14)\quad dH/dt + dB/dt = \delta_t$$

Define β_t as the fraction of the deficit that is monetized and write (14) as:

$$(15)\quad dH/dt = \beta_t \delta_t \quad .$$

This is nothing but an identity; it carries no behavioral implications -- not even that β_t is typically positive. Our interest is in the factors determining β_t.

First note that high-powered money is the sum of reserves plus currency, so:

$$(16)\quad dH/dt = dR/dt + dC/dt.$$

It is well known that the Fed supplies currency passively to meet demand so as to insulate the money stock, M, from short-term gyrations in the currency ratio. Remembering that M is the sum of deposits plus currency, a linear money-multiplier model would be:

$$M = mR + sC,$$

with m approximately equal to the reciprocal of the required reserve ratio, ρ, and s approximately equal to unity. If M is to be insulated from fluctuations in C, <16> then R will have to react to changes in C according to $dR/dC = -(s/m)$, which is approximately equal to $-\rho$. By (16) this means that H will have to react to C approximately according to $dH/dC = 1 - \rho$. Emodying this idea in (15) leads to:

$$dH/dt = \gamma_t \delta_t + (1-\rho)(dC/dt),$$

and then using (16) gives:

$$(17) \quad dR/dt = \gamma_t \delta_t - \rho(dC/dt).$$

In this expression, the first term includes all the things in which we are interested while the second term represents the Fed's efforts to offset currency fluctuations. Nevertheless, this second term does offer an informal test of the reasonableness of the empirical results: the coefficient of dC/dt should resemble a weighted average of required reserve ratios.

1. SOME SUGGESTED MONETIZATION RULES

Before estimating (17) let us consider some specific rules that have been suggested for the monetization decision.

MONETARISM

The most famous and most widely-discussed suggestion for a monetary rule can be attributed, more or less accurately, to Milton Friedman. Under Friedman's suggested regime, the Fed would keep the money supply growing at some constant rate regardless of budget policy and would refuse to deviate from the rule for cyclical reasons. Here I interpret this policy as a constant growth rule for bank reserves (or for the monetary base). Under such a rule the marginal monetization rate, γ_t in equation (17), would presumably be zero.

This is not the place to offer a comprehensive review of the pros and cons of the k-percent rule, but one new element that has entered the debate in recent years is worth mentioning. Some years ago, Solow and I (1973) showed that a policy of holding the money supply constant and financing all deficits by issuing bonds could destabilize the economy, whereas financing deficits by money creation probably led to a stable system. This finding, while derived in a very simple and special case with fixed prices, proved to be remarkably robust. Tobin and Buiter (1976) established a parallel result for a full-employment economy with perfectly flexible prices. Pyle and Turnovsky (1976) and others showed that analogous results obtain in models intermediate between these two extremes, such as models with an expectations- augmented Phillips curve.

Recently, McCallum (1981, 1982), Smith (1982) and Sargent and Wallace (1981) have re-emphasized the importance of this result for the monetarist policy rule. Though using rather different models, each has made the same point: that the system is liable to be dynamically unstable under a policy that holds both fiscal policy (defined in various ways by the different authors) and the money supply (or its growth rate) constant.

The mechanism behind these results is not hard to understand. Suppose some shock (such as an autonomous decline in demand in a Keynesian model) opens up a deficit in the government budget, and the monetarist regime is in force. Bonds will be issued to finance the deficit. With both interest rates and the number of bonds increasing, interest payments on the national debt will be increasing. But this increases the deficit still further, requiring even larger issues of bonds in subsequent periods, and the process repeats. If the real rate of interest exceeds the rate of population growth, then the real supply of bonds per capita will grow without limit. Consequently, unless bonds are totally irrelevant to other economic variables (as in the non-Ricardian view of Barro (1974)), the whole economy will explode. <17>

So the stabilizing properties of the monetarist rule are open to serious question, to say the least. What about its longer-run effects?

As a long-run defense against inflation, the monetarist rule seems to be very effective. Although academic scribblers can, and have, constructed examples of continuous inflaton without growth in reserves, my feeling is that policy makers can justifiably treat these models as intellectual curiosa and proceed on the assumption that a maintained growth rate of reserves will eventually control the rate of inflation.

But what about capital formation and real economic growth?

When a recession comes, the k-percent rule takes no remedial action. If there is an important accelerator aspect to investment spending, the slack demand will retard capital formation. At the same time, the issuance of new government bonds to finance the budget deficits that recession brings will push up interest rates. And this, too, will retard invesment spending. The likely result is that rigid monetarism will not create a climate conducive to investment unless long-run predictability of the price level is a more important determinant of investment than I think it is. <18>

It seems to me that much of the current fuss over lack of fiscal- monetary coordination and the concommitant pressures for monetization derives from concern over the implications of the policy mix for investment. If so, then hard-core monetarism, which eliminates the coordination issue by eliminating policy, does not look like a very good solution.

BONDISM

As McCallum (1981) pointed out, a potentially better monetization rule was actually suggested by Friedman in his earlier "A Monetary and Fiscal Framework for Economic Stability" (1948), but subsequently abandoned. For lack of a better name, Gary Smith (1982) suggested that we call the policy "bondism" because it treats bonds in much the same way as monetarism treats money.

Under the old Friedman policy, the marginal monetization rate would be unity, not zero. Specifically, Friedman suggested that government spending and tax rates be set according to allocative considerations so as to balance the budget on average, and that all deficits be financed by creation of money. <19> Both McCallum (1981, 1982) and Smith (1982) observed that this policy regime is equivalent to the "money financing" scenario in Blinder and Solow (1973), and hence probably leads to a stable system. On this score alone, it has much to recommend it over monetarism.

But there is more to the story. Consider what would happen when, for example, a deficiency of aggregate demand brought on a recession. Falling incomes would open up a budget deficit, and this would automatically induce the Fed to turn on the monetary spigot. The economy would get a strong anti-recessionary stimulus from monetary policy. Thus the old Friedman rule would seem to be a powerful stabilizer.

How does it score on the more long-run criteria? The fact that recessions would automatically engender easy money under the "bondist" policy augurs well for capital formation. So does the notion that cyclical disturbances would probably be quite muted. The one potential worry is over inflation. The rule can conceivably lead to a lot of money creation in a hurry, with subsequent inflationary consequences. But if the fiscal part of the rule keeps the high-employment budget balanced, and if the economy fluctuates around its high- employment norm, this should not be a major worry. Monetary expansions should subsequently be reversed by monetary contractions. <20> If the rule is believed, even large injections of money should not raise the spectre of secular inflation.

While I have never been an advocate of rigid rules, it seems to me that all this adds up to a clear conclusion: the old Friedman rule ought to get more serious quantitative attention and the new Friedman rule ought to get less.

2. GAME THEORY AND MONETIZATION

We have seen that it has been suggested that the optimal marginal monetization rate is zero and that the optimal marginal monetization rate is one. These suggestions would seem to bracket the relevant alternatives. But such is not necessarily the case once we remember that stabilization policy in the United States is in the hands of two independent authorities, one in charge of fiscal policy and the other in charge of monetary policy, with neither one dominating the other. <21>

When the two policy makers are at loggerheads, a policy mix of tight money and loose fiscal policy frequently results, with deleterious effects on interest rates and investment. <22> What outcome does theory lead us to expect when fiscal and monetary policy are in different hands and the two parties have different ideas about what is best for the economy?

A natural way to conceptualize this situation is as a two-person non-zero-sum game. And a natural candidate for what will emerge, it seems to me, is the Nash equilibrium. Why the

Nash equilibrium? Both policy makers understand that they do not operate in a vacuum. Each presumably understands that he is facing an intelligent adversary with a decision making problem qualitatively similar to his own. Furthermore, this is a repeated game; each policy maker has been here before and assumes that he will be here again. It seems natural that each would assume that the other will make the optimal response to whatever strategy he plays. If so, each will probably play his Nash strategy.

Let us see how the Nash equilibrium works out in a moderately realistic example. (See the payoff matrix in Figure 2.) I assume that each policy maker has two available strategies: the government can raise or lower the deficit, and the central bank can raise or lower bank reserves. I also assume that they order the outcomes differently, but know each other's preference ordering. Specifically, the fiscal authority (whose preference ordering appears below the diagonal in each box) is assumed to favor expansionary policy. From its point of view, the case of a monetized deficit is best (rank 1) and the case where both play contractionary strategies is worst (rank 4). The monetary authority (whose ordering appears above the diagonal) wants to contract the economy to fight inflation, and so orders these alternatives in the opposite way. However, as between the two outcomes which combine expansion and contraction, I assume that the two players agree that society is better served by easy money and a tight budget rather than

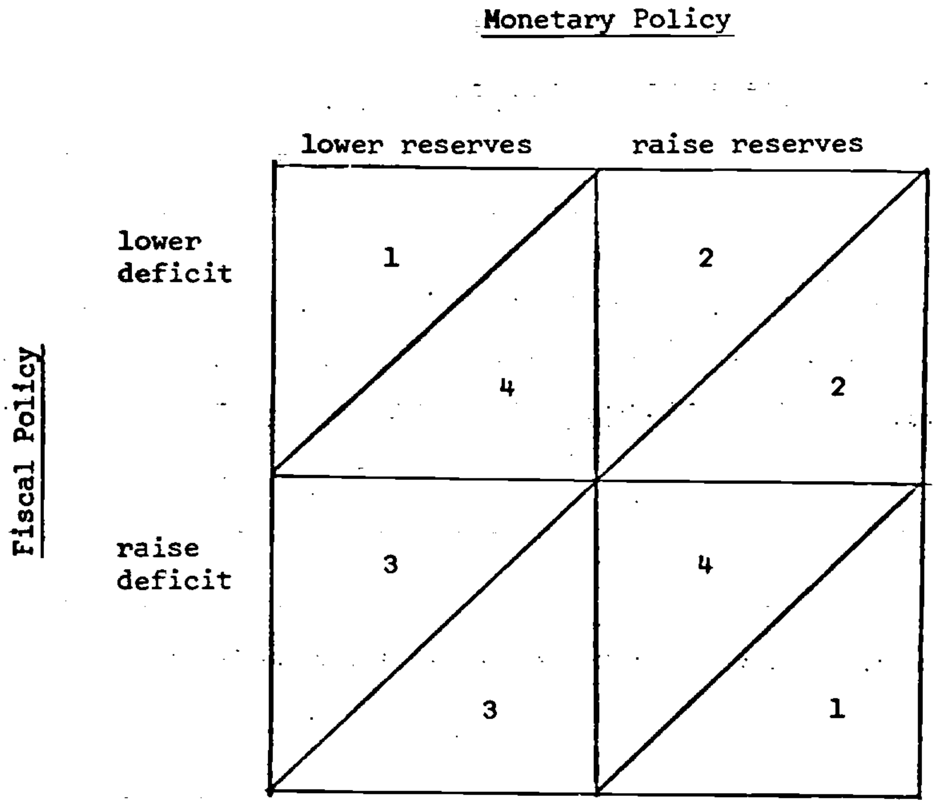

Monetary Policy
lower reserves
raise reserves
Fiscal Policy
lower deficit
raise deficit
1
4
2
2
3
3
4
1

Figure 2

tight money and a loose budget.

This explains the entries in the payoff matrix (Figure 2). Now where is the Nash equilibrium? The example is a case of the Prisoners' Dilemma since each player has a dominant strategy. Specifically, if the Fed raises bank reserves, the administration will plan for a higher deficit and the Fed will wind up with its least- preferred outcome (the lower righthand box). So the Fed will reduce bank reserves. Knowing this, the administration's best strategy is to raise the deficit, so the outcome will be the lower lefthand box. Clearly, this is the only Nash equilibrium for this game. It also seems to be the most plausible outcome of uncoordinated but intelligent behavior.

But notice two interesting aspects of this outcome. First, the deficit goes up and bank reserves go down; looked at from the perspective of equation (17), the marginal monetization rate is negative!

Second, both the Fed and the fiscal authority agree that the upper righthand box -- easy money plus tight fiscal policy -- is superior to the Nash equilibrium. Under full monetary-fiscal coordination, they might well select this policy mix. But, if they cannot reach an agreement, then the Nash equilibrium -- a Pareto- inferior outcome -- is likely to arise.

If this example is typical, then switching from a system of two uncoordinated policy makers to one with a single, unified policy maker might yield substantial gains. And there is good reason to think that it is typical, because it has long been known that there is no reason to expect Nash equilibria in two-person non- zero- sum games to be Pareto optimal.

The problem, of course, is that achieving greater coordination is more easily said than done. The two authorities have reasons for disagreeing -- reasons which may not be easily ironed out. <23> However, this example illustrates that full coordination (which is probably impossible in any event) may not be critical. What we need in this case is no more than an agreement to consult with one another enough to avoid outcomes that both parties view as inferior. Maybe this is not too much to ask.

However, things become far less clear if one policy maker lacks knowledge of either the preferences or the economic model of the other. Then there is no particular reason to think the Nash equilibrium will result, and other solutions become equally plausible. For example, each player may simply pursue his global optimum, ignoring the decision of the other. There are other possibilities as well. <24>

3. EMPIRICAL EVIDENCE ON MONETIZATION

Econometric study of the Fed's "reaction function" began some years ago and has generated some interesting papers. In recent years, several authors have investigated whether or not Federal deficits per se increase the growth of money (presumably via monetization). The evidence obtained so far is decidedly mixed.

PREVIOUS LITERATURE

The first papers to focus on the monetization issue, by Barro (1978) and Niskanen (1978), reached more or less the same conclusion: that the size of the federal deficit has rather little to do with money growth.

Barro studied the period 1941-1976, using an equation he had developed elsewhere to divide money growth into anticipated and unanticipated components. He found that the federal deficit (NIFA basis), when added to his annual regression (which included a federal expenditure variable), obtained the "wrong" sign, suggesting that deficits actually deter money growth. However, when the expenditure variable was omitted, the coefficient of the deficit was correctly signed. In view of the literature that followed, it is also worth mentioning that the estimated coefficients of the deficit in Barro's regressions changed dramatically when the war years (1941-1945) were excluded from the sample.

Niskanen's specification looked more like a traditional reaction function. Using annual data covering 1948- 1976, he sought to explain money growth by the lagged growth rates of real GNP and prices (reflecting stabilization objectives) and the federal deficit. His regression fit the data rather poorly but, unlike Barro's, yielded a correctly signed and statistically significant coefficient on the deficit. However, Niskanen found that the coefficient of the deficit became small and insignificant when he included a dummy variable for the years 1967-1976.

Hamburger and Zwick (1981) changed Barro's money growth and government spending variables to make them more comparable to his measure of the deficit and also to align them better in time; they also shortened the period to 1954-1976. Consistent with Barro, they obtained a coefficient of 1.09 (with a t-ratio of 2.2) on spending and a coefficient of -0.26 (with a t-ratio of 0.6) on the deficit. However, when they further shortened the period to 1961-1976 (leaving just 16 observations) the results changed dramatically. The coefficient of the spending variable fell to 0.18 (and became insignificant) while the coefficient of the deficit rose to 0.92 (with a t-ratio of 1.9).

These results appear to tell us as much about the extreme sensitivity of the estimates to the choice of sample period as they do about whether or not the Fed monetizes deficits. However, in a very recent paper Hamburger and Zwick (1982) extend their results through 1981 with very little change in the estimates.

These studies lead to no firm conclusions about the determinants of monetization. <25> However, they do create a skeptical attitude about facile assertions that deficits induce faster money growth. More importantly, the studies teach us some valuable lessons about the formulation of an approprate research strategy. Specifically:

(1) Results are extremely sensitive to the choice of time period, suggesting that the Fed's behavior pattern may have changed over time. This led me to do considerable testing of the estimated relationships for temporal stability.

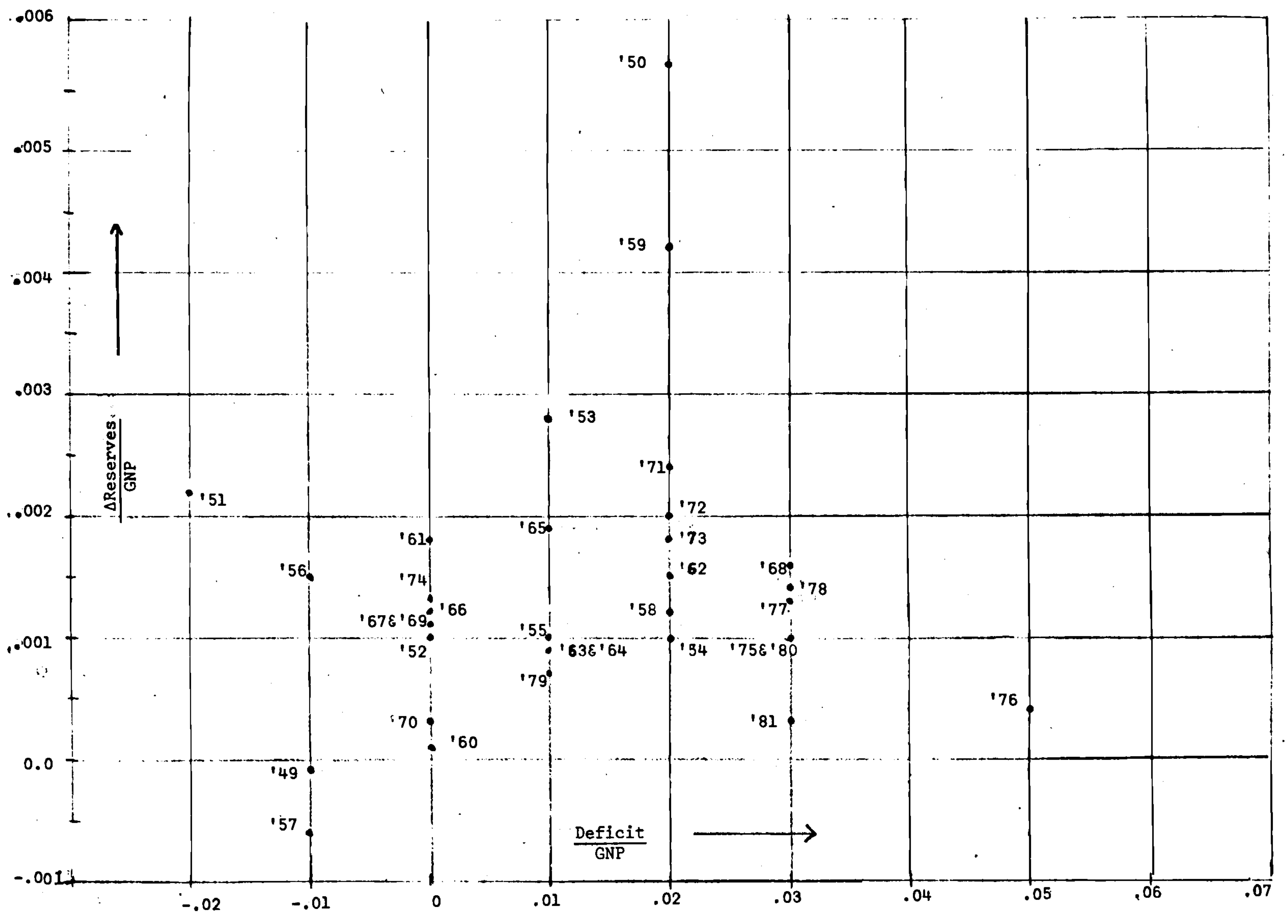
(2) Results are also rather sensitive to the particular time series that are used, suggesting a relationship that is far from robust. This led me to pay careful attention to the measurement of certain variables -- especially "money" and "the deficit" -- and their alignment in time. <26>

A FIRST LOOK AT THE DATA

My point of departure is equation (17), which can be thought of as a modified version of the government budget constraint. Until we specify the nature of γ_t more fully, all this equation does is remind us that (a) "monetization" means creation of high-powered money, not of any of the standard M's, and (b) currency changes ought to be controlled for in analyzing the determinants of changes in bank reserves.

Figure 3 plots the change in adjusted bank reserves against the increase in the outstanding stock of government interest-bearing debt. As in the regressions in Section I.4, the fiscal year is the unit for measuring time. The scatter diagram covers fiscal years 1949 through 1981.

Though the measure of "money" is quite different from that used in earlier studies, <27> we see immediately that more subtle techniques will be required to unearth a relationship



ΔReserves / GNP
Deficit / GNP
.006
.005
.004
.003
.002
.001
0.0
-.001
-.02
-.01
0
.01
.02
.03
.04
.05
.06
.07
'50
'59
'53
'71
'51
'72
'65
'73
'61
'56
'62
'68
'74
'78
'66
'58
'77
'67&'69
'55
'52
'63&'64
'54
'75&'80
'79
'76
'70
'81
'60
'49
'57

between deficits and growth in reserves. The eyeball, with its inability to do multiple regression analysis, is unable to discern any such relationship.

Regression (1) in Table 4 takes the next step. It controls for changes in currency as suggested by equation (17), but maintains the null hypothesis that γ_t is constant through time. <28> Once again, there is no apparent relationship between the deficit and growth in reserves; the adjusted R^2 of the regression, for example, is -.01! Note, however, that the coefficient of changes in currency, while insignificant, turns out more or less as expected (perhaps a bit too high).

Breaking the sample into smaller subperiods, as suggested by the previous literature, does not improve the relationship between deficits and growth in reserves. The data show no obvious correlation between the two variables.

REGRESSION ANALYSIS

Of course, a lack of zero-order correlation does not necessarily imply that there is no relationship once other pertinent influences are controlled for. Among the variables that might be expected to influence γ_t, the fraction of the deficit that is monetized, are

(a) the size of the deficit (if there is a nonlinear relationship);

(b) the lagged dependent variable (if there is inertia in the Fed's behavior); <29>

(c) interest rates (if the Fed wants to limit the

Table 4

Determinants of Monetization[a]

Time Period	(1) 1949-81	(2) 1949-81	(3) 1949-60	(4) 1961-81	(5) 1968-81	(6) 1954-81
Coefficient (s.e. of:						
Constant	.0014 (.0003)	.0010 (.0003)	.0005 (.0005)	.0013 (.0003)	.0006 (.0008)	.0006 (.0002)
δ_t/Y_t	.013 (.015)	.076 (.023)	.151 (.061)	.064 (.019)	.070 (.022)	.039 (.019)
$\pi_{t-1}(\delta_t/Y_t)$	--	-.862 (.303)	-5.015 (2.262)	-.733 (.194)	-.833 (.226)	-.550 (.228)
$x_t(\delta_t/Y_t)$	--	-.455 (.161)	-.645 (.297)	-.398 (.137)	-.367 (.154)	-.230 (.171)
$\Delta C_t/Y_t$	-.140 (.118)	-.061 (.107)	.093 (.307)	-.099 (.108)	.110 (.222)	.153 (.089)
R^2	.05	.36	.58	.56	.67	.27
DW	1.78	1.78	2.94	2.16	2.53	2.60

[a]Dependent variable = change in adjusted bank reserves, divided by nominal GNP.

extent to which deficits raise the rate of interest);

(d) real output (or unemployment) and/or inflation (reflecting traditional stabilization motives);

(e) the composition of federal spending (reflecting cetain "optimal public finance" considerations raised by Barro (1979) in considering the choice between debt and taxes).

(f) growth in the money stock, if the Fed was pursuing a monetarist-style money growth rule.

These variables were all tried, singly and in combination, as linear determinants of γ_t. With so many plausible hypotheses, and so little data, some data-mining was inevitable. My procedure was as follows. First, variables were tried one at a time, to see which had some explanatory power. Then other variables were added, to see which factors survived the inclusion of other variables (and hence had some claim to robustness). Finally, equations that had been estimated on the full sample (1949-1981) were estimated on subsamples to see which empirical relationships survived.

The explanatory variables that seemed to perform best on these criteria were the rate of inflation (lagged, to minimize least squares bias) and the rate of growth of real federal purchases (which is dominated by national defense purchases), henceforth denoted by x_t. Hence, I model the marginal monetization rate as:

$$\gamma_t = \gamma_0 + \gamma_1 p_{t-1} + \gamma_2 x_t \quad .$$

Regression (2) in Table 4 gives the result for the whole period. According to this regression, 7.6% of any deficit would be monetized if there were no inflation last year and real purchases were unchanged. Both inflation and growth of purchases tend to decrease the fraction of the deficit that is monetized. The coefficient of currency is reasonable. The explanatory power of the equation (R^2=.36) is moderate, at best. <30>

Regressions (3) and (4) break the sample into two subperiods, 1949-1960 and 1961-1981. This break point was prompted both by the Hamburger-Zwick results and by the observation that several of the residuals for years prior to 1960 were quite large. Although Levy placed the break in his regression after 1969, a series of regressions confirmed that the 1960/1961 break created a local minimum in the combined sum of squared residuals of the two equations.

Substantial differences emerge between the two equations. The effect of inflation on the rate of monetization is only about one-seventh as large in the later period, suggesting a greater tolerance of inflation. The coefficient of currency is reasonable in the later period, but unreasonable in the earlier period. The Durbin-Watson statistic is also far better in the later period. In general, the equation performs much better in 1961-1981 than it does in 1949-1960.

It is tempting to conclude that a stable relationship has existed since 1961, but not before, which would help explain some of the earlier results. To test this notion further, the time period for the 1961-1981 regression was changed by alternatively adding or subtracting a year from the start of the sample. I found a remarkably stable relationship as the period was shortened to begin later than 1961. For example, the regression over 1968-1981 (which has only 14 observations) is reported as regression (5) in Table 4. Except for the currency coefficient, it looks amazingly similar to regression (4). There was considerably less stability as the sample was lengthened by beginning earlier than 1961, however. As an illustration, regression (6) reports the results for the 1954-1981 period.

Two further tests for equation stability were performed. First, the equation for 1961-1981 was differenced, a procedure suggested by Plosser and Schwert (1978) as a test for specification error. The estimates changed little, which provides further support for the specification. (Changes were greater for the 1949-1960 regression, where we are a bit short on degrees of freedom.) Second, a Chow test was performed to look for evidence of a structural shift starting in 1973, the period of floating exchange rates. The F statistic for this test was nearly zero.

The implied marginal monetization rates for the two periods, based on regressions (3) and (4) in Table 4, are as follows:

$$\text{For 1949-1960:} \quad \gamma_t = .15 - 5.02\,\dot{p}_{t-1} - .65x_t;$$

$$\text{For 1961-1981:} \quad \gamma_t = .06 - 0.73\,\dot{p}_{t-1} - .40x_t.$$

The major difference is in the reaction to inflation. At the inflation rates near 2% (=.02) that were typical in the 1949-1960 period, the implied monetization rates are quite close (around 4% of the deficit). At higher inflation rates, the more recent rule leads to more monetization. For example, at 10% inflation (and 2% growth in real purchases), the 1949-1960 rule would monetize -36% of the deficit, whereas the 1961-1981 rule would monetize -2%.

A more important point, however, is this: no conceivable combination of the independent variables leads to very much monetization of deficits. Both estimated rules, for example, come much closer to the monetarist $\gamma_t = 0$ than to the bondist $\gamma_t = 1$. Negative monetization rates, such as suggested by the game-theoretic analysis in Section II.2, seem more likely than high monetization rates.

If deficits are mainly inflationary to the extent that they are monetized, then budget deficits should kindle little in the way of inflationary fears.

OTHER RESULTS

The measure of the Federal deficit used in the empirical work violates elementary principles of inflation accounting because it fails to net out the decrease in the real value of the outstanding debt caused by inflation. Putting the same point somewhat differently, it fails to include the implicit receipts from the inflation tax. Should the deficit be corrected for inflation?

If we want to model the Fed as a rational government bureau free of inflation illusion, then it is hard to argue against making the correction. True, it is the entire (uncorrected) deficit that must be financed by selling bonds. But some of these "new" bonds merely replace existing bonds whose real values are eroded by inflation. Since we do not count rollover as part of the government's borrowing requirement, neither should we count the portion of the putative deficit that merely maintains the real value of the existing debt.

On the other hand, casual empiricism suggests that it is only a minority of economists and accountants who are free of this particular form of inflation illusion. If we are interested in describing how the Fed actually behaved, rather than how it should have behaved, then perhaps the uncorrected deficit is the appropriate variable to use.

In fact, when I ran regressions like those in Table 4 using the inflation- corrected deficit, the fits of the regressions deterioriated enormously. The adjusted R^2 for the new version of regression (2) actually became negative! In other words, whatever success we have in explaining monetization of the uncorrected deficit completely disappears when we seek to explain monetization of the corrected deficit.

This leaves two possibilities. Either we have a passable model of the monetization decision of a Federal Reserve which suffers from inflation illusion, or the Fed is free of inflation illusion but its behavior is unpredictable. I am personally inclined toward the former view, but the data admit of both interpretations.

A second issue is raised by Barro's non-Ricardian equivalence theorem. I have tacitly accepted the view that taxes are something quite distinct from debt by taking debt and money as alternative ways of financing the excess of expenditures over tax receipts. But, if debt and taxes are equivalent, then the true decision is among current taxes, future taxes (i.e., debt), and money as alternative ways of financing government expenditures. On this view, expenditures, not the deficit, should be the independent variable in a regression explaining money creation.

To study this issue, I disaggregated the deficit into three additive components -- outlays, tax receipts, and net off-budget borrowing -- and re-ran the regressions in order to test the following two constraints:

(i) that outlays and the off-budget deficit have the same coefficient;

(ii) that the coefficient of tax receipts is equal and opposite to that of outlays.

Both constraints are imposed by the regressions in Table 4, and the results strongly supported them. Not only did an F test

III. SUMMARY

Simple "old-fashioned Keynesian" macro models suggest that budget deficits always expand aggregate demand, but that their effects are stronger if they are monetized; that is, monetary policy matters.

The time series evidence on nominal GNP growth offered here, though incapable of giving structural information, is consistent with these ideas. Information on changes in bank reserves helps predict nominal GNP changes, even when changes in government debt are controlled for. Symmetrically, changes in outstanding debt are a significant predictor of nominal GNP changes even after controlling for changes in reserves.

If we focus on inflation rather than nominal GNP growth, however, more surprising results are obtained. Growth in government debt is a significant predictor of inflation, even after growth in bank reserves are controlled for. But, surprisingly enough, the evidence that bank reserves contributes anything to the prediction of inflation that is not already supplied by debt is decidedly mixed.

The received theory gives us far less guidance on long-run issues. Some ambiguities arise from interest elasticities and wealth effects; others arise from complexities stemming from the reaction of expectations. A believable empirical model for addressing these issues is sorely needed, but has yet higher inflation or increased growth of real federal purchases by slowing the expansion of reserves. Then our regression, by forcing $\dot{p}_{t-1}$ and x_t to enter interactively with δ_t, might make the deficit appear to be a significant factor in the Fed's behavior when, in fact, it was not.

To examine this possibility, I re-ran regressions (2), (3), and (4) in Table 3 replacing the interaction variables $x\delta$ and $\dot{p}\delta$ by x and $\dot{p}$ alone. For the 1961-1981 period on which I focus, this substitution caused the fit of the regression to deteriorate enormously; R^2 fell to .10 and all the righthand variables were insignificant. For the 1949-1981 period as a whole, the R^2 deteriorated only slightly, but the Durbin-Watson statistic fell to 1.18, giving strong evidence of misspecification. Only for the short 1949- 1960 period did the simpler functional form work better.

fail (by a large margin) to reject them, but the point estimates conformed reasonably well to the constraints. By contrast, the non-Ricardian equivalence hypothesis would seem to call for a coefficient of zero on taxes, a restriction that was easily rejected.

As indicated earlier, other plausible righthand variables were tried, but did not contribute to the explanation of monetization. These included both nominal interest rates and unemployment, variables often thought to be stabilization targets of the Fed. The findings here are consistent with those of Levy (1981). If the Fed monetizes a larger fraction of small deficits than of large deficits, then the deficit itself should help explain γ_t. However, I had little success with either the deficit or its absolute value. If the Fed was targetting money growth, then it should have reduced reserves whenever M grew too rapidly. Tests of this hypothesis using (what we now call) M1 to measure money turned up no evidence in its favor. Whenever M1 had a significant effect on monetization, its coefficient had the wrong sign (from the point of view of this hypothesis). Finally, the lagged dependent variable was totally insignificant when added to the regression. This stands in stark contrast to the regressions using money growth as the dependent variable. (See footnote 29).

There is still one further possibility. Perhaps the Fed really ignored deficits, but systematically reacted to either to be developed. If the coefficients of the time series regressions are interpreted as reduced form multipliers, they imply that both monetized and nonmonetized deficits have sizable, though not always statistically significant, long-run effects on nominal GNP and prices. But this "evidence" is no more than suggestive, if that, given the non- structural approach that has been followed. I regard the question as open.

While the Fed has not followed any rigid monetization rule, its postwar behavior comes far closer to the "new Friedman" monetarist rule (no monetization at the margin) than it does to the "old Friedman" bondist rule (complete monetization at the margin). But when inflation has been high, the Fed typically has reduced bank reserves despite government deficits; that is, monetization has been negative -- an outcome "predicted" by the game-theoretic analysis of monetary and fiscal policy presented here.

In general, the empirical relationship between budget deficits and the creation or destruction of bank reserves seems far more stable and systematic than previous research would lead us to believe. However, the relationship appears to date only from 1961 or so.

This paper has focused on two empirical questions. The tentative answers suggested here are: Yes, monetization does matter -- certainly for real variables, and maybe for nominal variables as well. And: the Fed seems to look chiefly at the inflation rate and the growth rate of real government purchases in deciding what fraction of the deficit to monetize. I would like to close, however, by posing a theoretical question: Exactly why does the monetization decision matter?

The question is both deep and vexing. The usual story -- that easy (tight) money creates a surplus (shortage) of the medium of exchange which, in turn, spurs (retards) economic activity -- strains the credulity of many observers. Yet money creation does seem to have real effects in practice. Why?

One possibility, raised first by Tobin (1970) and recently by King and Plosser (1982), is that money simply reacts passively to real activity. On this view, money has no causal role; real activity simply pulls money along, creating a statistical correlation with no causal interpretation. I have some sympathy with this view. However most economists, and virtually all businessmen, seem to think they can identify periods in which tight money led to a downturn in economic activity.

A second possibility, which Joseph Stiglitz and I (1982) are developing in a forthcoming paper, is that creation of new bank reserves leads to an expansion of credit which loosens quantitative constraints that were previously binding. On this view, the statistical correlation between money and real economic activity is no accident, but it merely reflects their mutual connection to the same important phenomenon -- the ebb and flow of credit.

Neither of these views has yet been fully worked out and subjected to empirical testing. It may be that neither will prove correct. But little progress can be made in resolving the theoretical issues pertaining to monetization until we have a more convincing story of why monetary policy has real effects in the first place.

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FOOTNOTES

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1. The only possible slippage is between expansion of bank reserves (which is the direct consequence of monetization) and expansion of the money stock. In practice, the money multiplier is stable enough so that this is not a major worry.

2. As is well-known, Barro (1974) has argued against this assumption. For a critique of Barro's argument, see Buiter and Tobin (1979). For an analysis of the dynamics of the government budget constraint under the assumption that Barro was right, see McCallum (1982).

3. The existence of a wealth effect on the demand for money, though often assumed (see, for example, Tobin (1982)), is by no means guaranteed. It could be absent, for example, under a strict transactionist point of view.

4. See, among others, Tobin and Buiter (1976), Pyle and Turnovsky (1976), and Turnovsky (1978).

5. See, for example, Diamond (1965) or Phelps and Shell (1969). The latter shows that it is just a suggestion, not a clean

deduction.

6. If P is somehow fixed, as it was in the original Blinder-Solow article, then these difficulties do not arise. But such a model makes little sense for long-run analysis.

7. The stability of the economy under this last policy has been called into question. More on this later.

8. For a more detailed discussion of this issue, see Feldstein (1982).

9. Indeed, under the hypothesis advanced by Barro (1974) -- that each generation has an operative bequest motive based on the next generation's lifetime utility -- the period from now to the end of time is relevant.

10. See, for example, Blinder (1981), Hall and Mishkin (1982), Hayashi (1982), or Mankiw (1981). Bernanke (1981) is more optimistic about the PIH.

11. For an interesting discussion of forward-looking versus backward-looking wage contracts, and how we might distinguish between them empirically, see Taylor (1982).

12. Divergent expectations have been emphasized recently by,

among others, Phelps (1981) and Frydman (1981).

13. Nothing in the Granger-Sims methodology, which is atheoretic, tells us in what form to enter the variables. The form of equation (13) is suggestive of a theoretical model in which asset stocks influence income flows, like the quantity theory. By contrast, in Keynesian models the flow of income depends on the stock of reserves, but on the flow of additions to the national debt (i.e., on the deficit). This motivated me to experiment with a reformulation of equation (13) in which $\Delta^2 D$ replaced ΔD. However, this alternative version had less explanatory power than equation (13) in almost every regression I ran.

14. The series comes from the Federal Reserve Bank of St. Louis, and is adjusted both for interbank shifts of deposits and changes in required reserves.

15. The transition quarter was omitted. In aggregating quarterly data into fiscal years, I used seasonally adjusted GNP data due to their presumed greater accuracy than the seasonally unadjusted data.

16. Insulating the rate of interest from currency shifts amounts to the same thing. It is the schedule relating money supply to r that is presumed to be insulated by the Fed.

17. In a complex system, many more things are going on than I can describe in a single paragraph. For example, income and prices are changing, with important consequences for the budget deficit. Yet the basic mechanism described here seems to come shining through in all the models.

18. Or unless inflation itself is sufficiently damaging to investment via, for example, the deterioration of the real value of depreciation allowances. This last factor has been stressed in a number of places by Feldstein. See, among others, Feldstein (1980).

19. There is no distinction between money and high-powered money under Friedman's plan, since part of his plan was the elimination of fractional reserve banking.

20. This statement is predicated on defining high employment as approximately the natural rate. With a Humphrey-Hawkins type definition of high employment, the old Friedman rule can lead to inflationary disaster.

21. In reality, things are more complicated still because the President and Congress often disagree over national economic policy. A model with three stabilization authorities may be better.

22. The opposite policy mix -- tight budgets and easy money -- while conceivable, seems to be rarely encountered.

23. For a full discussion of the reasons for these disagreements, and why it is not obvious what to do about them, see Blinder (1982).

24. In the simple example of Figure 2, "going it alone" also leads to the Nash equilibrium. But this is not generally true. A fuller discussion of some alternatives appears in Blinder (1982).

25. McMillan and Beard (1982) study the same issue, reaching conclusions opposite from those of Hamburger and Zwick (1981). But Hamburger and Zwick (1982) argue that this is because McMillan and Beard fail to align the data correctly in time. A fifth study, far similar in spirit to my own, is that of Levy (1981). I will comment on Levy's work as I present my own results.

26. Hamburger and Zwick (1981, 1982) obtain stronger results when they use a better measure of the deficit, a measure which is similar to my own. They also stress the importance of properly aligning the data in time.

27. Except for Levy (1981). His dependent variable is similar to my own. The main difference is that he uses (quarterly) changes in the adjusted base, whereas I use (annual) changes in adjusted bank reserves. Viewed from the perspective of equation (17), Levy's choice imposes a coefficient of -1 on dC/dt. As will be seen below, the estimated coefficient is closer to zero.

28. To correct for potentially severe heteroskedasticity, all variables were divided by nominal GNP. Also, to allow for some "trend" provision of reserves even in the absence of deficits, a constant was added to the regression.

29. Barro (1978), Hamburger-Zwick (1981), and McMillan- Beard (1982) all found the lagged value of money (not reserves) to be important. Levy's (1981) study of changes in reserves also found a significant lagged dependent variable, but he worked with quarterly data.

30. Levy (1981) estimated a (constant) marginal monetization rate of 6.4% for the period 1952-1978, quite close to my estimate. The two equations cannot be compared in terms of goodness of fit because Levy did not make the correction for heteroskedasticity mentioned in footnote 28, used quarterly data, and got much of his explanatory power from the lagged dependent variable and seasonal dummies. I presume the fits

are comparable, and so cannot agree with his conclusion that "any implication that the largest portion of monetary policy is random (should) be rejected" (p.365).

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