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Bennett T. McCallum

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This paper contains preliminary findings from research work still in progress and should not be quoted without prior approval of the author.

DEPARTMENT OF ECONOMICS
THE UNIVERSITY OF WESTERN ONTARIO
LONDON, CANADA
N6A 5C2

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On Consequences and Criticisms of Monetary Targeting

Bennett T. McCallum*

Professor of Economics, Carnegie-Mellon University
and
Research Advisor, Federal Reserve Bank of Richmond

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ABSTRACT

The purpose of this paper is to review and evaluate the most important existing criticisms of policy strategies that feature adherence to money stock targets. Four main categories of criticism (and counterarguments) are analyzed. The first of these involves the claim that accurate money stock control is infeasible while the second contends that such control can only be obtained along with extreme volatility of interest rates. The third emphasizes difficulties resulting from technical change and deregulation, and the fourth concerns strategic issues of rules vs. discretion, activist vs. non-activist policy, and the logical function of intermediate targets.

Bennett T. McCallum
Graduate School of Industrial Administration
Carnegie-Mellon University
Pittsburgh, PA 15213
(412) 578-2347

I. Introduction

The topic "monetary targeting" has been discussed extensively in recent years, in large part as a result of the Federal Reserve's professed adherence to a policy strategy involving money stock targets during the period from October 6, 1979, until the third quarter of 1982. Because of the macroeconomic turbulence of that period and the severity of the recession that followed, a large number of writings--both popular and professional--have been devoted to strenuous criticism of the notion of monetary targeting.[1/] Proponents, in return, have argued that adherence to money stock targets during the period was seriously incomplete and also that avoidable technical flaws in the Fed's implementation of the strategy were crippling and rendered the experience irrelevant.[2/] The purpose of the present paper is to review and evaluate the most important of these criticisms and counterarguments.

The leading arguments put forth by critics of monetary targeting may be grouped into four main categories. The first of these involves the claim that accurate control of the money stock is simply not feasible on a month-to-month (or even a quarter-to-quarter) basis. This view is based in part on the experience from October 1979 through September 1982--which period will be referred to below as "1979-82"--and in part on the properties of detailed econometric models that emphasize money supply and demand behavior. A second line of criticism accepts the feasibility of reasonably tight month-to-month monetary control, but contends that it can only be obtained at the cost of inducing extreme volativity--and perhaps even explosive dynamic movements--of short term interest rates. A third type of argument emphasizes practical difficulties brought on by rapid but irregular technological change and deregulation in the payments industry, a process that tends to be constantly altering the macroeconomic significance of any officially-designated monetary aggregate. Finally, there is a class of "strategic" (as opposed to "tactical") objections involving issues of rules vs. discretion and activist vs. non-activist policy, as well as the debatable logic of basing policy on the behavior of an intermediate target of any designation. These four categories of criticisms will be emphasized below in Sections III-VI, respectively, though an entirely clean sectional demarcation will not be possible. In addition, Section VII will present a brief summing-up.

That leaves Section II. In view of the enormous number of analytical and empirical models of the "money market" that have been developed in the literature, I am reluctant to present another. But the effects of various operating procedures are central to the issues of Sections III and IV, and discussion of these effects is greatly facilitated by reference to an expository model that permits various points to be illustrated in an explicit manner. Consequently, an extremely simple framework of that type will be laid out in Section II. It should be emphasized that this framework is itself too simple to establish points; its function is to aid in the exposition of results that are derived elsewhere by manipulation of more complex theoretical or empirical models. Readers familiar with the literature may consequently wish to proceed directly to Section III and then refer to the framework in II as the occasion arises.

II. Illustrative Model

In our expository framework, we will, for maximum simplicity, ignore currency and assume that excess reserves fluctuate randomly around an average value that is negligible. Then in a system with contemporaneous reserve requirements (CRR), total reserves may be expressed as

$$(1) \qquad TR_t = \rho M_t + e_t \qquad\qquad \rho > 0$$

where M_t denotes deposits and ρ the reserve requirement ratio. Also, e_t is a white-noise stochastic disturbance that reflects both excess reserve fluctuations and the unpredictable component of required reserves that exists in practice because of requirement schedules that are non-uniform in various respects.[3/] The duration of the time periods implicit in (1) will be discussed below.

Next, suppose that the demand for discount window borrowing is

$$(2) \qquad BR_t = b(r_t - d_t) + \varepsilon_t \qquad\qquad b > 0$$

where r_t is a short-term interest rate, d_t is the policy-determined discount rate, and ε_t a white-noise behavioral disturbance.[4/] Then, letting NR_t denote non-borrowed reserves, we have

$$(3) \qquad \rho M_t + e_t = NR_t + b(r_t - d_t) + \varepsilon_t$$

as one of the two equations of our stripped-down money market model. The second is a money (deposit) demand function, taken simply to be

$$(4) \qquad M_t = a_0 - a_1 r_t + \eta_t \qquad\qquad a_1 > 0$$

where η_t is a white-noise disturbance reflecting shocks to money demand.

Supposing now that NR_t is the Fed's policy instrument, (3) and (4) together determine M_t and r_t as

$$(5) \qquad M_t = \frac{NR_t + (ba_0/a_1) - bd_t + \varepsilon_t - e_t + (b/a_1)\eta_t}{\rho + (b/a_1)}$$

$$(6) \qquad r_t = \frac{a_0\rho - NR_t + bd_t - \epsilon_t + e_t + \rho\eta_t}{a_1\rho + b}.$$

If at the start of a given period NR_t is set at the value that is expected to make M_t equal a target value M_t^*, the resultant error will clearly be

$$(7) \qquad M_t - M_t^* = \frac{\epsilon_t - e_t + (b/a_1)\eta_t}{\rho + (b/a_1)}.$$

Consequently, if the stochastic disturbances are mutually independent--as we assume--the mean-squared control error for M_t will be[5]

$$(8) \qquad E(M_t - M_t^*)^2 = \frac{\sigma_\epsilon^2 + \sigma_e^2 + (b/a_1)^2\,\sigma_\eta^2}{[\rho + (b/a_1)]^2}$$

where σ_ϵ^2 is the variance of ϵ_t, etc., and E( ) is the unconditional expectation operator. In a similar way the mean square of the unplanned movement in r_t can be expressed as

$$(9) \qquad E(r_t - r_t^*)^2 = \frac{\sigma_\epsilon^2 + \sigma_e^2 + \rho^2\,\sigma_\eta^2}{(a_1\rho + b)^2}$$

where r_t^* denotes the value of r_t that corresponds, at the planning stage, to M_t^*.

The foregoing type of calculation can be made in an analogous fashion for modified versions of (3) and (4) pertaining to alternative operating procedures. Such calculations will be made and utilized in the course of the following discussion.

III. Monetary Control Tactics

The object of this section is to consider arguments against monetary targeting that are based on a perceived infeasibility of money stock control. To a considerable extent, these arguments overlap with ones that rely crucially on actual U.S. experience during the period 1979-82 (i.e., October 1979 through September 1982)--the period of maximum attachment by the Fed to monetary targets. It is, of course, very well known that short term interest rates were extremely volatile during that period and that money growth rate fluctuations were also unusually large--facts that can be readily verified by visual inspection of time plots of the relevant variables.[6/] Sheer recognition of this volatility constitutes a type of argument against monetary targeting that is extremely simple, but which could be effective in the absence of an adequate response by targeting proponents. The main counterargument emphasizes flaws in the operating procedure employed by the Fed during the period, so an evaluation of analyses of the effects of alternative operating procedures--including, in particular, studies by Lindsey and others (1981)(1984) and Tinsley et al (1981b)(1982)--is essential to the discussion.

One preliminary matter that should be disposed of at the outset involves a contention advanced by Friedman (1984), Brunner (1983), Poole (1982), McCallum (1984), and others, namely, that the experience of 1979-82 did not constitute a "monetarist experiment." That contention emphasizes that money growth rates were both high and variable during the period, that activist policy was not forsworn, and that operating procedures differed sharply from those recommended by monetarists. That contention seems clearly correct but does not imply a denial that the period did, nevertheless, involve a greater degree of commitment to money stock targets than existed during any previous period of comparable duration. That greater commitment was in fact present is indicated, it would seem, by the severity of the interest rate fluctuations that were permitted to occur. Furthermore, Hoehn (1983) has noted that a regression of the form

$$(10) \quad \Delta r_t = a_0 + a_1(m_t - m_t^*) + \text{disturbance}$$

--where r_t is the federal funds rate, m_t is the log of M1, and m_t^* denotes the log of the midpoint of the Fed's target range for M1--yields a much larger estimate for a_1 when (monthly) data for 1979-82 are used than when the regression is based on similar data for the previous three years.[7/] While far from conclusive, this bit of evidence tends to support the view that the Fed was encouraging, more strongly than before, adjustments designed to keep the money stock from departing from the official target path.[8/]

As another preliminary matter, it should be noted that an argument against monetary targeting based on the experience of 1979-82 cannot legitimately complain about the average <u>level</u> of interest rates during the period or about the occurrence (or severity) of the 1981-83 recession, since those two features were consequences of the relative <u>tightness</u> of monetary policy,[9/] not the fact that this tightness was obtained and monitored by emphasis on monetary targets.

Let us turn now to the main line of argument. Whether interest rate volatility has serious detrimental effects on social welfare is a matter on which there is considerable disagreement, with proponents of monetary targeting clustering on the negative side. But even these economists would probably agree that monetary targeting is undesirable <u>if</u> they believed that the interest rate and money growth volatility observed during 1979-82 were necessary concomitants of that type of strategy. In fact, of course, they strongly disagree with that hypothesis. Instead, Friedman (1982), Brunner and Meltzer (1983), Poole (1982) and other proponents contend that the operating procedures utilized by the Fed were very poorly designed; that they led to an unnecessarily large amount of volatility for both money growth and interest rates.

The basic point is, as is now widely understood, that the Fed's use of a reserve aggregate as its main operating instrument is inappropriate when regulations in force involve lagged reserve requirements (LRR), i.e., provisions relating banks' required reserves to their deposits of two weeks earlier. As many analysts have shown, this combination is a very poor one for the purpose of week-to-week monetary control.[10/] This can be easily seen in the context of the illustrative model of Section II. Interpreting time periods as weeks, equation (3) becomes

$$\rho M_{t-2} + e_t = NR_t + b(r_t - d_t) + \epsilon_t \tag{11}$$

and it is readily verified that the mean-squared control error (MSE) for M_t changes from expression (8) to

$$E(M_t - M_t^*)^2 = \frac{\sigma_\epsilon^2 + \sigma_e^2 + (b/a_1)^2\,\sigma_\eta^2}{(b/a_1)^2} \,. \tag{12}$$

Thus the weekly money stock MSE is unambiguously greater under LRR than under CRR (contemporaneous reserve requirements) when NR_t is used as the instrument and monetary targeting attempted in each case.[11/] Furthermore, expression (12) is unambiguously larger than that which would pertain if the instrument were the interest rate, r_t, for in that case inspection of (4) shows that the relevant MSE would be equal to σ_η^2.

Intuitively, the reason for these results is quite simple. In particular, with LRR in force the system (11)(4) determining M_t and r_t is recursive: (11) determines r_t for given values of NR_t, d_t, and M_{t-2}, and then (given r_t) the demand function (4) determines M_t. With LRR in effect, the use of a non-borrowed reserves instrument amounts to an indirect (and therefore error-ridden) way of using a funds rate (r_t) instrument. This procedure may make sense for public relations purposes, but for monetary control it does not.[12/]

Because of the inappropriateness of this procedure, proponents of money stock targeting contend that the experience of 1979-82 is inconclusive. That experience does not indicate how much r_t and M_t variability would obtain if monetary targeting were conducted with an appropriate choice of instrument and reserve regulations, such as total reserves (or the monetary base) and CRR.[13/]

Recognizing the logical force of this argument, opponents of money stock targeting have responded by pointing to results obtained from simulations of econometric models which indicate that improvements from alternative operating procedures would be non-existent or inadequate.[14/] Our next task, then, is to examine the relevant findings of these econometric studies.

The two major studies of this type of which I am aware have been conducted by groups of researchers on the staff of the Board of Governors. Reports of their work are available in papers by Lindsey and others (1981); Lindsey, Farr, Gillum, Kopecky, and Porter (1984); Tinsley, Fries, Garrett, and von zur Muehlen (1981); and Tinsley, Farr, Fries, Garrett, and von zur Muehlen (1982). Let us consider first the JME paper by Lindsey et al (1984). This contribution begins by correctly pointing out that the relative predictability of money stock "multipliers" for different reserve measures, as computed from time series data, does not provide a conceptually appropriate basis for evaluating the relative desirability of these measures as instruments. Thus, for example, the greater historical predictability of the monetary base multiplier relative to the non-borrowed reserves multiplier does not necessarily imply that the base would be a better instrument, for the multiplier errors are not uncorrelated in the sample periods examined with prediction errors for the reserve measures themselves.[15/] In fact, when Lindsey et al (1984) go on to examine the characteristics as instruments of four reserve measures (total reserves, non-borrowed reserves, total base, and non-borrowed base), as implied by the properties of the Board's and San Francisco Fed's monthly models, they find that the non-borrowed reserves measure leads on average to the smallest control errors. In their words, "these results suggest that neither a total reserve nor a monetary base operating target would have led to more precise short-run monetary control relative to the control available with a non-borrowed reserve operating target" [i.e., instrument] (Lindsey et al 1984, p. 88). Some figures representative of their results are reported in Table 1.[16/]

These particular results do not, however, speak effectively to the issue at hand, for they all presume the continuation of lagged reserve requirements. And combining LRR with a total reserves instrument is clearly even more inappropriate than combining it with a non-borrowed reserves instrument. In that case, our schematic model would collapse to (4) and

(13) $\rho M_{t-2} + e_t = TR_t$,

Table 1

Estimated Volatility Results Reported by Lindsey et al (1984)

Instrument	RMS Control Errors for Indicated Money Stock[a/] First Exog. Assm.[b/] M1-A	M1-B	Second Exog. Assm.[c/] M1-A	M1-B
	(Board of Governors Model)			
Non-borrowed reserves	7.0	6.5	9.5	8.2
Total reserves	23.1	18.6	23.1	18.6
Non-borrowed base	6.1	5.6	9.8	7.5
Total base	12.3	9.9	11.8	10.4
	(San Francisco Fed Model)			
Non-borrowed reserves	5.4	5.6	5.2	4.9
Total reserves	10.6	10.6	9.4	9.0
Non-borrowed base	3.3	3.2	5.1	4.9
Total base	8.5	8.1	9.4	8.9

a/ These figures are root-mean-square monthly control errors, expressed in annualized percentage points.

b/ Assuming actual NR values were predetermined in sample period.

c/ Assuming planned funds rate values were predetermined in sample period.

in which (13) includes neither of the endogenous variables, r_t and M_t, while (4) includes both. The values of r_t and M_t are not even determinate in this (admittedly oversimplified) system.[17/]

The JMCB paper by Tinsley et al (1982) does include results, obtained from simulations with the Board's model, pertinent to a situation with contemporaneous reserve requirements. And these results, excerpted in Table 2, indicate that movement from LRR to CRR would reduce M1 control errors with either a TR or a NR instrument. But the figures also suggest that, contrary to the belief of targeting proponents, under CRR the TR instrument would be less effective than the NR instrument--and by a substantial amount. The plausibility of this finding, which seemed surprising to me, can be illustrated by reference to our schematic model. With CRR and a TR instrument, the system may be expressed as (4) and

(14) $\rho M_t + e_t = TR_t.$

Then the M_t control error becomes simply e_t/ρ, and the mean-squared error is

(15) $E(M_t - M_t^*)^2 = \dfrac{\sigma_e^2}{\rho^2}$.

Comparing this with (8), the value with the NR instrument, we see that (15) could easily be larger--even though the ϵ_t and η_t disturbances no longer matter--if the ratio b/a_1 is large relative to ρ. And it is not at all hard to believe that the latter could be true: if $b = a_1$, b/a_1 would be several times as large as ρ.

But by focusing attention on e_t, which includes the unpredictable component of required reserves,[18/] this example reminds us of the potential importance of another type of procedural improvement: greater uniformity and universality of reserve requirements. And, fortunately, there are results reported in

Table 2

Estimated Volatility Results Reported by
Tinsley et al (1981)(1982)

Instrument and Reserve Regime	Standard Deviations of Indicated Variables[a/] Money stock Control error		Federal Funds Rate Error	Federal Funds Rate Change
NR/LRR	11.0	(1.3)	5.0	9.6
TR/LRR	53.4	(8.3)	26.5	38.1
NR/CRR[b]	6.5	(1.0)	3.1	5.5
TR/CRR[b]	18.7	(2.8)	14.0	22.8
NR/UCR[c,d]	4.2	(0.7)	1.7	3.0
TR/UCR[c,d]	3.2	(0.4)	4.9	6.3

[a] Standard deviations of monthly errors or changes, expressed in annualized percentage points. Items in parentheses pertain to "annual" errors.

[b] Contemporaneous reserve requirements on demand deposits only.

[c] Tinsley et al (1981), Table 15, lines 2 and 10.

[d] "UCR" denotes uniform and contemporaneous requirements.

studies both by Lindsey and others (1981) and by Tinsley et al (1981) that pertain to the effect of this type of institutional change. In particular, Tinsley et al (1981) includes a table with results designed to be applicable "if prediction errors associated with graduated (non-uniform) reserve requirements and with non-universal (such as member vs. non-member) reserve requirements are eliminated" (1981, pp. 60,61).

The last two rows in Table 2, above, depict the dramatic difference that occurs in the absence of these reserve requirement prediction errors. While there is still further improvement in monetary control with the NR instrument, the improvement with the TR instrument is much greater, the monthly standard deviation falling to 1/5 of its value under CRR and 1/17 of its value under LRR in the second and fourth rows of Table 2. Indeed, the improvement in the performance of the total reserves instrument is so great that it becomes the better of the two instruments for purposes of monetary control.

The degree of improvement reflected in the last two rows of Table 2 is considerably greater, it should be said, than that indicated by the figures in the lower half of Table 7 in Tinsley et al (1982), which are there described as representing effects of "full implementation of the reserve requirements of the Monetary Control Act of 1980" (p. 841). My understanding is that these figures result from the use of regression equation (2) in Table 2 of Tinsley et al (1982) in place of equation (1) as the basis for predicting reserve requirements, a change that incorporates only the effect of knowledge of demand deposits in large and small member banks separately (and presumably a similar change for time deposits). The difference in comparison to the figures shown in Table 2 is, apparently, that only a small portion of the prediction errors resulting from non-uniform and non-universal requirements are attributable to the small vs. large member-bank effect. It would accordingly seem that the results in Table 15 of Tinsley et al (1981) are more relevant to the issue of concern.

As mentioned above, Lindsey and others (1981) also includes results--noted by Axilrod (1983)--for cases in which the "required reserve ratio on demand deposits and required reserves against savings and time deposits [are] known with certainty"--i.e., cases in which required reserve prediction errors are eliminated. The control errors for these cases, corresponding to those for the Board model in Table 1, are reported in Table 3. Again the improvement in results with the TR instrument is so strong that it becomes superior, for monetary control, to the NR instrument in three of the four cases examined. And the control errors are much lower with the TR instrument in the two cases in which the money stock under consideration is M1-A. Of course M1-B corresponds to the official definition as of 1984, but the appropriate definition for the purposes of the present comparison is the one with the smaller errors, since the object is to determine the maximum feasible improvement in control.

From the values in Tables 2 and 3, then, we see that simulation results with the Board's monthly econometric model support the contention of monetary targeting proponents that better money stock control can be obtained with a total reserve instrument than with non-borrowed reserves, provided that contemporaneous, uniform, and universal reserve requirements are in effect. The figures based on the assumed absence of prediction errors for required reserves suggest, moreover, that monthly errors would be substantially smaller under these preferred operating procedures than

Table 3

Estimated Volatility Results Reported by Lindsey and Others (1981)
Board Model, Without Prediction Errors for Reserve Requirements

	RMS Control Errors for Indicated Money Stock [a]			
	First Exog. Assm. [b]		Second Exog. Assm. [c]	
Instrument	M1-A	M1-B	M1-A	M1-B
Non-borrowed reserves	7.1	6.6	9.2	7.9
Total Reserves	2.9	7.0	2.9	4.9
Non-borrowed base	5.9	5.5	9.6	7.2
Total base	7.3	5.9	5.8	7.4

a/ b/ c/ See Table 1.

actually obtained during 1979-82. Based on the October 1979-October 1980 results, in fact, the RMS errors are suggested to be between one-half and one-third of those actually experienced.

There are reasons, furthermore, for believing that the simulation results obtained by Lindsey, Tinsley, and co-workers depict the operating procedures utilized during 1979-82 in a more favorable light than is warranted. The procedures actually in force during that period possessed flaws, that is, that are not fully reflected in the simulation procedures for the NR/LRR cases. Thus the potential for improvement in monetary control relative to the actual experience of 1979-82 is underestimated by the difference between the reported simulation error values for the NR/LRR and TR/UCR cases. (Here UCR denotes "uniform and contemporaneous requirements.")

There are two main discrepancies, that I have in mind in making this claim, between the representation of the NR/LRR regime in the formal simulations and the procedure that existed in actuality. The first of these discrepancies results from the time aggregation involved in working with monthly data. In particular, required reserves for month t are modelled as depending, under LRR, on the magnitude of deposits in months t and t-1. Thus the required reserve variable is treated in a way that makes it jointly dependent with deposits and the money stock, even though it is in fact predetermined in each and every week. The model consequently includes a second and "direct" mode of dependence of the money stock on non-borrowed reserves, and thereby fails clearly to reflect the outstanding feature of the NR/LRR regime described above: that it amounts to an indirect method of using a funds rate instrument. In this respect, there is a tendency for monthly models to underestimate the undesirable effects of LRR with a reserve instrument.

The second way in which the Board's model fails to accurately represent difficulties with the actual procedure of 1979-82 involves the crucial relationship describing banks' demand for borrowed reserves. While our schematic model and the Board's econometric specification[19/] express this relationship as involving only current variables, Goodfriend (1983) has convincingly argued that actual borrowing behavior involves intertemporal considerations in an important way. The point at issue is not merely a claim that the Board's borrowing equation is mispecified, however. Instead the main point is that the Fed did not behave, during 1979-82, in the manner that the econometric simulations presume. Perhaps (but not necessarily) because of the non-dynamic specification employed, the Fed's staff apparently felt uneasy about their understanding of the borrowing relationship during 1979-82. But the way in which the Fed's path for the NR_t instrument was set depended crucially on knowledge or assumptions concerning borrowing. Indeed, the logic of the procedure is to use money targets and multiplier forecasts to generate planned total reserve paths <u>from which estimated borrowing quantities are subtracted</u> to yield "instrument" paths for non-borrowed reserves.[20/] Given the uneasiness about knowledge of the borrowing equation, however, policy was in actuality frequently conducted by beginning a post-FOMC meeting period with the specified quantity of borrowings simply taken to be the most recent actual quantity. This quantity would, moreover, typically be planned to remain constant, in the absence of shocks, through the inter-meeting period. So the actual procedure did not proceed by the Fed using knowledge of a stable borrowing function to select optimal NR_t paths for given M_t^* and TR_t paths--as the simulation procedure presumes.[21/]

This point warrants emphasis, for the basic logic of the NR/LRR procedure requires--as an essential step in the derivation of the instrument path--the use of some specification concerning borrowing magnitudes. Without a model of borrowing behavior, the relationship between NR_t and interest rates is simply unspecified. Yet, as explained above, the procedure in question affects the money stock only by affecting interest rates and thereby the demand for money. The procedure works from the instrument NR_t to the target variable M_t by way of two relationships, knowledge of which is therefore crucial: the borrowings equation and the money demand function. It is consequently not a minor matter to note that, as Tinsley et al (1982, p. 849) have remarked, "Along with the demand for money, the borrowings function remains one of the more troublesome specifications in the monthly model." All of this serves to indicate how badly designed, for monetary control, the 1979-82 operating procedure actually was.

The foregoing discussion does not, it should be stressed, presume that monetary control over intervals as short as a week or month is itself of intrinsic significance. Instead it presumes that effective control over short intervals serves to facilitate improved control over longer intervals--such as a year--which is the main matter of concern to targeting proponents. That such a presumption is warranted is indicated by the control-error standard deviations, shown in parentheses in Table 2, calculated by Tinsley et. al. (1981) for "annual" monetary targets.[22/] As can readily be seen, these standard deviations for annual errors are highly correlated across control procedures with corresponding values for monthly errors. Thus improved control from the TR/UCR regime at the monthly interval translates into improved control--relative to other regimes--at the annual level.

The absolute magnitude of the annual control-error values in Table 2 suggests, moreover, that a satisfactorily high degree of money stock control can in fact be attained in a system with contemporaneous, uniform, and universal reserve requirements; the standard deviations are 0.7% with a NR instrument and just 0.4% with TR. And these figures pertain to a period during which, because of the selective credit controls program, the shocks to the system were probably much larger than normal. Consequently, the main conclusion of this section is that a persuasive objection to monetary targeting can not be based on an argument involving technical infeasibility of controlling the M1 money stock.[23/]

There is one qualification of the foregoing discussion that needs to be mentioned before moving on. In particular, it needs to be acknowledged that the cited results of Tinsley, Lindsey, and co-workers are all based on the implicit assumption that behavioral parameter values (including disturbance variances) would not themselves be altered by changes in operating procedures. In otner words, the cited results assume that there are no relevant difficulties of the type described in the famous "critique" of econometric policy evaluations put forth by Lucas (1976). Such difficulties may, of course, be crucial for certain important issues. But in the context of the particular issue at hand--whether reasonably tight monetary control is possible under a TR/UCR operating regime--the danger of going astray because of the Lucas critique does not appear to be large.[24/] The basis for this judgement is outlined in Appendix A, which appears below following Section VII. The reasoning rests primarily on the near-independence, under a TR/UCR regime, of the money stock from shocks to money demand, aggregate supply, saving-investment behavior, etc. The same properties of this regime that have commended it to monetary targeting proponents on theoretical grounds also serve to reduce the likelihood that control would be poorer than predicted econometrically because of the Lucas critique.

IV. Interest Rate Variability

We turn now to a class of objections to monetary targeting that accept the feasibility of accurate money stock control, but contend that such control can be brought about only by inducing extreme volatility--and perhaps even dynamic instability--of interest rate movements. Reservations of this general type have been expressed by explicit critics of monetary targeting, including Bryant (1983) and Kaldor (1982), but more frequently by writers who should be classified as skeptics rather than opponents.[25]

There are three distinct concepts of interest rate volatility that are pertinent to the discussion of this issue. The first two of these involve single-period changes in the value of the relevant interest rate, henceforth presumed to be the federal funds rate. In particular, as noted in Tinsley et. al. (1981, p. 53), any period-to period change in the funds rate can be decomposed into planned and unplanned components. The first of these is the change that is required at the planning stage in order to be consistent with the money stock target--i.e., the funds rate change that would be realized in the absence of stochastic shocks. The difference between this planned change and the actual change that comes about is then the unplanned component, which is attributable to the stochastic shocks that occur during the period in question. The third concept of funds rate volatility pertains not to single-period changes, but instead to multiperiod oscillations or explosions induced by the dynamic properties of the monetary system.

With respect to unplanned single-period changes in the funds rate, theoretical analysis can be conducted in much the same way as in the case of money stock control errors. The planned component of single-period changes is also of concern to targeting critics, however, and its behavior--unlike that of the unplanned component--depends on lags, serial correlation of disturbances, and other details of the dynamic specification of the relevant system. There can be little prospect, then, of obtaining robust conclusions regarding this component from theoretical analysis.

It is fortunate, consequently, that Tinsley et. al. (1981) have deduced volatility measures, as reflected in the Board's monthly econometric money market model, for single-period funds rate changes of both the planned and unplanned type. The computed standard-deviation measures pertaining to the six main operating procedures of present concern are reported in the final two columns of Table 2 (above). From these figures we see that, for each set of reserve regulations, use of a TR instrument involves more funds rate volatility--both planned and unplanned--than would obtain with a NR instrument. It will also be seen, however, that the volatility measures are smaller with the TR instrument under a system of contemporaneous, uniform, and universal reserve requirements than with the NR instrument under lagged reserve requirements. This statement applies, moreover, to both planned and unplanned components. Consequently, it appears from the Board-model results that the sizeable reduction in money stock errors that could have been realized during 1979-82, from the adoption of a TR/UCR regime, would have also involved reduced funds rate volatility--due to an improved position of the volatility frontier.

Let us then turn to the third concept of interest rate volatility mentioned above, that of the "instrument instability" type discussed by Cicollo (1974), Enzler and Johnson (1981), Higgins (1982), Radecki (1982), and perhaps others. The basic idea of these analyses can be explained very easily. Imagine, for simplicity, a money demand function of the following form, in which both current and lagged values of the funds rate are relevant:

$$(16) \qquad m_t = \alpha_0 - \alpha_1 r_t + \alpha_2 r_{t-1} + \eta_t \qquad \alpha_1 > 0.$$

Now suppose that the monetary authority manages its instrument, whatever its identity, so that m_t is kept constant over time: $m_t = m$. Then (16) implies that the funds rate r_t must evolve over time according to the stochastic difference equation

$$(17) \qquad r_t = \beta_0 + \beta_1 r_{t-1} + \beta_2 \eta_t$$

where $\beta_0 = (\alpha_0 - m)/\alpha_1$, $\beta_1 = \alpha_2/\alpha_1$, and $\beta_2 = 1/\alpha_1$. Consequently, if it happens that α_2 is negative then period-to-period oscillations in r_t will be implied. And if $|\alpha_2| > |\alpha_1|$, the dynamic behavior of r_t will be explosive.[26/]

Actual money demand functions will also include price-level and income (scale variable) terms, of course, but if these variables adjust much more slowly than r_t then the qualitative features of our oversimplified example will not be misleading. Furthermore, if the income variable is included in (16) but it in turn responds via an investment/saving relationship to r_t and r_{t-1}, then the exemplified type of dynamic behavior will be induced or reinforced from that source.[27/]

In giving consideration to the possibility of non-explosive oscillations of this type, the main point to be recognized is that the cyclical component would be entirely predictable: whenever r_t is higher than normal, equation (17) indicates that r_{t+1} will tend to be higher or lower than normal depending on the sign of β_1. Either way, the opportunity would exist for private investors to earn easy returns by exploiting the (stochastic) regularity of the relationship. And in doing so they would, of course, tend to eliminate the r_t cycles. For this reason--mentioned by Tinsley et. al.

(1981, p. 32)--the possibility of severe but non-explosive interest rate oscillations does not seem to warrant serious concern.

If, on the other hand, the α_1 and α_2 values implied a situation of dynamic instability, then the existence of speculative forces would not be sufficient to eliminate the difficulty under consideration. There is, however, a more basic reason for doubting the relevance of this case. To develop the argument, let us begin by noting that, from a theoretical perspective, past values of interest rates should not have any direct effect on asset demands.[28] That is because interest rates (or other prices) prevailing in the past would seem to fall clearly in the category of bygones--and the irrelevance of bygones is of course one of the most fundamental principles of economic analysis. This consideration argues strongly against the appearance of lagged r_t terms in (16) and, therefore, even more strongly against their predominance--which is needed for instability of the type in question.

To this argument it might be objected that empirical evidence indicates that, theoretical principles notwithstanding, lagged interest rate effects are in fact empirically important. But the evidence does not establish that the theoretical principle is incorrect, for the latter does not rule out indirect effects. Suppose, to illustrate the point, that the quantity m_t of some asset demanded in period t would depend only on r_t in the absence of adjustment costs, but that it is in fact costly--in terms of valuable resources--to rapidly change m_t from its previous value. Then the variable m_{t-1} will be a relevant determinant of the demand for m_t,[29] and if m_{t-1} were solved out of the implied relationship, past values of r_t would enter instead. Furthermore, in the presence of adjustment costs, expected future values of r_t would also be directly relevant. The demand function for m_t would in this case be of the form [30]

(18) $$m_t = \lambda m_{t-1} + \gamma_0 + \gamma_1 r_t + \gamma_2 E_t r_{t+1} + \gamma_3 E_t r_{t+2} + \dots + \eta_t$$

where $0 \leq \lambda < 1$ and $E_t r_{t+j}$ is the conditional expectation, based on full information in period t, of r_{t+j}. Precisely what results would be obtained, if the econometrician were to estimate an equation of the form (16) when (18) was in fact correct, cannot be ascertained without adoption of particular specifications concerning the η_t process and the behavior of the policy authority.[31] But in a wide variety of cases, lagged r_t values would be estimated by the econometrician to be relevant in (16), despite their actual irrelevance when expectations and lagged m_t values are taken into account.[32]

We now come to the main point of the present argument, which is that instability will not prevail in a system composed of (18) plus a policy-behavior equation that reflects period-by-period control of m_t.[33] Suppose, in particular, that the policy authority controls the supply of m_t so that

(19) $$m_t = m + \xi_t,$$

i.e., so that m_t is constant over time except for a white-noise random term ξ_t. Then if η_t were also white, the solution for r_t would be of the form

(20) $$r_t = \pi_0 + \pi_1 m_{t-1} + \pi_2 \eta_t + \pi_3 \xi_t,$$

where the π coefficients are related to m, λ, and the γ's.[34] From inspection of (20) it is apparent, however, that the behavior of r_t will be dynamically stable in this case whatever the values of the γ's, although the system features period-by-period control of m_t. Similar conclusions would be obtained, furthermore, for other specifications of the η_t process, provided only that it is itself stationary.

The foregoing argument depends, it should be acknowledged, on the assumption of rational expectations. But in this particular asset-demand context, that assumption seems entirely warranted, for systematic expectational errors would imply predictable cyclical movements from which speculators could easily profit.

The conclusion of the various arguments of this section, then, is that objections to monetary targeting, that are based on a presumption that extreme volatility of interest rates would be required, are not compelling. It appears, on the basis of theory and available evidence, that month-to-month control of the money stock would not induce dynamic instability or regular cycles, and that monthly funds-rate volatility would not be excessive. For convincing arguments against targeting one needs, evidently, to look elsewhere.

V. Financial Innovations and Deregulation

Up to this point no consideration has been given to one of the most prominent themes in the literature critical of monetary targeting, namely, the argument that ongoing processes of deregulation and innovation in the payments and financial industries give rise to frequent and unpredictable changes in the economic significance of any operationally-specified monetary aggregate. This theme has been put forth not only by critics--e.g., Bryant (1980), Hester (1981), and Morris (1982)--but also by economists who are more favorably inclined toward monetary targeting, including Cagan (1979)(1982).

The critics' basic line of argument--that the introduction of new financial assets alters asset demands so as to change the linkages relating monetary aggregates to instruments and to aggregate demand--is too well known to warrant a review here.[35] The response of monetary targeting proponents has emphasized the considerable extent to which these innovations have been stimulated by restrictive regulations and policy-induced inflation.[36] With the elimination of deposit rate ceilings that is now well-advanced, and perhaps the payment of interest on reserves, the incentives for new innovations will be sharply reduced. Thus the "optimistic view," to use Cagan's (1982, p. 6) term, is that regulatory reforms are capable of slowing innovations and reducing "their disturbing consequences for monetary policy."

Cagan goes on, however, to describe a "pessimistic counterpart that cannot be summarily dismissed" (1982, p. 6). In his words,

> the new electronic technology may make it cost-effective and attractive to supply transactions services as complements to other financial products outside depository institutions. The growth of many new financial services and instruments now appears inevitable. [These would be] ... hard to control unless ... deliberately prohibited by new regulations.... It would be necessary to invest the Federal Reserve with permanent authority to impose reserve requirements on any instruments that possess transaction capabilities. Whether this could be accomplished effectively is not clear.... [Thus if] financial developments blur the boundary between transaction and other balances, a policy of imposing reserve requirements on designated transaction balances whose selection is essentially arbitrary would be inequitable and would have to be abandoned. Policy could then set targets for the monetary base on the assumption that all payments ... have to be cleared through transfers of base money ... and the Federal Reserve could pursue its objectives by setting growth targets for the monetary base.... [But such a strategy] is untested and may be seriously questioned. Moreover, further financial developments are imaginable that would make the base useless for monetary policy.... [F]inancial institutions do not necessarily have to settle their net payments through transfers of federal funds. They could make arrangements to clear through deposits held with a few major banks or clearing houses.... With this further development the monetary base would consist almost entirely of currency. Furthermore, if an electronic payments system progresses far enough, currency could begin to decline (replaced by ubiquitous charge cards). The payments system would then have eliminated the government from the creation of money, and the supply of transaction balances would be virtually free of any government constraint. (Cagan, 1982, pp.6-8)

This scenario of Cagan's is certainly pessimistic from the standpoint of monetary ~~targeting~~ control. From a practical perspective, however, it seems reasonable to stop short of the final step (i.e., the near-elimination of currency) in the present discussion of monetary targeting.[37] Indeed, the issue of present concern does not involve the ultimate destination of the innovation process--which must be speculative in the extreme--but the pace and predictability of this process.

Even in this regard, however, it is difficult to find any firm analytical basis for predictions concerning the future. Indeed, there exists continuing disagreement among leading analysis concerning the extent of difficulties created by innovations in the recent past. Thus, while Lindsey (1984, pp. 15-20) emphasizes the role of innovations in creating M1 demand shifts that hampered policy efforts during 1979-82, Pierce (1984, p. 396) contends that "financial innovation did not produce large, unexpected movements in the quantity of money demanded during 1979-82" and so is not responsible for "the large fluctuations in money growth that occurred."

Given this inconclusive state of affairs, my strategy will be to draw only one (highly unexciting) conclusion and then move on to the next topic, hoping this the present issue can somehow be finessed. The one conclusion is that it seems unlikely that the Fed can entirely prevent the emergence of financial instruments that are free of reserve requirements yet which provide transactions services to holders--a conclusion that makes money stock targeting a somewhat less attractive proposition than it would be in the absence of ongoing innovation.

VI. Strategic Issues

The most sweeping and uncompromising criticism of monetary targeting that I am aware of is that provided by Bryant (1980)(1982)(1983). This fact is worthy of mention because in Bryant's opinion the objections discussed above in Sections III, IV, and V are of secondary importance compared to "strategic" issues concerning the desirability, rather than the feasibility, of adherence to money stock targets.[38/] In this section, we turn our attention to these strategic considerations, which involve issues of rules vs. discretion as well as the role of intermediate-target strategies in general.

Money stock targeting is, of course, but one particular type of an intermediate-target strategy, i.e., a way of conducting policy that focusses attention on the achievement of a target path for some variable that is itself neither an ultimate goal variable nor a directly-controllable instrument. Several writers--including Bryant (1980)(1983), B. Friedman (1975), Kareken, Muench, and Wallace (1973), and Tobin (1977)--have argued that any intermediate-target approach must be undesirable, as it can be improved upon by a strategy that straightforwardly specifies instrument settings (as functions of prevailing information) that are optimal with respect to the ultimate goal variables. The intrusion of an intermediate variable can only be redundant or detrimental to the achievement of the actual objectives, according to this argument. Now as a matter of theoretical principle, this position is rather appealing. But at the level of actual policy implementation its force is seriously weakened by the implicit assumption that the policy authority possesses a useful--imperfect, of course, but useful--model describing the relationships linking his instrument variable(s) to the ultimate goal variables that he seeks to influence. The poorer the model, the less compelling is the logic of the anti-intermediate targeting position. 39/

We will return to this point below, but first we need to emphasize that the targeting critics' argument does not adequately come to grips with the dynamic inconsistency phenomenon that has been prominent in recent discussion of the rules vs. discretion issue. In particular, it should be recognized that the analysis of Kydland-Prescott (1977) and Barro-Gordon (1983) strongly suggests that the implementation of "discretionary" (i.e., period-by-period) optimization calculations by the monetary authority will not lead to a desirable sequence of outcomes when the authority's objective function includes real (e.g., employment) as well as nominal (e.g., inflation) magnitudes. Instead, these outcomes will feature an unnecessarily large amount of inflation, on average, with no extra employment to compensate. 40/

This inefficiency could be remedied, according to the Kydland-Prescott and Barro-Gordon analysis, if instrument settings were based on a maintained policy rule itself determined from optimization calculations utilizing the authority's actual ultimate objectives. But in the absence of any effective mechanism for precommitment of future choices, there is nothing to keep the authority from recalculating "optimal" instrument settings each period. In an economy that possesses the potential for dynamic inconsistency--when, for example, employment levels depend on inflation surprises--these recalculated settings will differ from those specified by the rule. The recalculated settings will then be implemented by the discretionary monetary authority and, in the models under review, will result in the undesirable consequences mentioned above. 41/

Now consider an intermediate target strategy that consists of period-by-period optimization by the monetary authority with respect to a surrogate objective function, rather than the true objectives. From the foregoing description of the problem it would appear that this type of strategy might possibly lead to instrument settings that would result in an improved attainment of the true objectives, relative to the outcomes that would be forthcoming under the straightforward approach recommended by the anti-intermediate-targeting argument. Indeed, that this can be the case is carefully demonstrated in an imaginative and comprehensive treatment by Rogoff (1983). Specifically, Rogoff shows that--in a model economy with the sort of features that mainstream macroeconomists believe to be central to policy considerations[42/]--various forms of adherence to intermediate targets can enhance outcomes in terms of social objectives. Thus it turns out that, despite its intuitive appeal, the anti-intermediate-targeting argument is not correct even as a matter of theoretical principle. Instead, because of the excessive inflation that results (on average) from period-by-period decision making when the monetary authority's objective function includes real variables, it appears that intermediate targeting of some nominal magnitude is likely to be socially desirable.[43/]

This does not imply, however, that the money stock is necessarily the best choice of a nominal intermediate target. Which of several candidates (including the possibility of no intermediate target) is optimal depends, unsurprisingly, on the relative magnitudes of various structural parameters and disturbance variances. Nominal GNP targeting has better automatic stabilizing properties than money stock targeting, however, in response to money-demand or saving-investment shocks. Furthermore, the relationships connecting nominal GNP to potential instruments are likely to be less sensitive to the effects of technological innovation and deregulation than are demand and supply functions for any operationally-defined money stock measure. Consequently, many economists would favor a strategy based on a nominal GNP target over one with a money stock target.44/ I am personally inclined to share this view, which is reinforced by combining the general theme of the anti-intermediate-targeting argument with the belief that the weakest portion of existing macroeconomic analysis is that pertaining to the division of nominal GNP changes into inflation and output-growth components. But what seems most important to stress here is that money stock and nominal GNP targeting are closely related strategies, and that the choice between them is a relatively minor technical matter in comparison to the choice between one of them and targets involving real variables.45/

Officials of the Fed have gone on record, of course, as opposing nominal GNP targeting--see, for example, Volcker (1983) and Solomon (1984). The reasons mentioned, however, apply just as well to money stock targeting, or are based on the misleading notion that nominal GNP is an ultimate objective rather than an intermediate target,46/ or rely on presumptions of irrationality elsewhere in the society.47/ Perhaps such statements are made only for public relations purposes, to defend the Fed's current and recent actions. If that is a major motivation for the Fed's criticism of nominal GNP targeting, then it might be helpful to refer to nominal GNP--as Tobin (1983, p. 516) has suggested--as a "velocity-adjusted monetary aggregate."

Another way in which statements by Fed officials have been unconstructive is by suggesting that policy rules necessarily imply constant values of instrument (or target) growth rates and so must be non-reactive,[48/] i.e., non-responsive to current conditions.[49/] In fact, the crucial distinction brought out by the Kydland-Prescott and Barro-Gordon analyses is between optimal calculations of a maintained policy formula for setting instruments in response to current conditions (a "rule") and "optimal" calculations each period of instrument settings themselves ("discretion"). The difference is that the former procedure takes appropriate account of the effect that expectations have on current conditions in each period, while the latter simply treats each period's expectations as given data even though they are in part a reflection of the authority's past and present mode of behavior. To ignore the central aspects of this distinction in discussing the rules vs. discretion issue is to neglect the heart of the matter.

Tobin (1983) fully recognizes the analytical validity of this point, but declines to accept it as a practical matter. His objection is that "effectively binding rules are bound to be simple, like fixed growth rates for intermediate monetary aggregates. Simplicity gives them their political appeal and power" (1983, p. 508). But it is not our task as economists, I would think, to decide what has political appeal. Tobin also states that "It is not really feasible to spell out in advance what a central bank or government will or will not do in a long list of contengencies" (p. 508). But a rule that (for example) sets the annualized growth rate of the monetary base for month t at the value $2(U_{t-1} - 6)$, where U_{t-1} is the most recently observed percentage unemployment rate, covers a very large number of contingencies and must surely qualify as simple. One can certainly <u>define</u> rules and discretion differently, but the Barro-Gordon definition is useful in highlighting a crucial conceptual distinction.

This distinction does not, it should nevertheless be added, actually pertain to the extent to which the decision making process is automated or mechanized. Policy authorities not literally bound by any enforcable rule can make decisions that would correspond to those specified by the rule. But to do so they would have to ignore, in each period, expectational initial conditions. They would have to, in other words, abstain from attempts to exploit existing expectations, which would require that they <u>not</u> optimize with respect to the current situation. It is as an aid in this process that intermediate targeting, by focussing attention on nominal variables, can be socially productive.

An intermediate-target policy is not a fully specified rule, nevertheless, for the latter would dictate movements of an instrument as opposed to the path of a variable not precisely controllable by the authority. One advantage of a fully specified rule is that it leads to clarity concerning departures from target paths--it permits private agents and the policy authority itself to be certain whether such departures are intentional or the consequence of random shocks from non-policy sources.

In a previous paper, I have described qualitatively a rule of a type that appears to me attractive. This rule would govern the behavior of the monetary base, adjusting its growth rate up or down each month in response to recent deviations of nominal GNP from a constant-growth path that would be designed to be noninflationary.[50/] Hall (1985) and Meltzer (1985) have also suggested rules that should (i) provide automatic countercyclical forces, (ii) adjust to technological changes so as to prevent sustained inflation or deflation, and (iii) curtail attempts to exploit currently-given expectations. Empirical analysis designed to explore the properties of these and other rules has begun but needs to be taken farther.[51/]

VII. Conclusions

In conclusion, I will very briefly review the arguments developed above and, in the process, attempt to bring out the ways in which they are interrelated. First, in Section III it is argued that the experience of 1979-82 does not establish that accurate control of the (M1) money supply is infeasible, for the NR/LRR operating procedure employed during that episode is highly inappropriate for money stock control.[52/] Simulations of the Fed's monthly money-market econometric model indicate that the move to contemporaneous reserve requirements should reduce control errors to some extent.[53/] More substantial reductions are predicted to be obtainable from a system of uniform and universal (as well as contemporaneous) reserve requirements and, with such a system in place, use of a total reserve instrument would improve control even further--indeed, to an extent that should be entirely satisfactory to proponents of tight monetary control.

In Section IV it is indicated that such steps would not induce extreme volatility of short-term interest rates, the claim again being based in large part on simulations with the Board staff's monthly model. In addition, theoretical considerations are used to argue that strict M1 control would not induce severe multiperiod oscillations or explosions (as opposed to single-period changes) in interest rates.

Section V pertains to possible problems resulting from ongoing processes of technical innovation and deregulation in the payments industry. The only conclusion drawn is that the existence of these processes makes M1 targeting a less attractive proposition than it would be otherwise. The absence of stronger conclusions is not seriously damaging to the overall line of argument, however, for in Section VI it is concluded that an intermediate-target strategy could more fruitfully be based on the path of nominal GNP than that of the money stock.

More significantly, Section VI points out that, because of the sub-optimality of period-by-period decision making in an economy with price or wage rigidities, nominal intermediate targets can in principle be helpful in attaining ultimate goals even though these goals include real (employment or income) magnitudes. Adherence to a nominal intermediate target can provide some of the benefits of a policy rule. Such adherence does not constitute a rule, however, for it does not fully prescribe behavior of a directly-controllable instrument and is thus open to misunderstanding on the part of the public or the monetary authority itself.

Appendix A

The object here is to provide some basis for the judgement offered above that Lucas-critique effects would not be likely to reverse the main conclusion of Section III, namely, that accurate money stock control is possible under an operating regime with contemporaneous, uniform, and universal reserve requirements (UCR) and a total reserves instrument. We begin by noting that with a TR instrument, and in the absence of errors pertaining to reserve requirements, the only source of control error is excess reserves; if there were no excess reserves there would be no control errors. In the presence of excess reserves, moreover, the extent of the control errors will depend primarily upon the variance of shocks to the excess reserve demand function and on the interest-rate sensitivity of this same function. If this sensitivity is close to zero, the extent of monetary control will be independent of shock variances and parameter values in other parts of the system.

Consequently, we see that for the Tinsley et al results to significantly underestimate money control errors under a TR/UCR regime, they would need to be based on underestimates of the interest elasticity of excess reserve demand and/or the disturbance variance pertaining to that function. That the first of these conditions prevails seems unlikely because the Tinsley et al (1981) excess reserve demand function features an elasticity (with respect to the funds rate-discount rate spread) of approximately 0.3. But this figure is notably higher than is usually found in studies of reserve behavior--indeed, most investigators are unable to find any significant responsiveness of excess reserves to the interest rate differential. Thus it seems unlikely that the true magnitude, even if it were enhanced by a TR/UCR regime, would be greater than the figure used in the Tinsley et al simulations.

The other main relevant consideration is that, from a theoretical perspective, it is difficult to rationalize excess reserve holdings, except in frictional quantities, given the existence of a well-developed federal funds market. That statement would remain relevant under alternative operating procedures, furthermore,[54/] except for a regime with LRR and a TR instrument--under which banks could be assured of avoiding reserve deficiencies only by carrying large quantities of excess reserves.

Under a system with UCR and a TR instrument, then, theoretical considerations would lead one to expect excess reserves to be both small in magnitude and insensitive to the interest rate differential. But these conditions are just the opposite of those that would be conducive to the possibility of Lucas-critique effects that could invalidate the conclusion of Section III.

Appendix B

The object here is to provide a non-technical description of the logic of the argument concerning dynamic inconsistency, and rules vs. discretion, developed by Kydland and Prescott (1977) and elaborated by Barro and Gordon (1984). These writers assume that the monetary authority's objectives are represented by a loss function in which the arguments are the squared deviations of employment and inflation from values determined by reference to microeconomic principles. It will simplify matters without distortion of the argument, however, if we directly assume that the objective function is increasing in the current money growth surprise (surprise money growth enhances employment) and decreasing in the square of money growth itself (imagine the optimal steady-state inflation value is zero). Also, there are discounted values of similar terms expected for all future periods, but that does not matter. Now, if the authority were to adopt a policy rule by choosing among constant money growth rates he would recognize that on average surprise values will be zero whatever his choice, so the optimal choice would be a zero money growth rate. Similarly, an <u>average</u> money growth rate of zero would be implied by the optimal rule choice when a broader class of rules is considered.

But suppose that, instead, the authority proceeds in a discretionary manner, selecting current money growth rates on a period-by-period basis. In each period, then, he will take the prevailing expected money growth rate as a given piece of information (an initial condition). The current surprise value is then under his control, so the optimum choice of the current money growth rate is that which just balances the marginal benefit of surprise money growth against the marginal cost of money growth *per se*. With an objective function of the type described, this optimal value will be strictly positive. But rational private agents understand this process, so the public's expectations about money growth are correct on average. Thus the surprise magnitude is zero on average, over any large number of periods, even though the monetary authority views it as controllable within each period. Consequently, there is on average no benefit materializing from surprises to compensate for the cost of a positive money growth rate. The discretionary regime features more money growth (i.e., inflation) but the same amount of surprise money growth (i.e., employment) on average as under the optimal rule--consequences which are unambiguously poorer.

The logic of the foregoing example carries over, it must be emphasized, to cases in which the optimal policy rule is activist in design. The crucial step in obtaining superior outcomes is not constancy of instrument settings, but the avoidance of making period-by-period optimization calculations which attempt to exploit prevailing expectations--because of the effect that this pattern will have on expectations prevailing in the future. Thus, if an actual policymaker is not literally precommitted but somehow manages to ignore the apparent possibility of exploiting expectations--and does so each period--then the outcome could be as desirable as if some sort of a binding rule were in place.

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Footnotes

1. Among these are items by Blinder (1981)(1984), Bryant (1980 (1983), B.M. Friedman (1982)(1984), Gordon (1983), Hester (1981), Kaldor (1982), Morris (1982), and Tobin (1983).

2. In this category some leading items are Brunner and Meltzer (1983), M. Friedman (1982)(1983)(1984), Hetzel (1984b), and Poole (1982). Most of the writings by members of the Board of Governors staff fall cleanly into neither category, as they usually support the notion of monetary targeting in principle but argue against tight short-run adherence to targets. However viewed, some significant items from the Board staff include Axilrod (1981)(1983) and Lindsey (1983)(1984). In addition, papers by Board members Wallich (1984) and Volcker (1983) are of considerable interest.

3. A convenient and useful account of some of the complexities involving reserve requirements appears in Tinsley et al (1982).

4. For most of the uses to which the model will be put, the assumption that the disturbances are serially uncorrelated is not crucial. On this point, see McCallum and Hoehn (1983, p. 100).

5. This well-known type of analysis originated with Bailey (1961) and Poole (1970), and was first applied to a money-market model by Pierce and Thomson (1972). An extension to a dynamic setting with rational expectations is provided by McCallum and Hoehn (1983). Also see Hoehn (1984).

6. See, for example, charts in Bryant (1983, pp. 96-97), Hoehn (1983, pp. 2-3), and Lindsey (1984, pp. 15-17).

7. The estimates (standard errors) are 0.0138 (0.0038) for October 1976-September 1979 and 0.0709 (0.0180) for October 1979-September 1982.

8. Some readers have pointed out that this argument is not convincing; it is possible that the Fed was letting interest rates adjust more promptly to all sorts of influences without any special commitment to monetary targets. In that case Hoehn's regression would have many omitted variables and the coefficient on $m_t - m_t^*$ would accordingly be unreliable. It is therefore fortunate that the conclusions that I draw in this section do not rely upon the validity of my working hypothesis that the Fed was in fact more strongly committed than usual to monetary targets during 1979-82.

9. It is of course conceivable that the high interest rates and the recession were not attributable to monetary policy at all, but I am not inclined to make that argument. I am, however, inclined to emphasize that the period was one of monetary stringency only in relation to the path that would have resulted from an extrapolation of trends of the period prior to October 1979. By absolute standards--e.g., the growth rate of the monetary base--the period does not appear to be one of monetary stringency.

10. See, e.g., Coats (1976), Poole and Lieberman (1972), and McCallum-Hoehn (1983).

11. A qualification was pointed out to me by Alvin Marty: since e_t pertains in part to fluctuations in the reserve requirement ratio, its variance may be smaller under LRR than CRR. In that case, the stated absence of ambiguity does not prevail.

12. The unplanned variance in r_t with the NR_t instrument and LRR is $(1/b)^2\ (\sigma_e^2 + \sigma_\varepsilon^2)$, furthermore, which will be larger than expression (9) for a wide range of parameter values.

13. These are the two combinations most often proposed by M1 targeting proponents.

14. Here I am conducting a "stylized argument;" in reality the debate does not proceed in such an orderly fashion. Indeed, it is not in all cases possible to determine whether an individual is a proponent or critic of monetary targeting.

15. During the period studied, October 1979-October 1980, NR was the operating instrument so the base was not set in advance.

16. There I have limited attention to root-mean-square error measures and to simulations for the period October 1979-October 1980 in order to increase comparability with other results reported below. The Lindsey et al appendix figures for a 1979-82 simulation period are qualitatively similar.

17. This indeterminacy would not obtain if an interest-sensitive demand for excess reserves was included in the model.

18. The unpredictability under discussion is that pertaining to required reserves <u>given</u> deposits, not the magnitude of deposits themselves.

19. See Tinsley et al (1981, pp. 36-42) (1982, pp. 840-842).

20. See Levin and Meek (1981) and Goodfriend, Anderson, Kashyap, Moore, and Porter (1984) for clear descriptions of this logic and also for discussion of the points that follow.

21. Indeed, Goodfriend et al (1984) have argued that the Fed's actual procedure led borrowings--and thus the funds rate and the money stock--to evolve in a fashion analogous to a random walk! The point is that BR_t, borrowed reserves in week t, would be planned so that the expected value of BR_t would be BR_{t-1}. Thus if the stochastic discrepancy between actual and planned BR_t values were white noise, the BR_t process would be a random walk. This tendency is also mentioned by Pierce (1984, p. 396).

22. In the words of Tinsley et al (1981, p. 53): "The 'annual' money stock volatility performance ... is measured by the standard deviation of the gap in the tenth month of the policy horizon between the annual money stock path ... and the simulated outcome in the tenth month."

23. This one specific conclusion should not be interpreted as constituting a general disagreement with the reservations expressed by Anderson and Rasche (1982), in the final section of their useful paper, concerning the unreliability for some purposes of existing money market models.

24. In this regard, it might be noted that Walsh (1984) has developed a model in which the magnitudes of several parameters of the money demand function are related to the variability of bond prices (interest rates). Higher bond price variability shifts the money demand function in a manner that "suggests that a shift toward a policy that allows for greater fluctuations in the price of bonds, as, for example, occurs if the monetary authority changes from an interest rate to a reserve aggregate operating procedure, may result in a larger increase in bond price volatility than would have been predicted under the assumption of a constant structure" (1984, p. 148). It is a crucial feature of Walsh's analysis, however, that the model includes no interest-bearing asset with the same risk characteristics as money. In the presence of such an asset, the cited effect would not obtain. (This has been noted by Hoehn (1984).) Consequently, it is unlikely that the effect featured in Walsh's analysis is of substantial importance for the U.S. economy.

25. Most Federal Reserve analysts fall into this last category.

26. It should be clear from the logic of the example that <u>constancy</u> of m_t is not required; what the argument relies upon, rather, is exogeneity of an achieved m_t target path.

27. Since real rather than nominal rates appear in the IS relationship, this argument implicitly assumes relatively slow adjustment of inflationary expectations.

28. This point is also applicable, it will be noted, to the case considered in the previous three paragraphs.

29. The example is reminiscent of the well-known Goldfeld specification of the money demand function. Goodfriend (1985) has argued--persuasively, in my opinion--that the sort of portfolio adjustment costs that are relevant for money demand cannot plausibly explain the lags that are typically found in the money demand literature. But there are other relationships relevant to the argument at hand--the demand for fixed investment, for example--for which adjustment costs are presumably quite important. Goodfriend's analysis is, in any event, supportive of my main thesis.

30. It is not being argued that <u>linearity</u> is a consequence of adjustment costs; our illustrative examples are taken to be linear for simplicity, as that property is not at issue. The parameter λ in (18) must satisfy $0 \leq \lambda < 1$, however, precisely because it stems from adjustment-cost considerations.

31. It is being presumed that the policy authority controls m_t or r_t, or behaves so as to relate one to the other.

32. For example, suppose that the policy authority behaves according to $m_t = \mu_1 m_{t-1} + \mu_2 r_{t-1}$, that η_t is white noise, and that $\gamma_2 = \gamma_3 = \ldots = 0$. Then the solution for r_t will be of the form $r_t = \pi_0 + \pi_1 m_{t-1} + \pi_2 r_{t-1} + \pi_3 \eta_t$ and the expectational variable will be

$$E_t r_{t+1} = \pi_0 + \pi_1(\mu_1 m_{t-1} + \mu_2 r_{t-1}) + \pi_2(\pi_0 + \pi_1 m_{t-1} + \pi_2 r_{t-1} + \pi_3 \eta_t).$$

If m_{t-1} and $E_t r_{t+1}$ are omitted from the right-hand side of (18), we then have an expression in which r_{t-1} enters from several sources.

33. An argument that is essentially the same as mine, but worked out more thoroughly and in a more complete model, has recently been developed by Lane (1984).

34. That can be determined by inspection--as m_{t-1}, η_t, and ξ_t are the only relevant state variables in the system--and the π values can be found by using (19) and (20) in (18) via the undetermined-coefficients procedure. Formally, there exist other solutions, of course, as is the case in most rational expectations models of asset prices. The solution described in (20) is, however, the unique solution that is free of bootstrap effects--ones that exist only because they are arbitrarily expected to exist. For a lengthy discussion of this point and a rationalization of the (standard) practice of focussing attention on the bootstrap-free solution, see McCallum (1983).

35. Useful summaries have been provided by Cagan (1980) and Hester (1981), among others.

36. See, for example, Brunner and Meltzer (1983).

37. If complete, the elimination of currency would lead to the existence of a <u>non-monetary</u> economy, so difficulties with monetary control would become unimportant. For a discussion of some recent literature involving hypothetical economies with sophisticated accounting systems of exchange, see McCallum (1985).

38. Thus Bryant (1982, p. 598) says that "It needs to be emphasized at the outset that the issue discussed in this paper [i.e., the ability of the Federal Reserve to control the money stock] is <u>not</u> of major importance."

39. The force of the position is also weakened, of course, by the existence of political pressures of various sorts. While such pressures are obviously of enormous actual importance, this paper is not the appropriate place to attempt a systematic discussion. For one interesting recent effort, see Hetzel (1984a).

40. A non-technical exposition of the Kydland-Prescott and Barro-Gordon analysis is included in Appendix B.

41. The crucial features of the models that lead to this result are (i) an objective function that is increasing in output (or employment) over the relevant range and decreasing (with increasing marginal cost) in inflation measured relative to some optimal trend value; (ii) a positive dependence of output (or employment) on the current inflation or money growth surprise; and (iii) expectations that are correct on average over many periods. These are not stringent requirements. Item (iii) is a weaker condition than rational expectations, for example, and item (ii) permits multi-period nominal contracts provided that they are not of a form that is inconsistent with the natural-rate hypothesis.

42. The list is similar to that of the previous footnote. Rogoff's particular version of the Phillips curve (item ii) is based on one-period wage contracts that are incompletely indexed and his assumption is that expectations are rational. The connection between the monetary instrument and aggregate demand is provided by a standard IS-LM specification, which is compatible with (but more general than) the comparable features in the Kydland-Prescott and Barro-Gordon models.

43. I say "likely to" because there are some parameter configurations that make the purely discretionary regime preferable in Rogoff's model. These do not occupy a large subset of the parameter space.

44. Interesting evidence, supportive of the view that better performance would be available with a nominal GNP target, is provided by Tinsley and von zur Muehlen (1983). Specifically, their simulations with the Board's quarterly econometric model suggest that the volatility of inflation and unemployment would be lower than with targets for M1 (or some other variables). These simulations, it should be stressed, do not presume that the intermediate target variables can be accurately controlled, but only that the Fed can control--use as an instrument--the federal funds rate.

45. Tobin's (1983, pp. 509-511) arguments against "purely nominalist" targets do not address the claim being made, namely, that adherence to nominal targets can enhance social welfare as expressed in an objective function that includes real variables among its arguments.

46. Thus Solomon (1984, p. 4) objects to nominal GNP targeting because "it is simply not appropriate for the Federal Reserve to set broad economic goals. That is the task of elected officials."

47. Volcker (1983, p. 620) fears "that attempts to target GNP within a narrow range would, deliberately or not, provide an unwarranted sense of omnipotence for monetary policy ... ultimately leading to a sense of disappointment.... In addition, the impression conveyed that monetary policy would be 'held responsible' for meeting targets would, I suspect, only weaken the will of the Congress and the body politic to deal with other difficult issues, such as the budget, essential to the success of economic policy as a whole."

48. This is Tobin's (1983) term.

49. For example, in an argument against rules, Volcker (1983, p. 619) suggests that "attempts to follow a preset and inflexible money growth rule with M1 based on historical trends would have resulted over the past year, in my judgement ..., in a appreciably 'tighter' policy than intended at the start of the period." An exception is provided by Lindsey (1984).

50. Lindsey (1984, p. 7) has objected to this proposal on the grounds that "lags in the impact of policy actions would raise the potential problem of dynamic instability, since money base growth would continue to rise even during the early to middle phases of expansion in the business cycle, when nominal GNP rapidly approaches its target from below." The precise pattern of weights on various past target misses should, of course, be chosen with such possibilities in mind.

51. Hall (1985) has analyzed the properties of his rule under the assumption that a particular nominal-contracting model of John Taylor's provides a reasonable description of the economy.

52. Carried out by Lindsey and others (1981) and Tinsley et al (1981).

53. The current (1985) regulations do not, of course, feature full contemporaneousness. Goodfriend (1984b) has discussed procedures under which the two day lag could be damaging.

54. I recognize that this claim is disputed by many knowledgeable analysts.

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