A Price Target for U.S. Monetary Policy? Lessons from the Experience with Money Growth Targets

Author(s): Benjamin M. Friedman, Kenneth N. Kuttner, Mark Gertler and James Tobin

Source: *Brookings Papers on Economic Activity*, 1996, Vol. 1996, No. 1 (1996), pp. 77-146

Published by: Brookings Institution Press

Stable URL: https://www.jstor.org/stable/2534647

BENJAMIN M. FRIEDMAN
Harvard University
KENNETH N. KUTTNER
Columbia University

A Price Target for U.S. Monetary Policy? Lessons from the Experience with Money Growth Targets

SOMETIMES IT IS hard to leave well enough alone. During the first half of the 1980s U.S. monetary policy was the central actor at work in reducing the American economy's ongoing rate of price inflation from low double digits to low single digits—and, moreover, doing so at a real cost that was at most consistent with existing estimates of the cost of disinflation, if not a little better. In the first half of the 1990s inflation slowed further, again at a real cost well within the range of standard "sacrifice ratio" calculations. For well over a year, as of the time of writing, unemployment has been at or below the conventional 6 percent estimate of the "nonaccelerating inflation" rate of unemployment, while inflation itself, after allowance for the upward bias in the current consumer price index (as recently evaluated by the advisory commission established by the Senate Finance Committee), is within 1 percentage point of zero. Yet despite this impressive track record of success over a period now spanning a decade and a half, there is still no end to calls for fundamental reform of the way in which the Federal Reserve System goes about making monetary policy.

For practical purposes the cutting edge of this urge to redesign the U.S. monetary policymaking framework is a bill, currently pending before the U.S. Senate, that would formally establish the target of price

We are grateful to Jeff Amato and Dmitry Dubasov for research assistance; to Mark Gertler, James Tobin, and numerous other colleagues for helpful discussions; and to the G. E. Foundation and the Harvard Program for Financial Research for research support.

stability as the Federal Reserve's sole ongoing policy guideline. In recent years several other countries have likewise adopted either a price-stability target or an inflation target for their central bank, including New Zealand (1990), Canada (1991), the United Kingdom (1992), and Sweden (1993). In none of those countries, however, was the experience of either inflation or real growth in the years leading up to this change as favorable as it has been lately in the United States. Moreover, the United Kingdom and Sweden adopted their inflation targets in the wake of sizeable currency devaluations as they withdraw from the European exchange rate mechanism, and earlier on, Germany and Switzerland adopted inflation targets in large part as a response to the breakdown of the Bretton Woods system. By contrast, in the United States the proposal to institute a formal price stability target reflects less a response to a current problem (what is it?) than a generic desire to impose constraints on the central bank.

This desire is of long standing and it has given rise to an extremely rich literature of theoretical analysis as well as empirical evaluation.[1] A constant thread running throughout that literature is the crucial tension between the valid objective of making directly responsible to higher political authority what is, after all, an essential governmental function and the also valid objective of leaving monetary policy free to respond as appropriate to unforeseen contingencies: in other words, rules versus discretion. The heart of the matter, as James Tobin and others have long emphasized, is that while in theory it may be possible to design a rule that specifies the central bank's response under an extremely wide variety of circumstances, in practice the only effective rules in this context are simple rules.[2] Giving up policymakers' discretion is therefore likely to be costly, so that imposing a policy rule on a central bank is worthwhile only if doing so will avoid some even greater cost.

Fifteen years ago, when high and rising inflation rates loomed as a (in some cases, *the*) major economic issue in many industrialized countries, the theory of time inconsistency plausibly suggested that this

1. See Fischer (1990) for a thorough review. For more recent contributions, see Debelle and Fischer (1994), McCallum (1995), Walsh (1995), Posen (1995), and the references cited by these authors.

2. Tobin (1983). This principle has attracted wide agreement; see also Flood and Isard (1989), Taylor (1993), Friedman (1993), and McCallum (1995).

inflation was a natural consequence of a policymaking framework that allowed for discretionary monetary policy, so that the gain from restricting such discretion by a policy rule was potentially large. Today that claim is far less persuasive. Not only have most countries succeeded in slowing their economy's inflation, in most cases they have done so under monetary policymaking institutions no different than they had before. The United States is an especially good example in this regard. It is, therefore, ironic that a price stability target, which would directly address the time inconsistency problem, should be proposed just as time inconsistency no longer appears to be a compelling concern.

The more general point is the tendency, which may be inevitable, for policy rules to fight the last war—or, more accurately for purposes of monetary policy, fight the same war on the terrain of the last battle—in the sense of preparing policy to respond only to those contingencies that have actually occurred in the fairly recent past, rather than those that will arise in the future when the rule is in place. To be sure, assessing the potential importance of different kinds of disturbances when looking backward is far less problematic than when looking forward. But that is precisely the point.

The object of this paper is to examine this tendency to impose policy rules that amount to fighting the war on the last battle's terrain by studying the most recent effort by the Congress to impose a form of working rule on U.S. monetary policy: the injunction to the Federal Reserve System, under Concurrent Resolution 133, to formulate monetary policy by setting explicit targets for money growth. In brief, beginning in 1975 the Congress required the Federal Reserve to establish specific numerical money growth targets, publicly announce these targets in advance, and report back to the Congress on its success or failure in achieving them. In 1979 the Federal Reserve publicly declared that it had intensified its dedication to controlling money growth and implemented new day-to-day operating procedures designed to enhance its ability to do so. In 1987 the Federal Reserve gave up setting a target for the narrow money stock (M1) but continued to set targets for broader measures of money (M2 and M3). In 1993 the Federal Reserve publicly acknowledged that it had "downgraded" even its broad money growth targets—a change that most observers of U.S. monetary policy had already noticed earlier on. Since 1993 the Federal Reserve has continued to report to the Congress "ranges" for broad money growth (the

Congress has never repealed Resolution 133, and so the requirement to do so remains the law of the land), but it scrupulously avoids designating these ranges as targets—or even, for that matter, saying what is their relevance to monetary policy.[3]

The first section presents evidence documenting that the Federal Reserve did—for a while—genuinely use its money growth targets to conduct monetary policy, but eventually came to ignore the targets, even though the legislation calling for their use remained (and still remains) in force. The second section shows that the abandonment of money growth targets was a sensible response on the Federal Reserve's part to the collapse of prior empirical relationships between money and either output or prices. The third section poses the question why these empirical money-output and money-price relationships disintegrated as they did, suggesting four different hypotheses with sharply differing policy implications. The fourth section exploits a more structured analysis to test the three of these four hypotheses that cannot be immediately rejected by mere inspection of the relevant data. To anticipate, the evidence points mostly toward increased instability of money demand as the main reason why observed money growth lost its predictive content with respect to fluctuations of either output or prices, and therefore why targeting money growth became untenable as a way of conducting monetary policy. The final section uses these conclusions to draw lessons about the likely usefulness of the current proposal to direct the Federal Reserve to follow a price stability target.

The Use and Disuse of Money Growth Targets

Observing what central banks do is usually straightforward.[4] Establishing why they have done it is more problematic. Central bank purchases and sales of securities, the resulting changes in bank reserves,

3. In an amusing usage obviously designed to avoid the word *target*, the standard growth-cone chart in the semiannual *Monetary Policy Report to the Congress* (the Humphrey-Hawkins report) now plots the "actual range" and "actual level" of M2 and M3. (What, one is tempted to ask, is the meaning of an actual range when the actual level falls outside it?)

4. This section and the next draw in part on Friedman (1996).

and fluctuations in the relevant short-term interest rate are all known data not long after the fact. But few central banks make clear just why they have chosen the actions they have taken.

The usual critics notwithstanding, the problem in this regard reflects more than a preference for obfuscation. Under institutional arrangements like those at the Federal Reserve System, where the key decisionmaking authority rests in a sizeable committee (the Federal Open Market Committee [FOMC] has twelve voting members), different participants in the policy process may have different reasons for favoring the same action. Requiring them to agree not only on what to do but also on a precise statement of why they choose to do it would significantly raise the hurdle facing a policymaking process that must play out in real time. The situation is even more complicated in that the Federal Reserve is legally responsible to the Congress, which historically has been not only vague and inconsistent in stating its objectives for monetary policy but also—as subsequent sections of this paper argue—slow to alter its formal charges to the Federal Reserve as economic circumstances have changed.

Has the Federal Reserve actually attempted to implement its stated money growth targets? And if so, how would one know?

If there were never any disturbances to the relationships connecting money growth to prices and real economic activity, pursuing a money growth target would be empirically indistinguishable from simply varying the interest rate or the quantity of reserves in order to come as close as possible to achieving the desired objectives for prices and real activity themselves. Because money growth does not covary precisely with these indicators of macroeconomic performance, however, there is a difference between a monetary policy that responds only to movements of prices and real activity and a monetary policy that, at least in part, targets money growth.

The approach taken here to infer whether the Federal Reserve's money growth targets have actually affected its monetary policy actions is to look for *independent* effects of fluctuations in money, relative to the stated growth target, that are not already accounted for by prices and real economic activity. In particular, John Taylor has suggested that a simple formula relating the level of the federal funds rate to price inflation and the level of real activity relative to trend has approximately characterized U.S. monetary policy in recent years.[5] The approach taken here is to ask whether, and if so, when, the federal funds rate has *also* responded to departures of money from the stated target.

The first row of table 1 presents estimated coefficient values and Newey-West t statistics for the regression

$$r_t = \alpha + \beta_1\pi_{t-1} + \beta_2\pi_{t-2} + \gamma_1(U - U^*)_{t-1} + \gamma_2(U - U^*)_{t-2} + \delta(m - m^T)_{t-1} + u_t, \quad (1)$$

where r is the federal funds rate; π is the inflation rate measured over the preceding twelve months;[6] U and U^* are, respectively, the unemployment rate and Robert Gordon's estimate of the corresponding "natural" rate (Taylor's formula uses instead the deviation of real output from trend, but establishing the appropriate output trend is problematic over as long a time period as is ultimately treated here);[7] m and m^T are, respectively, the actual M1 money stock and the midpoint of the corresponding target range (both in logarithms);[8] and u is a disturbance term. For each year's observations, both m and m^T refer to the definition of M1 in use in that year, and the data used for m and used to construct m^T are taken from unpublished Federal Reserve sources dated shortly after the year's end.[9] (For purposes of this exercise it is essential to estimate the regression using data that correspond to what policymakers saw and construed as M1 at the time, rather than the standard data

5. See Taylor (1993). Bernanke and Blinder (1992), among others, have argued that the federal funds rate is the best single measure of monetary policy in the United States.

6. The price index used here is core CPI-U; that is, the consumer price index for all urban consumers, excluding food and energy items. The twelve-month inflation rate is calculated as $\pi_{t-1} = p_{t-1} - p_{t-13}$ and $\pi_{t-2} = p_{t-2} - p_{t-14}$, where p is the logarithm of the price index.

7. The unemployment rate is the rate for the civilian labor force aged sixteen and over. The natural rate is from Gordon (1993, table A-2), rendered into monthly values and continued at 6.0 percent after 1992. (Gordon's series ends in 1992:2, but it is constant at 6.0 percent throughout 1980–92.)

8. Friedman (1996) also experiments with an alternative representation that distinguishes discontinuously between values of money that are within and outside the target range by setting $(m - m^T)$ equal to zero whenever observed money is within the corresponding range and for observations outside the range, equal to the algebraic difference between m and the monthly path traced by either the upper or lower end of the target range, whichever is closer. The results are very close to those found here using the continuous representation based on the midpoint.

9. We are grateful to Donald Kohn and Richard Porter for providing historical data on the designated target ranges and the contemporaneous estimates of the money stock.

Table 1. Estimated Monetary Policy Reaction Functions[a]

		Independent variable							Summary statistic[b]		
Monetary aggregate	Constant	Lag sum	Inflation (t−1)	Inflation (t−2)	Unemployment gap (t−1)	Unemployment gap (t−2)	Money gap (t−1)	D × money gap (t−1)	SER	$\bar{R}^2$	DW or h
M1	2.23	...	1.77	−0.85	−1.16	1.19	0.50	...	2.36	0.60	0.16
	(4.0)	...	(3.3)	(−1.4)	(−1.1)	(1.1)	(1.9)	...			
M1	−0.01	0.98	0.02	0.01	−0.95	0.87	0.09	...	0.61	0.97	−0.30
	(−0.1)	(63.7)	(1.4)	(0.9)	(−2.3)	(2.3)	(1.7)	...			
M1	2.49	...	1.71	−0.85	−0.84	0.89	0.30	1.19	2.28	0.62	0.17
	(4.5)	...	(3.2)	(−1.4)	(−0.9)	(0.9)	(1.5)	(2.2)			
M1	0.11	0.97	0.01	0.01	−0.92	0.85	0.04	0.35	0.59	0.98	2.24
	(1.5)	(74.2)	(1.1)	(0.9)	(−2.6)	(2.5)	(1.7)	(2.6)			
M2	2.37	...	1.61	−0.66	−1.23	1.18	0.41	...	2.25	0.56	0.14
	(4.4)	...	(3.1)	(−1.1)	(−1.3)	(1.3)	(1.4)	...			
M2	0.05	0.99	0.01	0.01	−0.83	0.77	0.09	...	0.55	0.97	−1.20
	(0.8)	(86.9)	(0.9)	(0.7)	(−2.4)	(2.4)	(1.9)	...			
M2	2.45	...	1.61	−0.69	−1.06	1.03	0.25	0.86	2.24	0.57	0.13
	(4.5)	...	(3.1)	(−1.2)	(−1.3)	(1.2)	(0.8)	(0.9)			
M2	0.07	0.98	0.01	0.00	−0.79	0.73	0.03	0.33	0.54	0.98	−0.41
	(1.4)	(85.1)	(0.7)	(0.4)	(−2.6)	(2.5)	(1.4)	(1.4)			

Source: Authors' calculations. The regressions use the civilian unemployment rate and the seasonally adjusted consumer price index (for all items except food and energy) compiled by the Bureau of Labor Statistics. The "natural" rate of unemployment is from Gordon (1993). Data for the average effective federal funds rate are from the Board of Governors of the Federal Reserve System, as published in release G.13, "Selected Interest Rates and Bond Prices." The money stock and target data are from unpublished Federal Reserve sources.

a. Dependent variable is the federal funds rate. Estimated equations are equations 1 and 2 from text. Data are monthly. Sample is January 1960 through December 1986 for regressions using M1, and January 1960 through December 1995 for regressions using M2. Newey-West t statistics shown in parentheses.

b. SER denotes the standard error of the regression; DW denotes the Durbin-Watson statistic; and h denotes the Durbin h statistic, which is computed for the regressions with lagged dependent variables.

available today, which incorporate subsequent revisions and changed definitions.) All variables included in the regression are measured monthly, beginning in January 1960, and all are in units corresponding to percent.

Following the passage of Resolution 133, the Federal Reserve's first formally stated money growth targets specified growth ranges for the M1, M2, and M3 aggregates over the one-year period from March 1975 to March 1976. April 1975 was therefore the first month for which the actual value of any given measure of money could be compared to the value implied by the corresponding growth target (and with a one-month observation lag, May 1975 was the first month in which success or failure in achieving its money growth target could plausibly have influenced the Federal Reserve's setting of the federal funds rate). For purposes of the regression, therefore, $(m - m^T)$ simply assumes the value zero for all months in the sample through March 1975. For April through June 1975, m^T is defined by tracing out for those three months the growth path implied by the 6.25 percent per year midpoint of the 5 to 7.5 percent M1 growth target specified for the period running from the first quarter of 1975 to the corresponding quarter of 1976.

In June 1975 the Federal Reserve moved forward the base from which it was targeting the monetary aggregates and also shifted to a *quarterly* computation basis, so that the new targets specified growth ranges for the period 1975:2 to 1976:2. For purposes of the monthly regression, therefore, m^T for July through September 1975 is defined by the monthly values along the path implied by the midpoint of this new M1 growth target (again 5 to 7.5 percent per year, but from the 1975:2 base). Similarly, m^T for October through December 1975 is defined from the midpoint of the next new target for M1 growth, set in September for the period 1975:3–1976:3 (yet again 5 to 7.5 percent per year, but now from the 1975:3 base). For January 1976 through December 1978, values of m^T are similarly defined from the successive midpoints of the rolling annual growth targets that the Federal Reserve continued to establish for M1 on a quarterly basis.

Beginning from 1979 the Federal Reserve shifted to *annual* money growth targets, in each case based from the fourth quarter of the previous year, with the possibility of changing the target at midyear. For January 1979 through December 1986, therefore, m^T is defined from the midpoints of these successive annual target ranges for M1 (in some years called "monitoring ranges"), as amended during the year in both 1983 and 1985.[10] The Federal Reserve has not designated a formal growth target for M1 since 1986, and so the regression sample ends with December 1986.

The estimates for equation 1 shown in the first row of table 1 are roughly consistent with standard interpretations of monetary policy behavior, including Taylor's. Faster inflation leads the Federal Reserve to set a higher interest rate, although the specific combination of β_1 and β_2 values suggests a response both to inflation and to the change in inflation. Similarly, the combination of γ_1 and γ_2 values suggests that an increase in unemployment (relative to the "natural" rate), rather than a greater level, leads to a lower interest rate.

More important for purposes of this paper, the coefficient on the money gap variable ($m - m^T$) does suggest—albeit with only marginal statistical significance—an *independent* response by the Federal Reserve to movements of M1 growth in relation to the corresponding target path. Specifically, a level of M1 that is 1 percent above the midpoint of the target range leads, on average over the entire time when the Federal Reserve was setting M1 growth targets (May 1975 through December 1986), to a federal funds rate 50 basis points higher than prevailing levels of inflation and unemployment would otherwise warrant.

To be sure, evidence of this form does not distinguish between monetary policy responses that genuinely target money—in the strict sense that once observed money has departed from the designated range, the proximate objective of policy is taken to be getting the actual money stock back within range—and policy responses that merely exploit variations of observed money relative to the designated range as an information variable.[11] (Similarly, a significant coefficient on unemployment would not necessarily constitute evidence that preferences with respect

10. For 1980 and 1981 the Federal Reserve established separate targets for what were then called M1-A and M1-B. For those two years the regression relies on the M1-B aggregate, which, as of 1982, was simply relabeled M1.

11. On the distinction between an intermediate target variable and an information variable, see, for example, Friedman (1993). One way to draw this distinction empirically would be to include the Federal Reserve's forecasts of inflation and unemployment in the regression. McNees (1992) carries out an analysis of this kind, albeit for a different specification of the reaction function than that used here, and finds evidence indicating that the Federal Reserve did treat M1 growth as an independent target variable, not just as an information variable.

to unemployment per se were guiding monetary policy; even if the Federal Reserve had been solely seeking to control inflation, it might have varied the federal funds rate in response to observed fluctuations of unemployment if those observations helped to predict future inflation.) Under either interpretation, however, evidence of a direct, independent response to $(m - m^T)$ represents a reliance on money growth targets that clearly differs from the kind of behavior posited by Taylor for more recent years.

Not surprisingly, the estimates for equation 1 shown in the first row of table 1 suffer from severe serial correlation (hence the use of Newey-West *t* statistics). The Federal Reserve's well-known preference for smoothing interest rates makes the policy response to any independent variables like those included here—money growth, too—equivalent to a partial adjustment process. The second row of the table reports the results of reestimating equation 1 with twelve lags of the federal funds rate also included as independent variables, and the annualized one-month inflation rate substituted for the twelve-month rate. (Preliminary investigation indicated that eliminating all significant first-order serial correlation requires at least eleven lags.) Given these lagged interest rate terms, the coefficients on inflation become smaller and lose all statistical significance. By contrast, the coefficients on the unemployment terms become distinctly more significant. The estimated *long-run* response of the federal funds rate to observed M1 that remains permanently 1 percent above the target midpoint is 500 basis points [0.085/(1 − 0.983)].

There is no reason, however, to assume that the Federal Reserve's behavior with respect to its M1 growth target remained unchanged over the nearly twelve-year period during which it formulated a target for the narrow money aggregate.[12] Most obvious, the Federal Reserve's own official statements, as well as the widespread opinion among observers of U.S. monetary policy, indicated that money growth targets played an especially important role in the policymaking process during the three-year period beginning in October 1979. As a test of this proposition, the third and fourth rows of table 1 present estimates (with

12. There is also ground for supposing that the response to inflation and unemployment changed over time (see, for example, the evidence presented in Friedman, 1996), but that is not the focus of attention in this paper.

and without twelve lags of the dependent variable, respectively) for the expanded regression

$$\begin{aligned} r_t = \alpha &+ \beta_1\pi_{t-1} + \beta_2\pi_{t-2} + \gamma_1(U - U^*)_{t-1} \\ &+ \gamma_2(U - U^*)_{t-2} + \delta(m - m^T)_{t-1} \\ &+ \theta[(m - m^T)_{t-1} \times D_t] + u_t, \end{aligned} \tag{2}$$

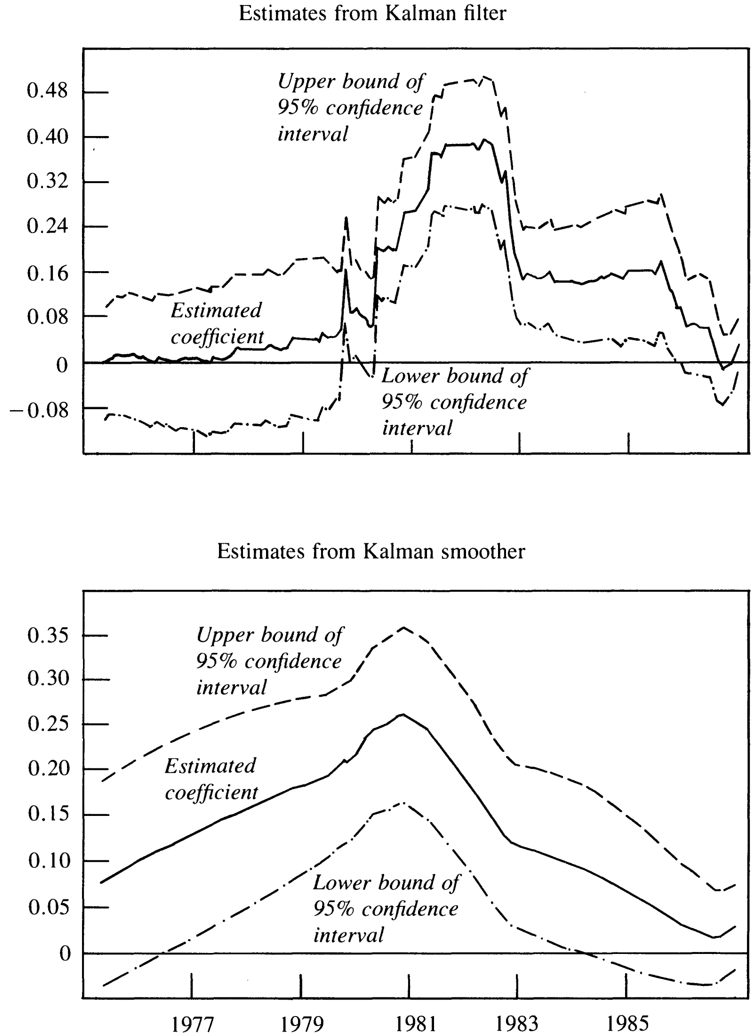
where D is a dummy variable equal to one in each of the thirty-six months spanning October 1979 through September 1982 and equal to zero both before and after, so that the regression distinguishes the Federal Reserve's attempt to target M1 growth during the "monetarist experiment" of the early 1980s from that at other times.

The results of estimating equation 2 do support the claim that the Federal Reserve placed much greater emphasis on its M1 target during the 1979–82 episode. The regression without lags indicates an interest rate response of 148 basis points (0.295 + 1.185) to a 1 percent movement of M1 away from the target midpoint during 1979–82, and only 30 basis points at other times. The larger estimate is significant at standard levels (the t statistic for the sum of δ and θ is 2.7), while the smaller is not. The regression with lags indicates a corresponding long-run response of 1182 basis points [(0.041 + 0.349)/(1 − 0.967)]—which seems too large to be entirely credible—during 1979–82, and 124 basis points at other times. (Here the t statistic for the sum of δ and θ is 3.0.)

Figure 1 shows the result of yet a finer attempt to explore the changing importance of the M1 growth target for U.S. monetary policy by estimating equation 1, again including twelve lags on the federal funds rate, using an explicit time-varying-parameter model for the coefficient δ. The upper panel displays the time series of recursively updated δ_t estimates computed from the Kalman filter, in which any given month's estimate of δ relies on data only through that month, and therefore corresponds to the behavior of monetary policy as observers at each point in time could have assessed it.[13] The lower panel displays

13. The model replaces the time-invariant δ coefficient in equation 1 with a time-varying δ_t, which is assumed to follow a random walk, $\delta_t = \delta_{t-1} + \epsilon_t$. The other coefficients are not allowed to vary over time. The initial conditions for the coefficients other than δ were taken from the ordinary least squares regression of the federal funds rate on the variables other than $(m - m^T)$ over the subsample from February 1960

Figure 1. Coefficient on Money Deviation Term in Monetary Policy Reaction Function with M1[a]



Source: Authors' calculations. The regressions use the civilian unemployment rate and the seasonally adjusted consumer price index (for all items except food and energy) compiled by the Bureau of Labor Statistics. The "natural" rate of unemployment is from Gordon (1993). Data for the average effective federal funds rate are from the Board of Governors of the Federal Reserve System, as published in release G.13, "Selected Interest Rates and Bond Prices." The money stock and target data are from unpublished Federal Reserve sources.

a. Based on a time-varying-parameter model relating the federal funds rate to two lags of the monthly inflation rate, two lags of the difference between the employment rate and the "natural" rate, twelve lags of the federal funds rate, and the difference between observed money and the midpoint of the Federal Reserve's target range. The coefficient on the money term is constrained to follow a random walk, where the standard deviation of the shock is 0.01. The data are monthly and expressed in units corresponding to percent. Further details are provided in the text and note 13.

the equivalent time series of δ_t estimates computed from the Kalman smoother, which uses data from the entire sample to construct the retrospective minimum mean square error estimate of each month's δ_t.

The filtered estimates provide no evidence that the money growth target actually mattered for Federal Reserve policy in the first two years or so following the adoption of Resolution 133. The estimated coefficient on $(m - m^T)$ begins to rise modestly in late 1977, but it does not become consistently significant until early 1980, when it rises much more sharply. It declines sharply in mid-1982, but remains significant. It begins to decline again in early 1985 and continues to do so, ceasing to be significant some time in 1986.[14]

The smoothed estimates tell much the same story. From its peak in late 1980 the coefficient on $(m - m^T)$ declines steadily, and it has become statistically insignificant by mid-1984. Only for the late 1970s do the two sets of time-varying-parameter estimates present differing views of monetary policy, in that the smoothed estimates indicate a positive influence on the federal funds rate due to the gap between observed money and the target range midpoint. In part, however, this apparent difference merely reflects the imprecision of the estimated coefficient in the early part of the sample.

One potential source of concern about results like those presented in table 1 or figure 1 is the consistent use of the federal funds rate as the dependent variable that represents the direct operating instrument of monetary policy. While there is substantial agreement that the federal funds rate was, indeed, the relevant policy instrument both before and after the experiment of 1979–82, during this period the Federal Reserve stated that it was using a different operating procedure that, in effect, made the growth of nonborrowed reserves the central bank's instrument variable.[15] To verify that the results presented in table 1 are not a

through April 1974. The starting value of δ was set to zero, with variance 0.25. Other plausible starting values yielded virtually indistinguishable results. The standard deviation of the shock to the δ_t coefficient, σ_ϵ, was set to 0.01. (In principle, maximum likelihood estimation of σ_ϵ is feasible, but the results were very similar for a wide range of assumed values of σ_ϵ.)

14. These results are very similar to those presented by Friedman (1996) using an expanding- or rolling-sample regression model with dummy variables that mimics a time-varying-parameter model in a step-wise fashion.

15. For a description of the nonborrowed reserves procedure, see Board of Governors of the Federal Reserve System (1981). Subsequent research has mostly supported

consequence of using an incorrect dependent variable in the regression during the period when money growth targets apparently mattered most, the first two rows of table 2 show the results of estimating equations 1 and 2 with the annualized growth of nonborrowed reserves plus extended credit as the dependent variable. (The estimated regressions include no lagged dependent variables because there is no evidence of serial correlation.)

The positive coefficient on $(m - m^T)$ reported in the first row of table 2 for the entire period during which the Federal Reserve formulated M1 growth targets is consistent with the implication of the use, over most of that time, of an operating procedure based on the federal funds rate as the direct instrument variable. For a given interest rate level, a greater level of money (relative to target) means more reserves to be provided through open market operations. By contrast, when the dummy variable distinguishes the period from October 1979 through September 1982 from the periods before and after, the different response of nonborrowed reserves to $(m - m^T)$ is clearly evident. When the Federal Reserve was using nonborrowed reserves as its operating instrument, reserves growth responded *negatively* to observed deviations of money from the target midpoint.

The lower rows of tables 1 and 2, and figure 2, present similar analyses for the Federal Reserve's M2 target—but extending through the end of 1995. The results are roughly in line with those reported above for M1, although in the case of M2 the coefficient estimates are generally less significant. In the time-varying-parameter model, however, the response to $(m - m^T)$ is again clearly significant from mid-1980 through late 1986. Thereafter the estimated coefficient remains positive, but it is never again statistically significant.

In sum, the evidence is clear that the Federal Reserve did—for a while—target money, in the sense that it varied either the federal funds rate or nonborrowed reserves (whichever was its operating instrument at the time) in response to observed fluctuations of either M1 or M2 that departed from the corresponding stated targets. The failure to do so in the first few years after the Congress adopted Resolution 133 can perhaps be explained away as a delayed, or cautiously gradual, response

the claim that during this period the instrument variable was nonborrowed reserves; see, for example, Bernanke and Mihov (1995).

Table 2. Estimated Reaction Functions for Nonborrowed Reserves[a]

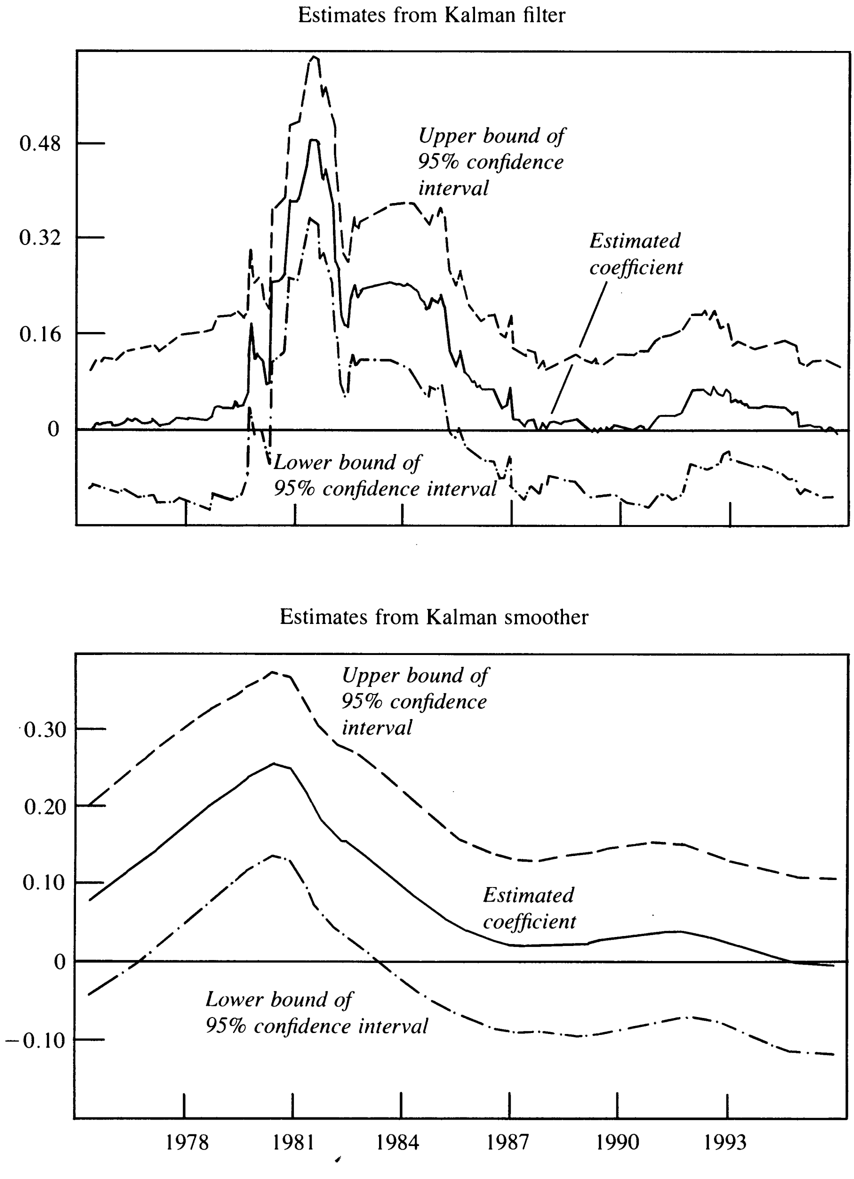
		Independent variable						Summary statistic[b]		
Monetary aggregate	*Constant*	*Inflation (t−1)*	*Inflation (t−2)*	*Unemployment gap (t−1)*	*Unemployment gap (t−2)*	*Money gap (t−1)*	*D × money gap (t−1)*	*SER*	$\bar{R}^2$	*DW*
M1	4.01	5.68	−5.78	12.94	−11.98	1.72	...	18.87	0.03	1.99
	(2.6)	(1.7)	(−1.7)	(2.2)	(−2.1)	(1.3)	...			
M1	2.95	5.92	−5.74	11.50	−10.65	2.62	−5.22	18.70	0.04	2.02
	(1.9)	(1.7)	(−1.6)	(2.2)	(−2.1)	(2.6)	(−2.1)			
M2	4.21	5.46	−5.47	11.36	−9.62	−0.47	...	17.31	0.02	1.88
	(2.1)	(1.7)	(−1.6)	(2.3)	(−2.0)	(−0.3)	...			
M2	3.93	5.45	−5.37	10.79	−9.11	0.08	−2.95	17.31	0.02	1.88
	(2.0)	(1.7)	(−1.6)	(2.3)	(−2.0)	(0.0)	(−1.0)			

Source: Authors' calculations, using the data sources for table 1.

a. Dependent variable is the annualized percentage change in nonborrowed reserves plus extended credit. Estimated equations are equations 1 and 2 from text. Data are monthly. Sample is January 1960 through December 1986 for regressions using M1, and January 1960 through December 1995 for regressions using M2. Newey-West t statistics shown in parentheses.

b. SER denotes the standard error of the regression; and DW denotes the Durbin-Watson statistic.

Figure 2. Coefficient on Money Deviation Term in Monetary Policy Reaction Function with M2[a]



Source: Authors' calculations, using the data sources for figure 1.
a. See figure 1.

to the new legislation. What is more interesting, for purposes of this paper, is the effective abandonment of the money growth targets in the mid-1980s, when the pertinent legislation remained in force (as it does today).

Why has the Federal Reserve come to disregard the instruction given to it by the Congress, to which the central bank is directly responsible? To answer this question it is necessary to examine the relationship between money and the objectives that monetary policy seeks to achieve in the first place.

The Changing Information Content of Money

The standard rationale for using a money growth target to guide monetary policy is that, under the right conditions, doing so provides a coherent way of taking into account unforeseen developments. The opportunity to exploit a variable like money for this purpose arises because the actions of central banks and their economic consequences are separated both by time and by behavioral process: A change in the interest rate (or the quantity of reserves) effects a difference in economic activity later on, *and* the economic behavior that gives rise to that difference involves actions that are, at least in principle, observable along the way. In principle, money growth is an observable element of that intermediate behavior standing between central bank actions and their ultimate economic consequences.

Given that the central bank's main form of monetary policy action in a fractional reserve banking system is the purchase or sale of securities in exchange for bank reserves, most familiar models of the behavioral process connecting monetary policy to economic activity plausibly provide at least a potential role for fluctuations in some measure of money to anticipate movements in prices, real output, or both. In the most conventional models, open market purchases provide reserves that enable banks to create more deposits, thereby reducing interest rates (as long as the demand for deposits is negatively interest elastic) and stimulating spending. A closely related alternative focuses on the importance of bank lending in the financing of either business or household expenditures, so that movements in money anticipate spending primarily because they reflect what is happening on the credit side of the banking system's balance sheet. Yet a different view focuses on the presumed link between money and prices, so that any effects on real activity arise as a consequence of the output decisions of producers who are unsure of how to interpret the limited information they receive as prices change.

In each of these models, however, the behavior that ultimately generates changes in prices or real activity also involves movements of money. To the extent that these movements in money occur not just logically but *chronologically* before the corresponding movements in prices or output, the central bank can—again, under the right conditions—exploit them to make whatever changes in its interest rate or reserves instrument unforeseen events may warrant. Strictly defined, the use of a money growth target means that the central bank not only treats all unexpected fluctuations in money as providing information about as yet unobserved fluctuations in prices or output, but also, as a quantitative matter, responds to such aberrant movements of money by changing its instrument variable in such a way as to restore money growth to the originally designated path. Alternatively, the central bank could incorporate money growth into its monetary policymaking process in a more flexible way, recognizing that movements in money are not *always* a sign of movements in prices and output to come, and hence deciding on a case by case basis whether, and if so by how much, to move its instrument variable when observed money growth behaves unexpectedly. Doing so amounts to using money growth not as a target, but as an information variable.

But regardless of whether the central bank makes money growth a formal target or uses it as an information variable, the whole idea is senseless unless observed fluctuations in money do anticipate movements of prices, or output, or whatever constitutes the ultimate objective of monetary policy. What would it mean to exploit an information variable that contained no relevant information? What would be the point in pursuing an intermediate target that was not observably intermediate between the central bank's actions and the intended consequences? In either case, whether movements in money anticipate movements in prices, or output, or both, is crucial.[16] That, in turn, is an

16. What matters for this purpose is merely that movements in money *precede* movements in prices or output. It is not necessary that money play any part in "causing"

empirical question. Moreover, because economic circumstances change, the answer at one point in time need not be the same as at a later point.

Figure 3 addresses this issue by showing, for each of a series of eighty-one overlapping sample periods, the contribution of money to subsequent movements in real output (top panel) and prices (bottom panel) as estimated by means of the standard unrestricted vector autoregression (VAR) methodology. For each of the eighty-one samples, the figure indicates the respective percentages of output and prices accounted for by money at a two-year horizon.[17] Each such percentage is the product of a variance decomposition based on an underlying *quarterly* four-variable vector autoregression, including real gross domestic product, the corresponding price deflator, and the M1 money stock (all in logarithms and all seasonally adjusted), and the federal funds rate (not seasonally adjusted), with four lags on each variable. The orthogonalization of this system for purposes of the variance decomposition places output first, prices second, money third, and the interest rate fourth. In each panel the solid line plots the estimated contribution of money to either output or prices, as estimated over a sample ending at the date denoted on the horizontal axis, while the pair of dashed lines indicates the one-standard-error band of uncertainty associated with this estimate.

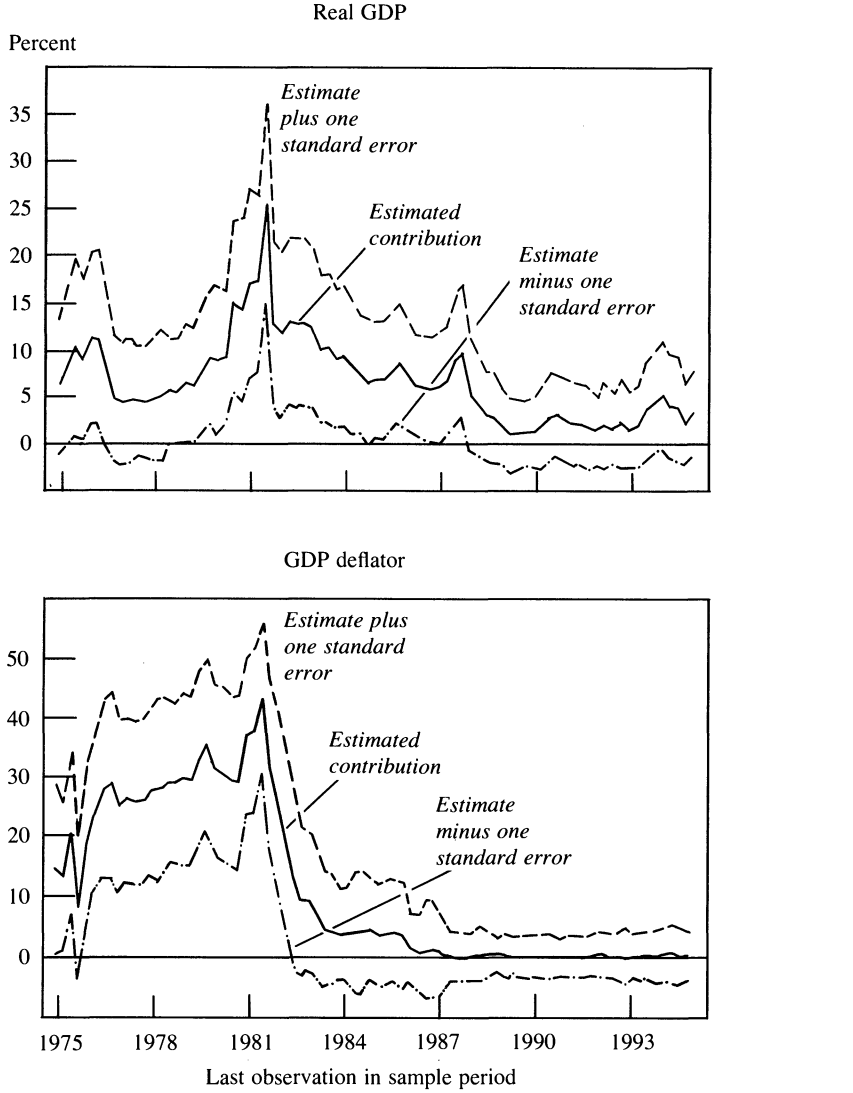
The initial percentage plotted in each panel of figure 3 refers to the variance decomposition based on the four-variable vector autoregression estimated using data beginning in 1959:1 and ending in 1974:4. (Because of the four lags on each variable, the regression's first observation is 1960:1, and so this initial sample includes sixty observations.) The two initial percentages therefore indicate how someone applying this methodology in early 1975 would have assessed the contribution of the M1 money stock to predicting that part of the subsequent fluctuation of output and prices that is not already predictable from the prior fluctuation of output and prices themselves.[18]

movements in prices or output, in the classical sense. The discussion below follows Tobin (1970) in emphasizing this distinction. In particular, the use of the vector autoregression methodology merely determines whether money has predictive content for such movements, not whether money is causal.

17. The results are very similar for a one-year horizon; see Friedman (1996).

18. To show more precisely how someone in early 1975 would have answered this

Figure 3. Contribution of M1 to Output and Price Variance[a]



Source: Authors' calculations. Data for output and prices are from the National Income and Product Accounts (NIPA), 1987 base year. Data for the quarterly average money stock and average effective federal funds rate are from the Board of Governors of the Federal Reserve System.

a. Based on eight-quarter-ahead variance decompositions from a vector autoregression (VAR) that includes the log levels of real GDP, the implicit GDP deflator, and money (M1), and the level of the federal funds rate, with four lags on each variable. The system is orthogonalized in that order. Data are quarterly. The VAR is estimated on an expanding sample through 1979:4, and on an eighty-quarter rolling sample thereafter. Further details are provided in the text.

The answer, as of 1975, is that knowing the recent movements of M1 contributes fairly little to predicting *output*, but modestly more to predicting *prices*.[19] At the two-year-ahead horizon considered in figure 3, money accounts for about 6 percent of the subsequent variation in output, but over 14 percent of the variation in prices. The output percentage is not significantly different from zero even at the weak level reflected by the one-standard-error band. The percentage for prices is barely significant at this level.

The other eighty points plotted in each panel of figure 3 indicate the results of analogous variance decompositions based on sample periods ending in 1975:1, 1975:2, and so on through 1994:4. In each case the question at issue is the same—how much M1 contributes to predicting that part of the subsequent fluctuation of output and prices not already predictable from prior output and prices—but the vantage point from which the question is asked continually moves forward in time. As the end date of the sample advances from 1974:4 to 1979:4, the initial observation remains 1960:1, so that the sample size expands (one observation at a time) from sixty to eighty quarters. Thereafter the end date and the beginning date advance together, so that the sample size remains eighty quarters.

The estimates change substantially as the end of the sample advances from 1975 to 1995. The contribution of M1 to explaining subsequent *output* fluctuations initially briefly increased somewhat, but mostly remained small until the early 1980s. It then increased sharply (and briefly became significant at conventional levels), but since the mid-1980s it has mostly declined and has remained clearly insignificant at any interesting level.[20] The contribution of M1 to explaining subsequent *price*

question would require using data that existed then—not, as here, the revised data for 1959–74 that exist now. The work reported in the first section of this paper follows that approach. By contrast, in this and following sections the emphasis is on how the relevant economic behavior has changed over time, and so the results reported rely on the latest revised data available as of the time of writing.

19. Moreover, ordering money ahead of the interest rate for purposes of the orthogonalization biases the results shown here *in favor* of a predictive content for money.

20. Because of the rolling-sample procedure, the odd spike at 1981:2 in the output panel of figure 3 (and, to a lesser extent, in the price panel) could in principle be due either to sequentially adding 1981:2 and then 1981:3 to the sample, or to sequentially dropping 1961:2 and then 1961:3. Experimentation shows that what matters is sequentially adding the new observations. When the underlying vector autoregression is run on

fluctuations increased rapidly in both magnitude and statistical significance at first, only to decline equally rapidly and lose all significance in the early 1980s. It has since become negligible.

An alternative way of addressing the contribution of money to predicting the subsequent variation of output or prices is to test explicitly the hypothesis that money has no such predictive power at all. In principle, the eighty-one vector autoregressions underlying the variance decompositions reported in figure 3 readily admit such a test. Because each of the four included variables (the respective log levels of output, prices, and money, and the nominal interest rate) is nonstationary, however, standard test statistics based on the normal distribution would be inappropriate for these regressions. Moreover, the distributions of the appropriate test statistics are known only for certain special cases.[21]

The two panels of figure 4 therefore plot p values for tests of the null hypothesis that all coefficients δ_{xi} or δ_{pi} are zero in the two *differenced* equations

$$\Delta x_t = \alpha_x + \sum_{i=1}^{4} \beta_{xi} \Delta x_{t-i} + \sum_{i=1}^{4} \gamma_{xi} \Delta p_{t-i} + \sum_{i=1}^{4} \delta_{xi} \Delta m_{t-i} + \sum_{i=1}^{4} \theta_{xi} \Delta r_{t-i} + u_t \tag{3}$$

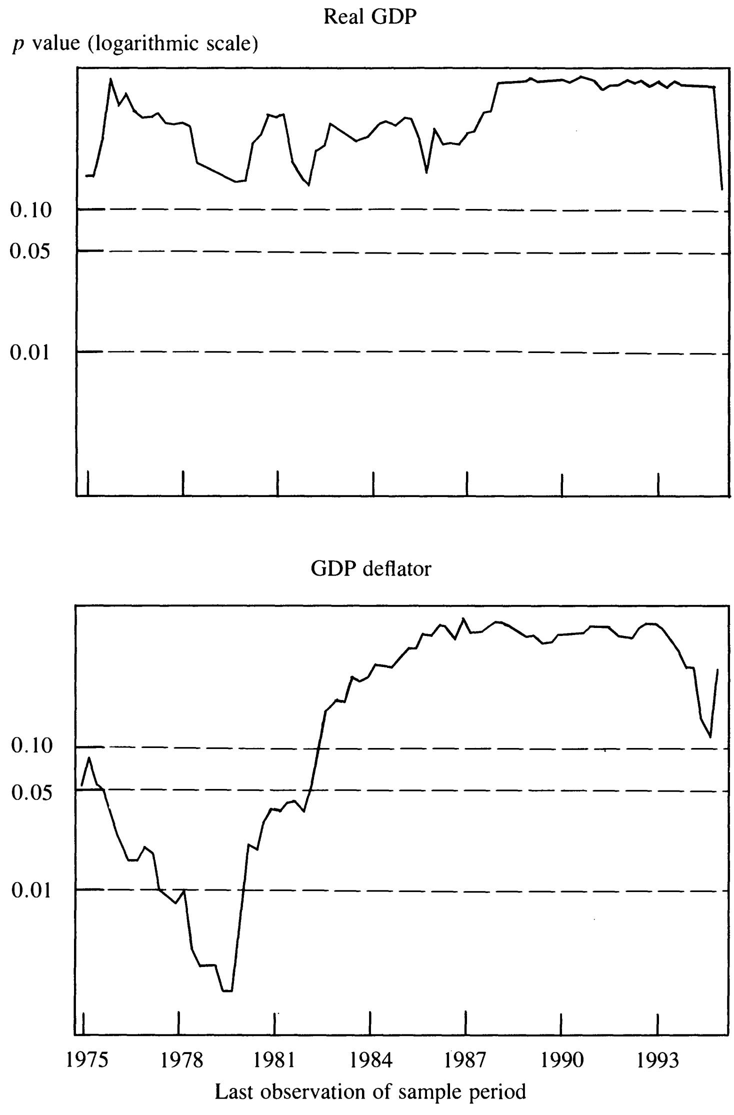
and

$$\Delta p_t = \alpha_p + \sum_{i=1}^{4} \beta_{pi} \Delta x_{t-i} + \sum_{i=1}^{4} \gamma_{pi} \Delta p_{t-i} + \sum_{i=1}^{4} \delta_{pi} \Delta m_{t-i} + \sum_{i=1}^{4} \theta_{pi} \Delta r_{t-i} + v_t, \tag{4}$$

differenced data, the same general pattern appears, but these spikes are much less pronounced.

21. See the discussion in Sims, Stock, and Watson (1990). As these authors point out, the "levels" regression used above for purposes of the variance decompositions preserves any cointegrating relationships that obtain among the included variables without explicitly imposing those relationships. One potential cost of using differenced relationships like equations 3 and 4 below is that they do not incorporate the long-run relationships implied by cointegration. Evidence for the existence of cointegration in this context is weak, however; see, for example, Friedman and Kuttner (1992) and Miyao (1997).

Figure 4. Significance of M1 in Predicting Output and the Price Level[a]



Source: Authors' calculations, using the data sources for figure 3.

a. Based on *F* statistics for the exclusion of the money terms from a regression of real GDP growth (top panel) and growth in the implicit GDP deflator (bottom panel) on four lags of each of real GDP growth, growth in the implicit GDP deflator, money growth, and the change in the federal funds rate. Data are quarterly. The equations are estimated on an expanding sample through 1979:4, and on an eighty-quarter rolling sample thereafter. Further details are provided in the text.

where x, p, and m are, respectively, the logarithms of real gross domestic product, the price deflator, and the M1 money stock; r is the federal funds rate; u and v are disturbance terms; and α and β_i, γ_i, δ_i, and θ_i in each equation are all coefficients to be estimated. In parallel with figure 3, the first p value plotted in each panel of figure 4 gives the result of testing the null hypothesis of zero predictive content of money over the sample ending in 1974:4, and the subsequent eighty values refer to the samples ending in 1975:1, 1975:2, and so on through 1994:4. The dashed horizontal lines in each panel indicate the 0.01, 0.05, and 0.10 significance levels.

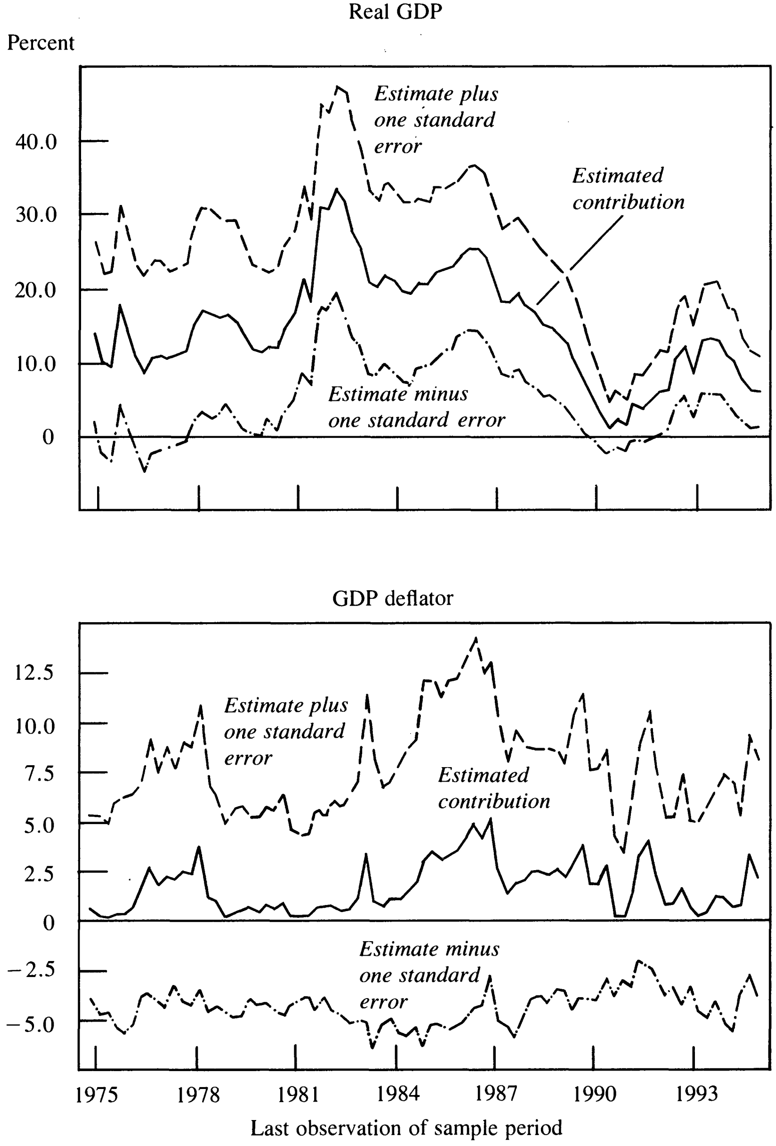
The results generated by this more explicit hypothesis test differ conceptually from the variance decomposition results shown in figure 3 for several reasons. Most basically, asking the yes-or-no question of whether money has *any* predictive content with respect to output or prices is not the same as asking *how much* predictive content money has. In addition, the significance test based on the regression coefficients refers (by construction) to a one-quarter-ahead prediction, while the variance decompositions reported above refer to an eight-quarter horizon. Finally, levels are not the same as growth rates, although it is impossible to evaluate the force of this distinction because of the nonstationarity problem.

Given all of these differences of method, it is not surprising that the p values shown in figure 4 do not fully correspond to the variance decomposition results in figure 3. Here, money never has predictive power with respect to *output* that is significant, even at the 0.10 level, as seen from any of the eighty-one vantage points spanning the twenty years.[22] Money has significant predictive content with respect to *prices* when judged from any vantage point through early 1983. During most of this early period, this predictive content is significant at the 0.05 level, and for a brief period it is significant at the 0.01 level. From no vantage point since 1983, however, is there any evidence of predictive content with respect to prices, even at the 0.10 level.

Figures 5 and 6 present evidence for M2 that is analogous to that

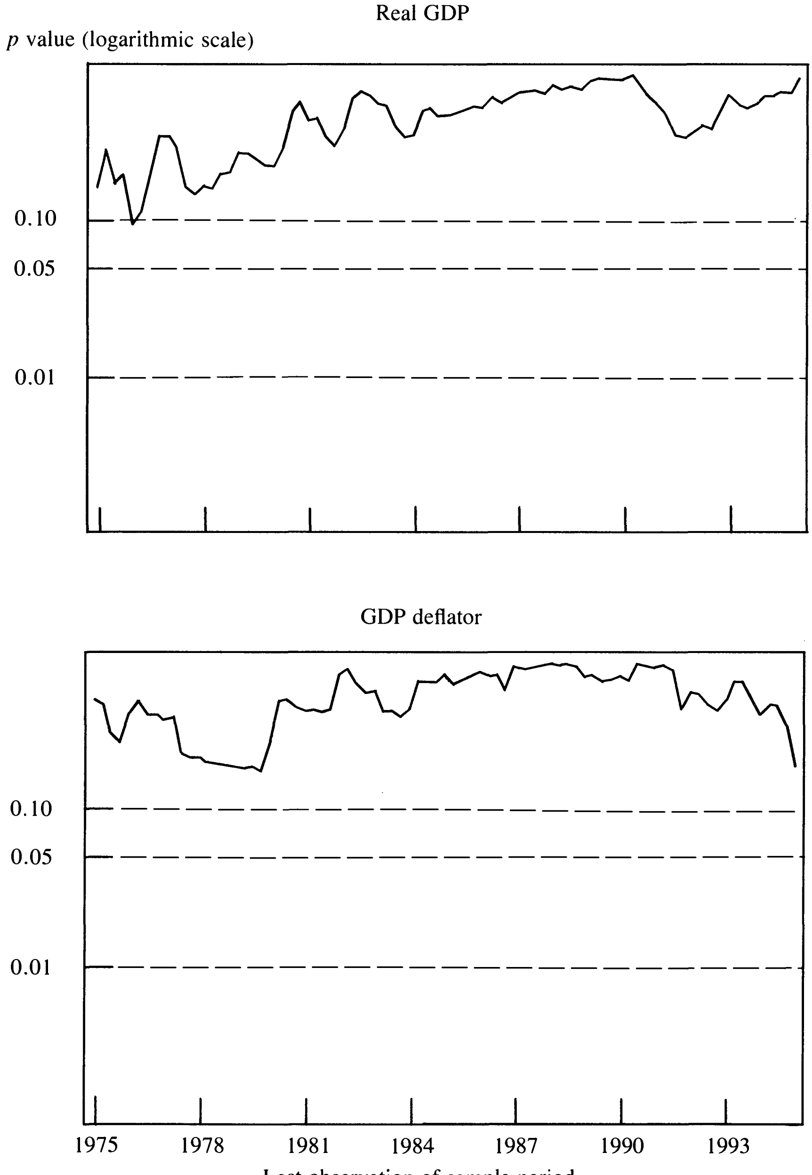
22. Stock and Watson (1989), among others, argued that also including a time trend in the regression restored the predictive content of M1 with respect to output in this kind of regression, but Friedman and Kuttner (1993) show that this result depends on the use of a specific interest rate. Stock and Watson's result also disappears when the sample is extended beyond 1985.

Figure 5. Contribution of M2 to Output and Price Variance[a]



Source: Authors' calculations, using the data sources for figure 3.
a. See figure 3

Figure 6. Significance of M2 in Predicting Output and the Price Level[a]



Source: Authors' calculations, using the data sources for figure 3.
a. See figure 4.

presented for M1 in figures 3 and 4, respectively. In figure 5 the percentage of the subsequent variation of *output* explained by M2 is consistently significant (by the weak criterion of the one-standard-error band) as seen from all vantage points from 1977 through 1989, and again (surprisingly) after 1991—although then the estimated percentage is generally smaller. By contrast, M2 accounts for only a small and insignificant percentage of the subsequent variation of *prices* throughout. As figure 6 shows, however, with the exception of a solitary vantage point at the end of 1975, the predictive content of M2 with respect to *output* as measured directly from the differenced autoregression is never significant, even at the 0.10 level, and the directly measured predictive content of M2 with respect to *prices* is never significant, even at the 0.10 level.

Whether money does or does not have predictive content with respect to output or prices is essential to assessing whether the use of money growth targets, or even the use of money as an information variable, constitutes a potentially effective strategy under which to carry out monetary policy. Policymakers need not have been tracking estimated relationships of exactly the same form as those reported in figures 3 and 4 for M1 and figures 5 and 6 for M2, but to the extent that these results, based as they are on data only up through specific points in time, provide an indication of whether money did or did not have such predictive content, that kind of evidence—or lack of it—at least *should* have been an important factor in the central bank's choice of monetary policy strategy.

For the most part, the Federal Reserve System's use and disuse of money growth targets as guidelines for U.S. monetary policy over the past twenty years appears to have been roughly consistent with what this changing evidence on money-output and money-price relationships has warranted. The evidence presented in the first section of this paper suggests that, with some notable exceptions, money growth targets have been a visible influence on U.S. monetary policy actions primarily at times when at least some forms of evidence (although certainly not all) on these money-output and money-price relationships have appeared to justify it. More obvious, the Federal Reserve's turning away from money growth targets has been entirely consistent with what the evidence on these changing relationships has warranted.[23] The Federal

23. See Friedman (1996) for a detailed evaluation of changes in the Federal Re-

Reserve's actions in this regard are aptly summarized by former Bank of Canada governor John Crow's often quoted description of the Canadian experience: "We didn't abandon the monetary aggregates; they abandoned us."

Why Did Money Lose Its Predictive Content?

Whether or not U.S. monetary policymakers were right to respond to the change in the observed relationship of money to output and prices by deemphasizing their money growth targets, for purposes of this paper the more pertinent question is why these key relationships changed as they did. Four potential explanations—more seriously, only three—are familiar from long-standing discussions centering on these issues.

HYPOTHESIS 0: STABLE MONEY GROWTH. The most obvious reason why fluctuations in money could in principle have ceased to predict subsequent movements in either output or prices is that money itself (or its growth rate) could have ceased to fluctuate. Traditional advocates of stable money growth rules have always maintained that the ideal world would indeed be one in which money had zero correlation with both output and prices—but therefore also one in which the variation *of output and prices would be much less than would have been the case* if money also varied. In terms of Milton Friedman's classic argument against activist policy, the variance of output (or prices) σ_X^2 can be expressed as

$$\sigma_X^2 = \sigma_Z^2 + \sigma_M^2 + 2\rho\sigma_Z\sigma_M, \quad (5)$$

where σ_M^2 reflects that part of σ_X^2 due to variance of money (or its growth rate), σ_Z^2 the part of σ_X^2 due to factors independent of the variation of money, and ρ the correlation between these two components. Friedman's point was that fixed money growth would immediately eliminate both σ_M^2 and the covariance term, leaving σ_X^2 simply equal to σ_Z^2.[24]

serve's reliance on money growth targets in light of evidence corresponding to that presented in figures 3–6.

24. Friedman (1953). Friedman also went on to show that *if* the central bank attempts to offset shocks from other sources *fully* (so that $\sigma_M^2 = \sigma_Z^2$), activist policy is stabilizing only if $\rho < -1/2$. This result has often been misunderstood, however, and its importance consequently overstated. In the presence of uncertainty, the optimal activist policy is to

As figure 7 shows, however, the disappearance of the predictive content of money with respect to income and prices is certainly not due to a smaller variance of money growth. The quarterly moving-average standard deviation of M1 growth, measured with a ten-year window, increased dramatically at the beginning of the 1980s and kept on increasing—just as the predictive content was vanishing, as shown in figure 3. The moving-average standard deviation of M2 growth behaved more irregularly over this period, but there is no evidence of a systematic trend toward smaller variance.

A closely related analog to Milton Friedman's idea also suggests a reason why—again, in principle—money might have lost its predictive content. To recall, the vector autoregression methodology underlying the results reported in the previous section infers the consequences of fluctuations in money solely from the innovations by which money departs from whatever is its typical systematic relationship to prior values of the other variables in the system.[25] The F tests underlying figures 4 and 6 therefore test the *incremental* predictive power of money, over and above that part of the fluctuation of output or prices that is not already predictable from past values of output and prices themselves (and of the interest rate). The variance decompositions reported in figures 3 and 5 likewise refer to the share of the variation of output or prices attributable to the orthogonalized *residuals* in the equation relating money to past values of these same variables. Hence if the observed movements of money consisted entirely of systematic responses to prior movements of output, prices, and the interest rate, then these fluctuations in money might still have large effects on output and prices, but they would be impossible to detect within the standard VAR methodology. (Moreover, because money is ordered after output and prices for purposes of the orthogonalization, the same result follows for systematic responses of money to contemporaneous output and price movements.)

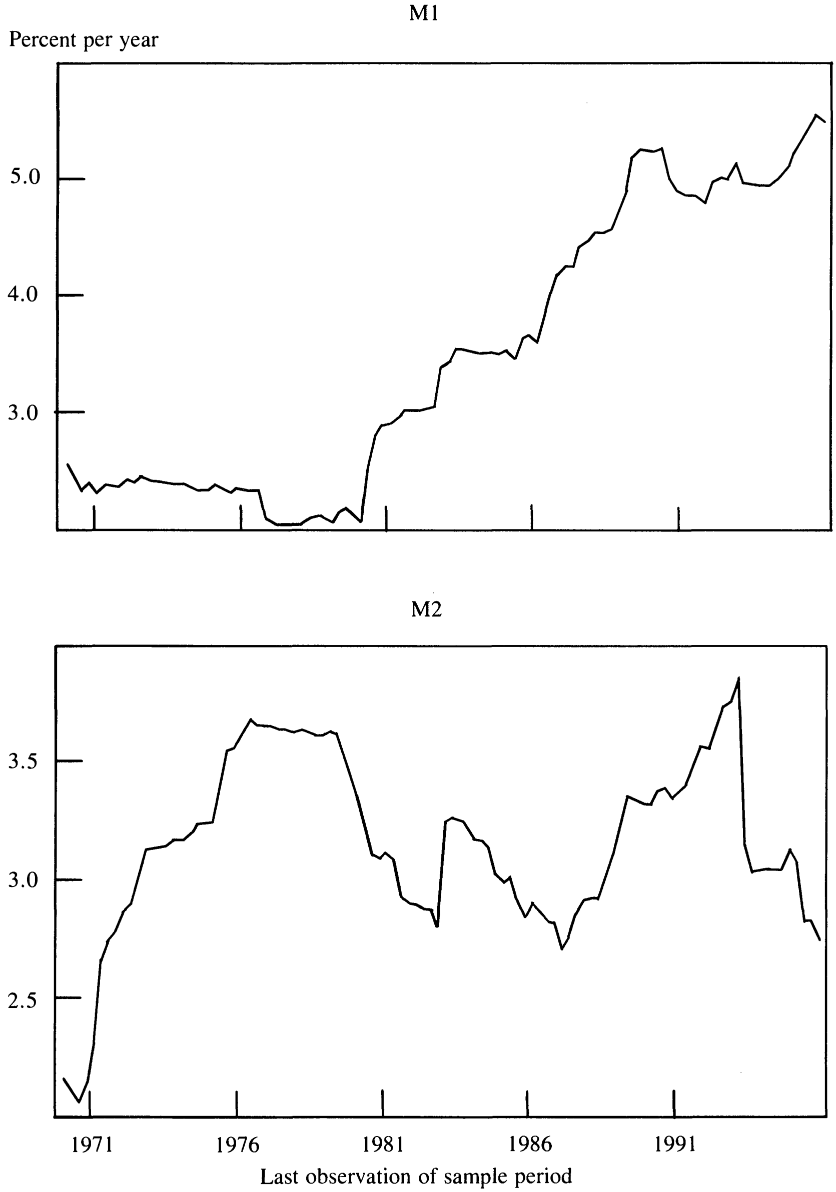
Figure 8 shows that this alternative version of the hypothesis is no more consistent with the facts than the original. For each of the 101

---

offset expected shocks less than fully (that is, $\sigma_M^2 < \sigma_Z^2$), and so ρ need not be so negative as $-1/2$ for policy to be stabilizing; Brainard's (1967) exposition of optimal policy under uncertainty, though couched in different terms, in effect makes this point.

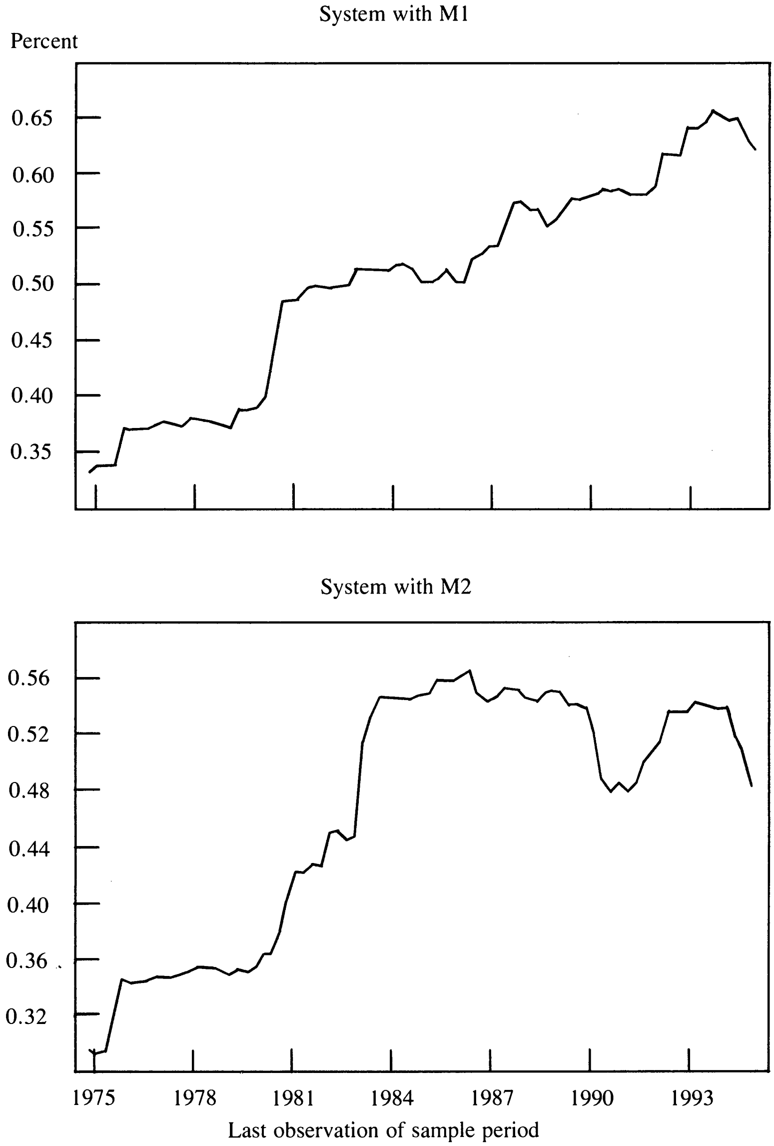
25. This point again stems from the nature of the VAR methodology, which can provide evidence only on chronological precedence, not causation; see footnote 16.

Figure 7. Standard Deviation of Nominal Money Growth[a]



Source: Authors' calculations, using the data sources for figure 3.
a. Moving-average standard deviation based on a forty-quarter window.

Figure 8. Standard Deviation of Orthogonalized Money Residuals[a]



Source: Authors' calculations, using the data sources for figure 3.
a. Based on the VARs used for figures 3 and 5; see notes to those figures.

samples used in constructing figures 3–6, the respective panels of figure 8 plot the standard deviation of the orthogonalized M1 or M2 innovations. In this case, instead of shrinking as the predictive content of money disappears, the nonsystematic variation of both M1 and M2 becomes much larger. The standard deviation nearly doubles over time for both innovation series.

HYPOTHESIS 1: STABILIZATION POLICY. A quite different potential explanation, which is also implicit in Milton Friedman's idea, is that money has lost its predictive content not because the Federal Reserve has abandoned the attempt to stabilize the economy but because it has largely succeeded in doing so. As equation 5 immediately shows, fluctuations in money growth will have an observable effect on output or prices if they are independent of the influence on these variables due to whatever forces are represented within σ_Z^2—for example, shocks to aggregate demand or aggregate supply. By contrast, if the central bank accurately anticipates those independent influences and varies money growth so as to offset them (that is, $\rho < 0$), then standard regression methods may underestimate the effect due to money, or miss it altogether, or possibly even estimate the wrong sign for it.

In principle, this situation is just what vector autoregression—or, for that matter, partial regression, as opposed to simple correlation—is meant to address. The problem, however, is that no simple regression system includes all relevant variables. As Stephen Goldfeld and Alan Blinder and, more recently, William Poole have pointed out, if the central bank varies money growth because it is seeking to offset some disturbance to output or prices that is *not* captured by the system's other variables, then the regression will underestimate the effect of the change in money growth, and in the limit it would find zero effect.[26] Worse yet, if the central bank seeks to offset such disturbances only in part, as is optimal in the presence of uncertainty, then the regression would even imply the wrong sign for the effect of money growth on output and prices. (In the case of a positive aggregate demand shock, for example, money would be smaller but subsequent output larger. For an adverse aggregate supply shock, money would be smaller but subsequent prices higher.)

Establishing whether or not increasingly effective stabilization policy

26. Goldfeld and Blinder (1972); Poole (1994).

by the Federal Reserve was responsible for the disappearance of the predictive content of money clearly requires an empirical approach that goes beyond the unstructured vector autoregression underlying the results presented in the previous section. In particular, some more structured analysis is necessary to distinguish the different behavioral disturbances that lie behind the residuals in the unstructured VAR.

HYPOTHESIS 2: UNSTABLE MONEY DEMAND. Any notion that money covaries positively and systematically with output or prices—regardless of whether that covariation is taken to be causal or not—implicitly begins from the assumption of a stable functional demand for money. As an enormous empirical literature has documented, however, during the last twenty years or so the demand for money (however defined) in the United States has been far less closely and consistently related to income, prices, interest rates, and the other usual variables suggested by the standard theory of the demand for cash balances. Familiar candidate explanations for this increased instability include the effects of advances in data processing technology, deregulation, innovations in forms of deposit holding (prompted, in part, by both deregulation and changing technology), sharply increasing and then decreasing price inflation, increasingly integrated global financial markets, and so on.[27]

When money demand is unstable, observed fluctuations in money need not anticipate subsequent movements of output or prices. Faster money growth, for example, could simply mean that the public is choosing to hold larger deposits in place of other forms of wealth holding for reasons unrelated to its spending or production decisions (and, of course, that monetary policy is allowing this greater money demand to boost the observed money stock). This problem is likely to be especially severe in a modern financial system that offers myriad forms of liquid instruments, of which only an arbitrary subset is defined as any particular measure of money like M1 or M2.

As in the case of hypothesis 1, establishing whether increasing instability of money demand is what has caused observed money to lose its predictive content with respect to income and prices requires some kind of structural methodology. More specifically, the money residuals estimated in an unstructured VAR do not necessarily represent money

27. Two well-known reviews of this vast literature are Judd and Scadding (1982) and Goldfeld and Sichel (1990).

demand shocks alone, and to test this hypothesis it is necessary to identify the distinct money demand shock component.

HYPOTHESIS 3: INEFFECTIVE MONETARY POLICY. Finally, a view that has recently become popular in many nonacademic discussions of monetary policy is that modern economies, in particular their financial systems, have evolved to the point that the central bank's actions have little influence over economic activity anyway.[28] The basic claim is that with ever more institutions able to advance credit and even issue deposit-like instruments without having to hold reserves at the central bank—familiar examples are brokerage firms, money market mutual funds, nonbank finance companies, and, in some cases, even insurance companies—the central bank's position at the apex of the fractional reserve banking system is no longer relevant. Numerous empirical researchers have attempted to test this view, and the evidence has mostly not supported it.[29] Even so, it bears examination here as yet one more possible reason why money has lost its predictive power with respect to output and prices.

This explanation, too, requires a more structural approach to test it. In parallel with the need to distinguish the unstructured VAR's money residuals from behavioral money demand shocks, what is needed here is to identify the structural shocks due to the central bank's independent monetary policy actions and the real economic consequences of those shocks.[30]

Testing the Three Structural Hypotheses

What is needed, then, is an analytical framework that is capable of identifying, from the output-prices-money–interest rate autoregression system presented above, structural disturbances corresponding to aggregate demand (or, IS) shocks, aggregate supply shocks, money demand shocks, and monetary policy shocks. With a four-variable vector

28. See, for example, the lengthy survey aptly entitled "Who's in the Driving Seat?," published in the *Economist*, October 7, 1995.

29. See, for example, Akhtar and Harris (1986), Bosworth (1989), and Friedman (1989).

30. The same identification objective underlies, for example, Romer and Romer's (1989) use of nonquantitative data drawn from the minutes of Federal Open Market Committee meetings.

autoregression, and hence a residual variance-covariance structure made up of ten distinct elements, six restrictions are needed to render the system "just identified" in this way.

Figures 9 and 10 plot the moving-average standard deviations of these four structural shocks—aggregate demand, aggregate supply, money demand, and monetary policy—derived by applying the following set of six restrictions suggested by Jordi Gali for exactly the four-variable system used here.[31] First, as initially suggested by Olivier Blanchard and Danny Quah, none of the three demand-side disturbances—those to aggregate demand, money demand, or monetary policy—has a *long-run* effect on the level of real output (three restrictions).[32] Second, neither money demand disturbances nor money supply disturbances have a *within-quarter* effect on real output (two restrictions). And third, the demand for money is such that demand for real balances depends on real output and the nominal interest rate (equal to inflation plus the implied real interest rate), but not on either inflation or the real interest rate separately (one restriction).[33]

As Gali demonstrates, with these six restrictions the four-variable system estimated previously can be interpreted as consisting of an aggregate demand equation (or IS curve), an aggregate supply equation, a money demand equation, and an equation representing the within-quarter relationship among the interest rate, money, output, and prices. Following the discussion and evidence above, this fourth relationship readily bears interpretation as a "monetary policy" equation.

The four-variable system underlying the results plotted in figures 9 and 10 also follows Gali by specifying the autoregression in terms of the growth rate of real output (Δx), the change in the federal funds rate (Δr), the level of the federal funds rate minus the growth rate of prices ($r - \Delta p$) (in other words, the level of the real interest rate), and the growth rate of money minus the growth rate of prices ($\Delta m - \Delta p$).[34] This normalization is consistent with treating each of the four underlying

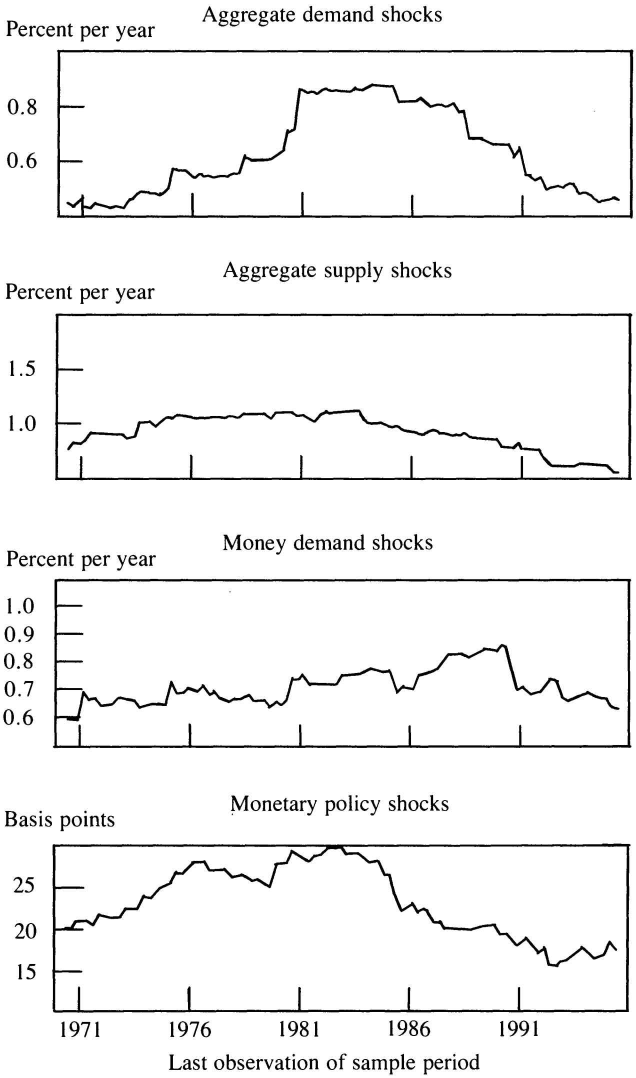
31. Gali (1992).

32. Blanchard and Quah (1989).

33. Gali also suggests two potential alternatives to this sixth restriction—that monetary policy does not respond contemporaneously to real output, and that monetary policy does not respond contemporaneously to inflation—but both are contradicted for quarterly time aggregation by the results presented in the first section of this paper, based on monthly data.

34. All growth rates are calculated as log changes.

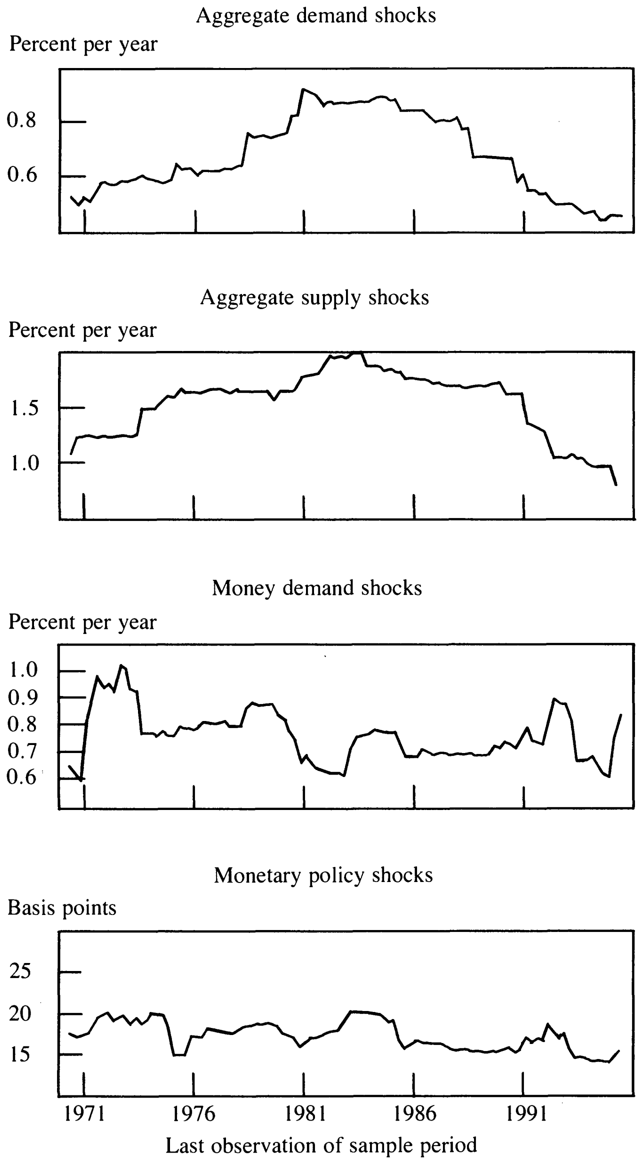
Figure 9. Standard Deviation of Structural Shocks, System with M1[a]



Source: Authors' calculations, using the data sources for figure 3.

a. Based on a structural VAR that includes log differences of real GDP and real balances, the change in the federal funds rate, and the difference between the level of the federal funds rate and the log-differenced implicit GDP deflator, with four lags on each variable. Data are quarterly. The structural decomposition uses the covariance matrix computed over a forty-quarter rolling window. Further details on the identifying assumptions and estimation procedure are provided in the text.

Figure 10. Standard Deviation of Structural Shocks, System with M2[a]



Source: Authors' calculations, using the data sources for figure 3.
a. See figure 9.

variables—output, inflation, money growth, and the interest rate—as stationary in first differences. It also implies that the nominal interest rate and the inflation rate are cointegrated (so that the real interest rate is stationary), as well as that nominal money growth and inflation are cointegrated (so that the growth of real balances is stationary).[35]

One way of capturing the variation over time that is the focus of interest in this paper would be to follow the method used in deriving the unstructured VAR results presented in the second section—that is, to estimate the *structural* VAR separately over the same eighty-one sample periods and, in a manner directly analogous to the exercise underlying figure 8, examine the resulting eighty-one structural variance-covariance estimates given by applying the Gali restrictions. The alternative procedure used here, in the interest of conserving degrees of freedom, is to estimate the underlying vector autoregression only once, using quarterly data for 1960:2–1995:2, but then to perform separately the decomposition of the estimated VAR residuals into the four structural disturbances using a rolling ten-year window.

The obvious shortcoming of this procedure is that it holds the coefficients on the *lagged* variables constant over the entire thirty-five-year period. The benefit, however, is that the smaller number of parameters to be estimated permits the use of a shorter window than in the earlier results (forty quarters versus eighty, but even using twenty is now a possibility) for estimating the *contemporaneous* relationships between the model's variables and the disturbances. Especially since the contemporaneous relationships embody most of the model's structural content, the trade-off seems well worthwhile. Figure 9 plots the resulting moving-average standard deviations for the system based on M1 growth, and figure 10 does the same for the system relying on M2 growth.

The most obvious lesson conveyed visually by the changing standard deviations of these structural disturbances is simply that they do indeed change over time—and, most important for purposes of the implications of familiar ways of analyzing alternative policy regimes, they change relative to one another. In the system where money growth is defined as M1, aggregate demand shocks became sharply more variable in the late 1970s, only to decline in variability, albeit more gradually, a dec-

35. See Gali (1992) for evidence and discussion in support of these stationarity assumptions. Jordan and Lenz (1996) show that assumptions about stationarity matter importantly for the results in exercises of this kind.

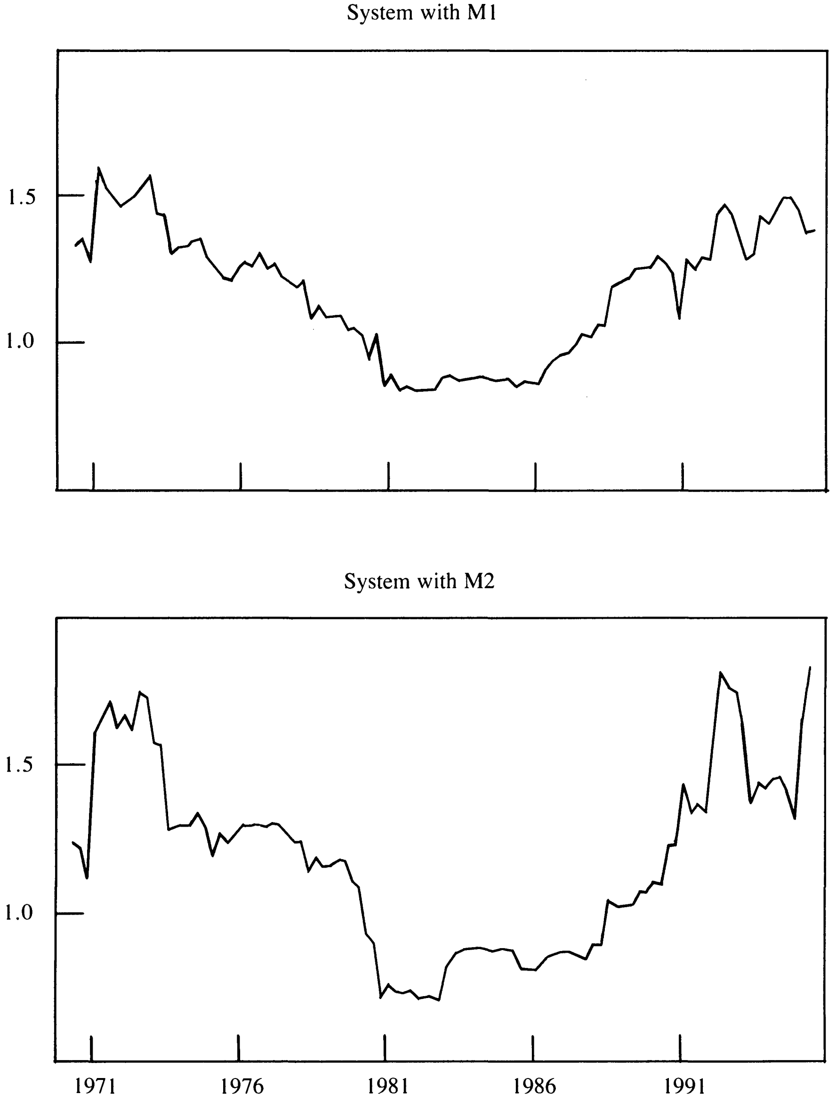
ade later. (The dates shown on the horizontal axis give the *end* of the rolling ten-year window.) Aggregate supply shocks became more variable with the first OPEC price increase in 1973, remained highly variable through the early 1980s, and since then have steadily declined in variability. Money demand shocks behaved irregularly until the early 1980s, but then became progressively more variable throughout the decade, before this variability also declined in the 1990s. Monetary policy shocks irregularly increased in variability until the early 1980s, and since then have become steadily less variable.

What matters for most analyses of alternative policy regimes is not just the absolute variability of any particular source of uncertainty but the variability of one kind of disturbance relative to another. In terms of Poole's classic analysis, for example, whether it is better to fix money growth (in a simple model in which it is feasible to do so) or an interest rate depends, in part, on the *relative* variability of aggregate demand shocks and money demand shocks (in Poole's model, IS shocks and LM shocks, respectively).[36] As the top panel of figure 11 shows, while at first they declined in variability relative to aggregate demand shocks, since the mid-1980s M1 money demand shocks have sharply increased in variability relative to aggregate demand shocks. The ratio of standard deviations for ten-year windows ending in the early 1990s is nearly double that for windows ending in the first half of the 1980s. While the correspondence is not precise, comparison of the top panel of figure 11 with either panel of figure 3 provides support for hypothesis 2 among the different possibilities suggested in the previous section: that increasingly unstable money demand has been at least partly responsible for the disappearance of the predictive content of M1. (An analogous plot of the standard deviation of money demand shocks relative to that of aggregate supply shocks would show roughly the same pattern, especially from about 1980 onward.)

Figure 10 and the lower panel of figure 11 tell approximately the same story for the system based on M2. In this representation also, aggregate demand shocks were first more variable and then less so. Aggregate supply shocks have become less variable since the early 1980s, and especially so in the early 1990s. The variability of money demand shocks has changed more irregularly, but the first few years of

36. Poole (1970).

Figure 11. Ratio of the Standard Deviation of Money Demand Shocks to the Standard Deviation of Aggregate Demand Shocks[a]



Source: Authors' calculations, using the data sources for figure 3.
a. See figure 9.

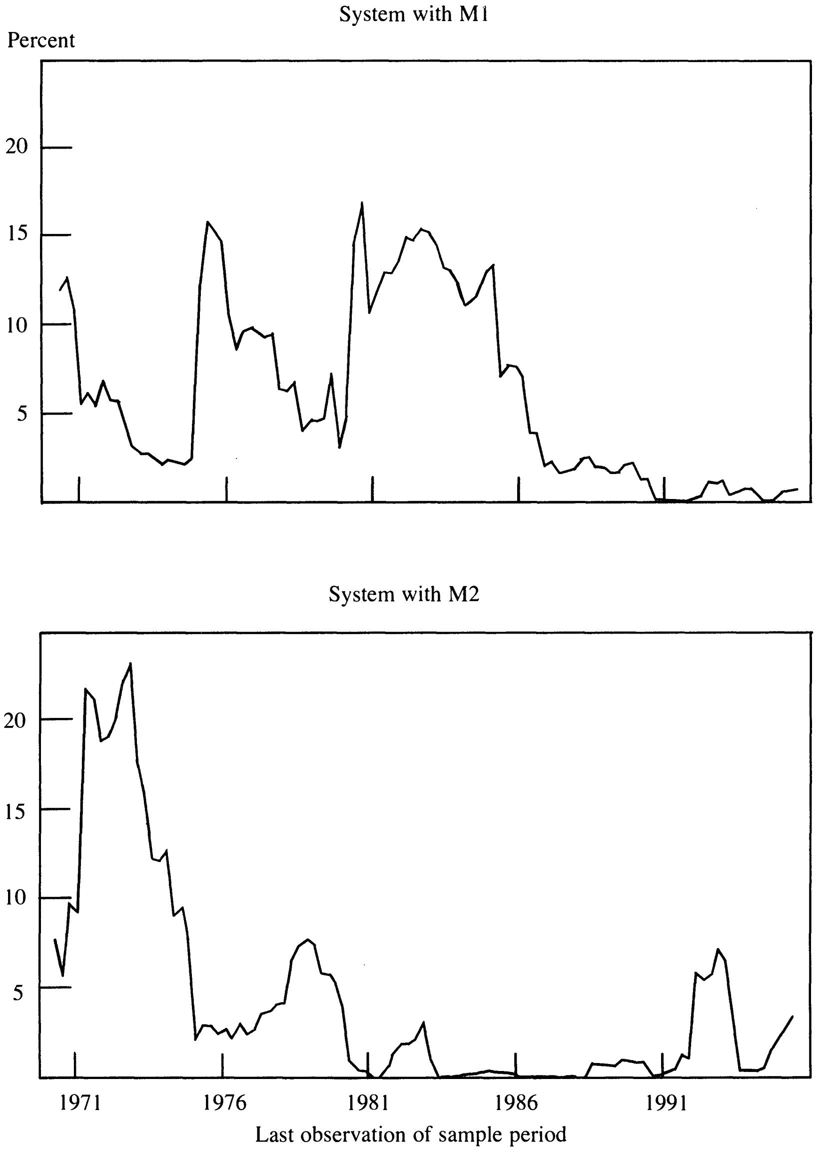
the 1980s clearly marked a low point and the first few years of the 1990s a high point. The ratio of the respective standard deviations of money demand shocks and aggregate demand shocks (lower panel of figure 11) again shows a relative movement very like what happened in the case of M1. Comparing this ratio to either panel of figure 5 again provides support for hypothesis 2, which attributes the declining predictive content of money to increased instability of money demand.

What about the other two hypotheses advanced in the previous section? A sharp implication of hypothesis 1, which posits deliberate stabilizing variation of money to offset shocks originating from other sources, is that those other nonpolicy shocks should be playing a greater role in determining observed money growth. The evidence from the relevant variance decompositions, shown in figure 12, directly contradicts this proposition, however. The percentage of the variation of observed M1 growth attributable to aggregate demand shocks at a four-quarter horizon was at its peak (which, even so, was only 17 percent) in 1980—when M1 did have modest predictive content—and since the mid-1980s it has declined to nearly zero. The analogous percentage of the variation of M2 growth explained by aggregate demand shocks was larger in the early 1970s, but since then it has been quite small throughout (note the difference in scale between the upper and lower panels), and it was nearly zero during much of the 1980s. Comparing the upper and lower panels of figure 12 to figures 3 and 5, respectively, hardly generates confidence in hypothesis 1.

The basic assumption underlying hypothesis 3, which posits a diminished ability of the Federal Reserve to influence economic activity because of institutional changes in the financial system, is that monetary policy shocks have had a diminishing impact on output. The evidence from the relevant impulse responses does provide some support for this proposition, albeit only for the few most recent years. The respective panels of figure 13 show the variation over time in the impact of a constant-value monetary policy shock (a 100 basis point decline, where the equation is normalized on the federal funds rate) on the *level* of output (hence the cumulation of the effect on output growth due to the monetary policy shock) at an eight-quarter horizon. Analogous results for a four-quarter horizon are highly similar.

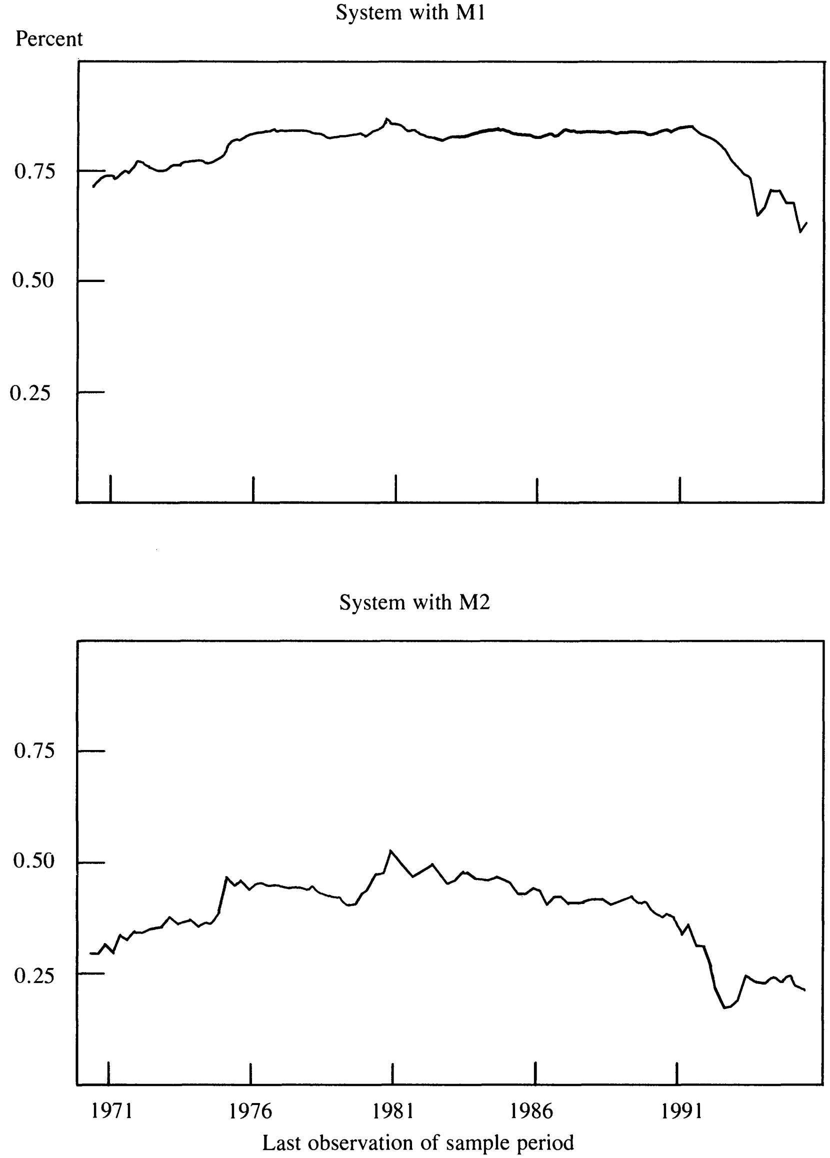
For the system based on M1, the effect of a 100 basis point monetary policy shock on the level of output was roughly unchanging, at about

Figure 12. Contribution of Aggregate Demand Shocks to the Variance of Money Growth[a]



Source: Authors' calculations, using the data sources for figure 3.
a. Based on eight-quarter-ahead variance decompositions from the VAR described in figure 9, note a.

Figure 13. Response of Real GDP to a 100 Basis Point Monetary Policy Shock[a]



Source: Authors' calculations, using the data sources for figure 3.
a. Based on eight-quarter-ahead impulse response functions from the VAR described in figure 9, note a.

0.8 percent, until the early 1990s, when that impact decreased to slightly over 0.6 percent. In the system based on M2, the impact on output from a 100 basis point monetary policy shock varied irregularly around an average value of roughly 0.4 percent until the early 1990s and more recently it has averaged approximately 0.25 percent. Especially for M1, the timing of the decline does not match that of the vanishing predictive content of money with respect to real output (see figures 3 and 5). Even so, these results do provide some limited support for hypothesis 3.

In sum, the evidence drawn from this more structured analysis of the four-variable autoregression system suggests that increasing instability of money demand is the most consistent explanation for the fact that, sometime during the mid- to late 1980s, fluctuations in money growth ceased to anticipate subsequent fluctuations in either output or prices. The change in empirical relationships that presumably led the Federal Reserve to abandon its money growth targets, notwithstanding that the Congress's Concurrent Resolution 133 remained in force, was therefore not merely a creation of the Federal Reserve's own policy regime as hypothesis 1 (and hypothesis 0) implies. In abandoning money growth targets, the Federal Reserve was therefore not just "chasing its tail," as wistful defenders of these targets have suggested. Changes in objective conditions—new technology, deregulation, new forms of deposit holding, globalization, and so on—over time eroded the main behavioral prop that had always underpinned the idea of basing monetary policy on money growth targets: stable money demand. The Federal Reserve simply reacted accordingly.

More General Lessons about Monetary Policy Rules

What lessons do these conclusions provide for a regime that would dedicate U.S. monetary policy to a price stability target?

The currently pending Economic Growth and Price Stability Act, which is sponsored by the chairman of the Joint Economic Committee and was cosponsored by the then Senate majority leader, gives the Federal Reserve System two basic monetary policy instructions: "(1) establish an explicit numerical definition of the term 'price stability'; and (2) maintain a monetary policy that *effectively promotes long-term* *price stability*'' (emphasis added).[37] The proposed bill specifically repeals the Full Employment and Balanced Growth Act of 1978, which constitutes the current congressional instruction on monetary policy. It also explicitly amends the Employment Act of 1946, insofar as that legislation applies to monetary policy.

For purposes of comparison, the section of the current Federal Reserve Act (as amended under the Full Employment and Balanced Growth Act) that the pending bill proposes to replace by the language quoted above instructs the Federal Reserve to ''maintain long run growth of the monetary and credit aggregates commensurate with the economy's long run potential to increase production, *so as to promote effectively the goals of maximum employment, stable prices, and moderate long-term interest rates*'' (emphasis added).[38]

Reading the current and the proposed language together makes clear that what is new in the pending bill is not that the Federal Reserve would be instructed to seek price stability, but that it would be instructed to seek *only* price stability.[39] A subsequent section of the pending bill also instructs the Federal Reserve to ''take into account any potential short-term effects on employment and output,'' but this section refers to the initial transition to price stability, presumably from a starting point of positive inflation.[40] Moreover, the specific injunction to pursue ''*long-term* price stability'' presumably means that, after this initial transition, any episodes of price increase are to be offset by subsequent episodes of absolute price decline. Unlike in the more general case of a period-by-period inflation target, a target of long-term price stability means that bygones are not simply bygones.

Setting a target for a variable like prices that constitutes an ultimate goal of monetary policy is, of course, not the same as setting an intermediate target for a variable like money. In terms of Guy Debelle and

37. *Economic Growth and Price Stability Act of 1995*, S. 1266, 104 Cong. 1 sess. (GPO, 1995), p. 4.

38. *Federal Reserve Act*, sect. 2A, para. 1, in *Federal Reserve Act and Other Statutory Provisions Affecting the Federal Reserve System* (Washington: Board of Governors of the Federal Reserve System, 1988).

39. The proposed bill would also eliminate the instruction to formulate monetary policy in terms of money (and credit) growth targets. As the evidence discussed in earlier sections of this paper indicates, this change is well warranted and has already been implemented by the Federal Reserve, even while the existing instruction remains in force.

40. *Economic Growth and Price Stability Act of 1995*, pp. 5–6.

Stanley Fischer's useful taxonomy, ''goal independence'' and ''instrument independence'' differ in ways that are important in principle and potentially important in practice.[41] Legislating targets like price stability, or maximum employment, or stability of the banking and financial system, means that the higher authority to which the central bank is responsible is defining what contribution monetary policy is expected to make to the nation's economic well-being. By contrast, under a legislated interest rate rule or reserves rule, that higher authority is telling the central bank not only what objectives to achieve but also how, operationally, to go about doing so. Legislating a target for a variable like money growth represents an intermediate stage, but over time horizons long enough to render money growth controllable, it too means that the central bank does not have instrument independence.

As Debelle and Fischer and others have shown, there is a good case for giving the central bank instrument independence but not goal independence. No legislated rule governing the instruments of monetary policy can plausibly take account of the vast range of unforeseeable circumstances to which actual central banks need to respond on a real-time basis, including just the kind of changes in empirical relationships that the evidence presented in this paper documents for the United States. And as this U.S. experience demonstrates, legislated targets for intermediate variables like money growth suffer from the same shortcoming. By contrast, for monetary policy to pursue basic goals determined by the higher governmental authority that is the ultimate source of the central bank's political legitimacy—under the U.S. Constitution, that means the Congress—is no more than what is consistent with the fundamental principles of a democracy.

Merely drawing the distinction between goal independence and instrument independence, however, does not constitute an argument that a price-stability target—or, for that matter, any other specification of goals—is necessarily a good way to conduct monetary policy. To the contrary, several well-known analyses have shown that a price-stability target makes good sense for monetary policy under some conditions, but not others. The usual conclusion is that when wage rates are not fully flexible, holding prices stable is not optimal in the presence of supply shocks that represent disturbances to productivity. By contrast,

41. See Debelle and Fischer (1994).

holding prices stable may be optimal under some circumstances as long as the disturbances to the economy consist entirely of demand shocks of one kind or another.

Joshua Aizenman and Jacob Frenkel, for example, demonstrate the nonoptimality of a strict stable-price monetary policy in a static model in which supply shocks are explicitly productivity shocks and the basic impediment that prevents the economy from reaching the correct post-shock equilibrium is inflexible wages.[42] Simply put, the argument is that this new equilibrium warrants a changed real wage (higher after a favorable productivity shock, lower after an adverse shock). But if wages are not fully flexible, holding prices stable prevents the real wage from adjusting as it should.

For example, a large literature has compared the more favorable growth and employment experience of the United States to the less favorable European experience in the years following the OPEC oil shocks of 1973 and 1979, in just the manner suggested by this line of analysis. To be sure, part of the difference between the respective post-OPEC experiences of the United States and Europe stems from differences in labor market institutions. But the message of Aizenman and Frenkel's analysis, and the host of similar models, is that the U.S. experience would have been very different had the price level not been able to adjust. In particular, given the downward rigidity of nominal wage rates, an increase in the price level was necessary to bring about lower real wages in line with the adverse productivity shock due to OPEC.[43] Under a price stability target, the Federal Reserve would have had to pursue a sufficiently tight monetary policy to prevent that rise in prices, thereby also preventing the downward reduction in real wages that kept such a large fraction of the U.S. labor force employed. And if prices had risen anyway (nobody pretends that the central bank has perfect control over the price level in the short run), the no-bygones character of a *long-term* price stability target means that the Federal Reserve would have had to maintain this tight policy long enough to drive the price level back down.

In making arguments like these it is important to be clear that what enables an economy to adjust to supply shocks is not a new permanent

42. Aizenman and Frenkel (1986).

43. See the evidence reviewed by Akerlof, Dickens, and Perry in this volume on the downward rigidity of nominal wages in the United States.

level of inflation but rather a once-and-for-all change, up or down, in the price level. (In principle, there could perhaps be a permanent stream of productivity shocks, but that idea strains the notion of a shock.) This distinction cannot be explicit in static models like that of Aizenman and Frenkel, but it is so in Kenneth Rogoff's dynamic model.[44] Here again, what makes holding to a price stability policy target suboptimal is shocks to productivity when wage rates are not fully flexible.

Rogoff's main result is that while placing a large weight on inflation stabilization relative to employment stabilization reduces the long-run average rate of inflation associated with the time inconsistency problem, doing so "suboptimally raises the variance of employment when supply shocks are large."[45] While the optimal policy regime therefore places large weight on inflation stabilization, it does not focus *exclusively* on price objectives. Moreover, a *long-run* price stability target, which not only places exclusive weight on prices but also requires that any inadvertent price level changes (for example, in response to supply shocks) be offset by subsequent price level changes in the opposite direction, represents an extreme form of Rogoff's suboptimality.

Evaluating just how serious these problems would be in practice, for the United States or any other country, would require an analytical apparatus well beyond that developed in this paper. As Aizenman and Frenkel, Rogoff, and many others have shown, the crucial comparisons depend not only on the variance-covariance structure of the relevant disturbances but also on the magnitudes of key structural parameters.[46] Moreover, it would also be necessary to distinguish supply shocks that represent disturbances to productivity from supply shocks that merely change the economy's "natural" rate of output without affecting production relationships at the margin.[47] Constructing such a model and then carrying out this kind of exercise—comparatively evaluating a price-stability target, an inflation target, a nominal income target, various mixed inflation-output or inflation-employment targets (for the

44. Rogoff (1985).

45. Rogoff (1985, p. 1169).

46. The same is true in simpler models like Poole's (1970) that incorporate only demand-side disturbances.

47. This distinction emerges especially clearly from the exchange between Bean (1983) and West (1986).

sake of nostalgia, even a money growth target)—would perhaps be a useful endeavor.

But the main lesson of this look back at the Federal Reserve System's experience with money growth targets is that even if the relevant relationships (as seen today) did appear to warrant adopting a price-stability rule, there is little ground for confidence that they would continue to do so over the length of time that would make legislating this or any other monetary policy target sensible. For a while money did have significant predictive content with respect to income and prices, and the Federal Reserve did formulate money growth targets and respond to deviations of observed money from these targets in setting the federal funds rate. The underlying money-output and money-price relationships changed, however—not merely as a consequence of the Federal Reserve's own changed regime, but mostly because money demand became functionally unstable. In other words, a key behavioral disturbance that once appeared quantitatively modest enough to be acceptable (even though qualitatively it was obviously not helpful under a money-growth-target strategy) later became much more volatile, both absolutely and relative to other kinds of shocks.

Hence even if productivity shocks were to look sufficiently small at any given time to warrant adopting a price-stability target—and notwithstanding the declines shown in figures 9 and 10, that case remains to be made—there is no assurance that they would not likewise grow more volatile. If that happened, and if the Congress had legislated a price stability target, the Federal Reserve would once again face the dilemma of either holding to a poorly designed monetary policy framework or disregarding the legal instructions issued by the higher governmental authority to which it is accountable. Neither choice would do much to enhance the cause of responsible monetary policymaking.

Comments and Discussion

Mark Gertler: This paper is really two in one. First, it is a fascinating account of the rise and fall of monetary targeting. Second, it is an attempt to use this experience to evaluate recent proposals to make price stability the main objective of monetary policy.

The main conclusion that the authors reach is a familiar one: in the world that we live in, writing down a tightly specified policy rule is not a realistic option. The problem, of course, is unforeseen structural shocks. In the case of monetary targeting, the culprits are money demand shocks. In the case of price level (or inflation) targeting, they are supply shocks. In the end, the authors seem to argue, discretion is working well, so just stick with it: ''If it ain't broke, don't fix it.''

The authors make a strong case. While I am sympathetic to their sentiments, I am not so sure that the issue is as clear cut as they suggest. Both they and I, as well as many others, believe that the record of U.S. monetary policy over the last fifteen years has been exceptional. But many of us also believe that it was not so good during most of the 1960s and 1970s. If, for example, Friedman and Kuttner had written this paper in 1972 or 1977, would they still have argued in favor of unmitigated discretion? Or would they instead have argued the need for some kind of insurance against another episode of Burns or Miller policymaking?

Put differently, are there no mechanisms available to guarantee that the good aspects of recent policymaking are carried into the future? (After all, Alan Greenspan cannot remain in office forever.) Even if extreme proposals for price level or inflation targeting are unattractive, are there not more moderate versions (for example, medium-term inflation targets with clearly articulated escape clauses) that might do the job? This issue at least deserves serious discussion.

The Rise of Monetary and (Implicit) Inflation Targeting After October 1979. To flesh the matter out, I first present some evidence on the key differences in U.S. monetary policy before and after October 1979. In doing so, I provide a different perspective on the authors' story of the rise and fall of monetary targeting, although one that is quite complementary. I argue that the rise of monetary targeting was symptomatic of a (so far) permanent change in the response of monetary policy to inflation that took place in October 1979. This change appears to have involved the adoption of an implicit form of inflation targeting. While monetary targeting has been effectively abandoned, this kind of implicit inflation targeting remains. Further, it is quite consistent with what I describe below as moderate proposals to target inflation. Whether or not it is advisable to codify a form of this rule is an open question. But before there is any discussion of policy proposals, it is important at least to identify the central features of a monetary policy era that is generally regarded as having been effective.

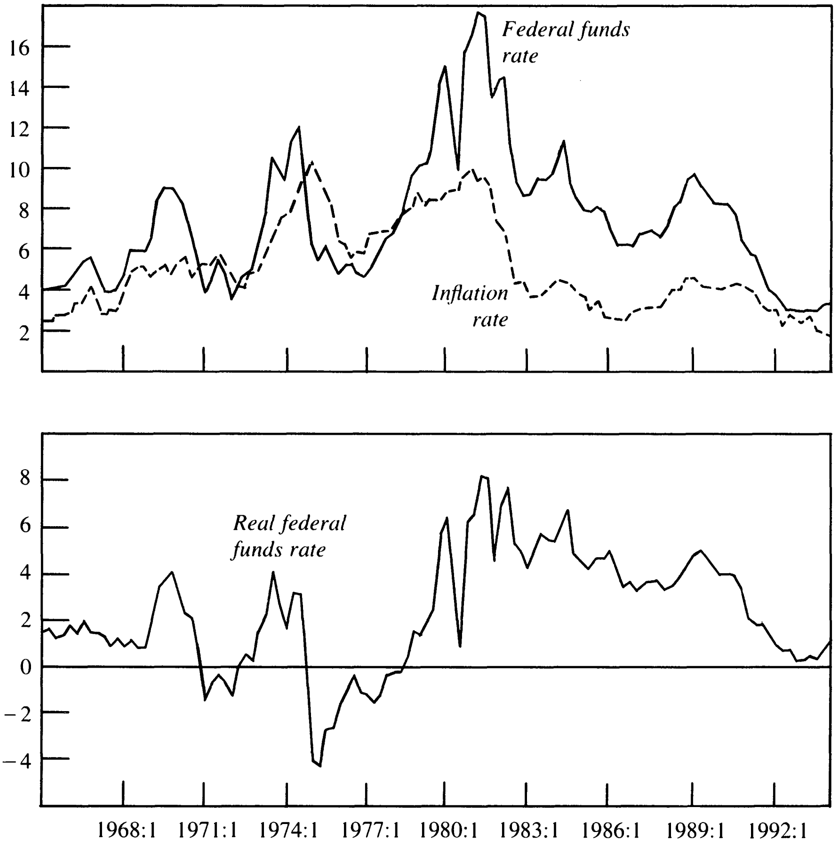
Turning to the data, the top panel of figure A1 plots the federal funds rate and inflation using quarterly data over the period 1965:1–1994:1. Inflation is measured as the percent change in the price level over the previous four quarters. The bottom panel measures the ex post real funds rate, using this measure of inflation.

The graphs strongly suggest a structural break in the funds rate process after October 1979. (Others have made this point formally.) During most of the 1970s, the real federal funds rate was equal to zero or negative. It began to rise sharply in October 1979. While more than monetary policy influences the real interest rate, it surely provides the most logical explanation for the sharp rise in the real federal funds rate around this time. Note, in addition, that small pickups in inflation after October 1979 were met with sharp increases in the funds rate (for example, in 1984 and 1988.) A similar systematic response to inflation is not apparent before October 1979.

Where does monetary targeting fit in? As the authors show, monetary targeting was introduced in October 1979 and remained largely in effect through 1982. (The unusually bumpy behavior of the funds rate over this period is consistent with the introduction of this policy.) As I have suggested above, the move to monetary targeting reflected a fundamen-

Figure A1. Inflation and the Federal Funds Rate

Percentage points



Source: Data on the federal funds rate are from the Board of Governors of the Federal Reserve System release G.13, "Selected Interest Rates and Bond Prices." Inflation is calculated using the GDP deflator of the NIPA.

tal shift in the way the Fed would respond to inflation, as opposed to a mere technical change in operating procedures. The shift in policy was probably based on two considerations. The first was that a money target could provide a nominal anchor for the price level. The second was that such a shift in operating procedures could provide political cover for the nearly 1,000 basis point increase in the federal funds rate that occurred over this period.

To demonstrate formally the change in policymaking, I estimate a variant of Friedman and Kuttner's policy rule that omits the money target and, instead, allows for a break in the coefficients on inflation and the output gap at October 1979.[1] I use quarterly rather than monthly data, and I use the log difference of real GDP from a quadratic trend to measure slackness in the real economy, instead of the authors' unemployment gap. Both these changes make the specification closer, in spirit, to Taylor's familiar rule, thus facilitating comparison with that analysis as well.[2] Finally, like the authors, I include the lagged funds rate to soak up serial correlation that is otherwise present in the data.

The equations below show estimates of the policy reaction function for the whole sample period, 1965:2–1994:1, and for two subsamples, 1965:2–1979:3 and 1974:4–1994:1. The estimates, with standard errors in parentheses, are presented along with calculations of the implied target funds rate (the rate that would arise after full adjustment to the lagged funds rate).

1965:2–1994:1
$$r_t = \underset{(0.28)}{0.07} + \underset{(0.05)}{0.12}\Pi_t + \underset{(0.05)}{0.22}YGAP_t + \underset{(0.04)}{0.91}r_{t-1}$$
$$r_t^0 = 0.78 + 1.27\Pi_t + 2.44YGAP_t$$

1965:2–1979:3
$$r_t = \underset{(0.34)}{0.74} + \underset{(0.07)}{0.08}\Pi_t + \underset{(0.05)}{0.37}YGAP_t + \underset{(0.07)}{0.81}r_{t-1}$$
$$r_t^0 = 3.87 + 0.40\Pi_t + 1.75YGAP_t$$

1979:4–1994:1
$$r_t = \underset{(0.39)}{0.13} + \underset{(0.14)}{0.57}\Pi_t + \underset{(0.07)}{0.14}YGAP_t + \underset{(0.09)}{0.68}r_{t-1}$$
$$r_t^0 = 0.41 + 1.75\Pi_t + 0.44YGAP_t,$$

where $r \equiv$ the federal funds rate; $r^0 \equiv$ the target funds rate; $\Pi \equiv$ the percent change in the price level over the past year times 100; and $YGAP \equiv$ the log difference of output from a quadratic trend times 100.

1. I identify the break in October 1979 on the basis of preliminary work with Richard Clarida. As Alan Blinder noted at the Brookings Panel meeting, there is also some evidence of a change in policy between the tenures of Volcker and Greenspan. This change, however, lies mainly in the response of the federal funds rate to the output gap, rather than to inflation—there was a weaker response to output under Volcker than under Greenspan. Nevertheless, the key point is that it is reasonable to identify the shift in the policy response to inflation as having occurred in October 1979.

2. Taylor (1993).

For the whole sample, the reaction function suggests a modest response to inflation and an aggressive response to the output gap. Once one splits the sample, however, one observes sharp differences across the subperiods. In the first subperiod, the response of the funds rate to a 1 percent rise in inflation is only 40 basis points. This implies that the Fed actually let the real funds rate drop in response to rising inflation, everything else equal. It responded aggressively to the output gap, adjusting the funds rate by 175 basis points in response to a 1 percent change in the output gap. The impression that these estimates gives accords with the popular view that over this period, the Fed placed a high priority on stabilizing the real economy, but paid only limited attention to reining in inflation.

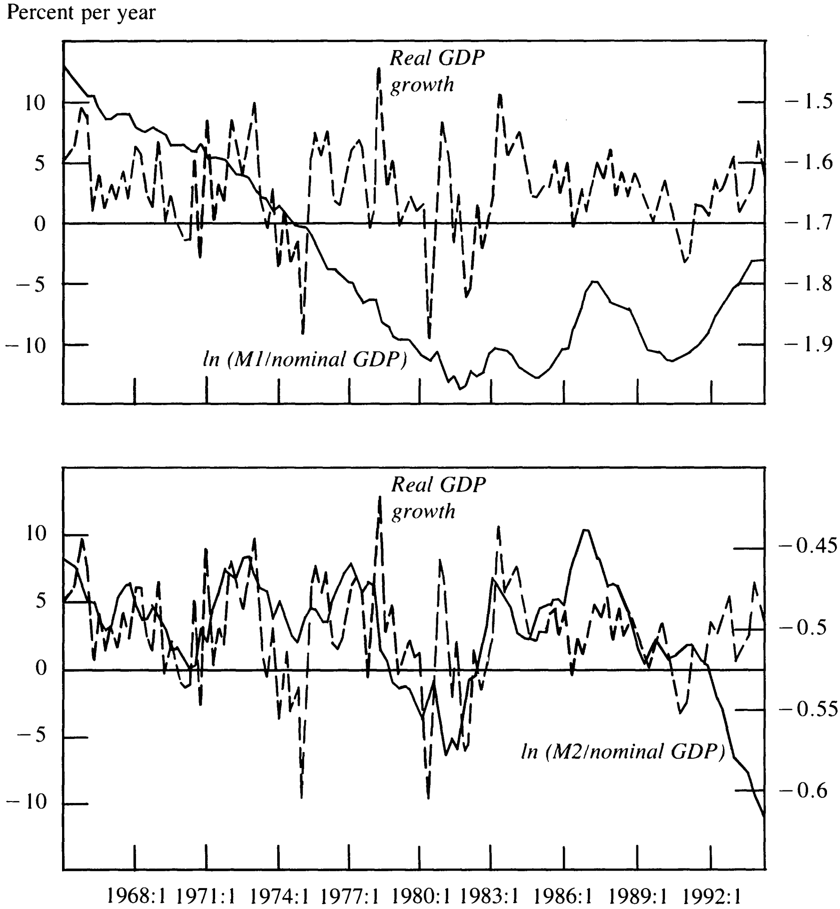
The response to inflation increases sharply in the later subperiod. The target rate rises by 175 basis points in response to a 1 percent increase in inflation, implying a significant, 75 basis point rise in the real rate. The Fed remained responsive to the output gap, but the coefficients drop to 44 basis points. Interestingly, the coefficients on inflation and the output gap are quite close to those with which Taylor characterizes the Greenspan era (150 basis points on inflation and 50 basis points on output).

One can interpret the policy reaction function in the second half of the sample as embedding an inflation target, in the sense that the Fed adjusted the real funds rate to bring inflation back to the desired level. To be sure, the estimated rule also allows for output stabilization. However, since future inflation depends on the output gap today, stabilizing output may be viewed as a preemptive attack on inflation, and thus is compatible with a number of inflation targeting proposals.

The Demise of Monetary Targeting. While implicit inflation targeting has remained a feature of monetary policy since October 1979, the Federal Reserve abandoned monetary targeting relatively soon after its inception. I share the authors' view that the volatile behavior of money demand accounts for the demise of monetary targeting. Again, pictures tell the story. The top panel of figure A2 plots real GDP growth and the log of the ratio of M1 to nominal GDP, or equivalently, minus the log of velocity, over the period 1965:1–1994:1. The bottom panel does the same for M2.

The volatile behavior of M1 velocity is apparent from the plot in the top panel. For much of the pre-Volcker period, M1 velocity increased

Figure A2. Velocity and Real GDP Growth



Source: Data on real and nominal GDP are from the NIPA. Data on the M1 and M2 money stock are from the Board of Governors of the Federal Reserve System release H.6, "Money Stock Measures and Liquid Assets."

sharply; the pace picked up around 1973, as nominal rates began a sharp ascent. Both formal and anecdotal evidence suggests that the Fed had great difficulty in tracking the course of M1 during this period. The change in policy under Volcker only compounded this difficulty. After an initial sharp increase (due to the tightening), M1 velocity reversed course and began to fall. The introduction of interest-bearing M1 accounts (NOW accounts) was responsible for this phenomenon. In 1986 M1 rose sharply as the economy weakened. It is not surprising that the Fed downgraded its M1 target at this time, as the authors report. The shift in the trend of M1 velocity after 1979 that is reflected in the graph explains why the authors find a rise in M1 shocks during this period.

As the bottom panel indicates, there is a fairly tight relation between M2 velocity and real GDP growth until about 1991. This explains why several analysts have found that M2 velocity forecasts output growth well over this period. However, the relation clearly breaks down after 1991. The growth of bond and stock mutual funds sucked assets from M2 accounts, and M2 velocity rose, despite the fact that the economy picked up. The break in the pattern of M2 velocity is consistent with the authors' findings that M2 demand shocks rose during this period.

Moderate Proposals for Targeting Inflation. The breakdown in the M2 relation prompted a search for other nominal anchors in the United States. In this context, proposals to target inflation began to crop up. Friedman and Kuttner concentrate on an extreme version of such proposals that sets a strict target for the path of the price level. I am sympathetic to their skepticism about pure price level targeting. But it is important to recognize that there exists a family of more moderate proposals in this vein, all of which attempt, in one way or another, to meet the kinds of objections raised by Friedman and Kuttner. In the absence of a compelling argument that discretion will always work as well in the future as it does today, these more moderate proposals deserve scrutiny.

The moderate proposals differ from the more extreme versions in the following ways:

—Targeting inflation versus the price level: It is now widely recognized that measurement error induces a positive drift in the major price indexes. The estimated drift in the CPI due to measurement error, for example, is about 1 percent per year. (The main problem lies in accounting for quality improvements.) For this reason, most sensible proposals advocate targeting inflation, as opposed to the price level. The Bundesbank, for example, sets its goal for inflation at 2 percent, in order to allow for measurement error.

—Should bygones be bygones? The extreme policies require that overshooting the target in one year be made up by equivalent undershooting in the next. In theory, it should not be a problem for the Fed to engineer this undershooting, since fully credible disinflations should be painless. Unfortunately, there is no hard evidence to support this theory. Further, supply shocks can cause complications, as the authors duly note.

The moderate inflation target policies, therefore, forgive past errors. After a stated period, the targets are benchmarked anew, without reference to any deviations in the previous period. The length of time over which an inflation rate is to be maintained (for example, one year, or two, or three) varies across plans. The Bundesbank, for example, benchmarks on an annual basis.

—Multiple objectives: A virtue of an explicitly stated inflation goal is that it holds the policymakers accountable. There is little disagreement that the Fed should be held accountable for the medium- and long-term performance of inflation. Yet, while the Fed clearly cannot influence the long-term behavior of the real economy, its decisions do have consequences for short-run behavior. Should it be completely unaccountable for the short-run performance of the real economy? Or, should real short-run performance enter as a weighted objective, along with inflation? These questions involve some complicated considerations.

Again, examining the behavior of the Bundesbank can be instructive. While the Bundesbank has formal targets for money growth and inflation, it does allow exchange rate considerations to influence its policy decisions. Thus, at least implicitly, it appears to pursue monetary policy with multiple objectives in mind.[3]

Finally, it is true that moderate proposals for inflation targeting allow for a more flexible policy rule than the strict price level targeting that Friedman and Kuttner characterize. Does this flexibility undermine the discipline over policymaking that such a rule is supposed to provide? I do not think so. At a minimum, introducing the kinds of guidelines that these proposals suggest forces a focused discussion of policy. If there

3. See Clarida and Gertler (1996).

is a deviation from the guidelines, the policymaker must explain. Such discussions may be one way to ensure that good policies are carried on and bad ones are left behind.

James Tobin: This paper is a worthy sequel to the long series of Friedman's contributions to the study of monetary policy, many of them at the Brookings Panel, many of them with younger collaborators who have gone on to productive professional careers. Clearly the Friedman-Kuttner team is another fruitful partnership. Friedman and company always call the shots as they see them, independent of schools of thought and policy lines.

Price Stability as the Mandated Goal of Monetary Policy. The paper begins and ends by claiming relevance to proposed legislation to establish price stability as the exclusive target of Federal Reserve policy. At the end of the paper, the authors mount a devastating attack on the so-called Economic Growth and Price Stability Act—which has nothing to do with economic growth, but exemplifies the fashion of decorative titles for statutes—which would instruct the Fed to define and maintain a monetary policy that "effectively promotes long-term price stability," to the exclusion of the employment and output goals of existing mandates. Friedman and Kuttner eloquently condemn this bill, and I applaud their appraisal.

Their criticism of this proposal stands on its own feet, independent of their analysis of experience with mandated targets for monetary aggregates. After all, those M targets were not goals, like price stability, but intermediate instruments. The authors cite with approval the distinction between central bank "goal independence," which they regard as inappropriate, and "instrument independence," of which they approve. The Fed felt justified in suspending or abandoning the monetary rules when they found them inconsistent with the basic goals to which they were committed by statute. They would not be free to abandon a price stability commitment, no matter how unpleasant its by-products.

The thrust of the proposed rule is to tell the Fed not to let their attention be diverted by worries about employment and output and their growth. Its sponsors evidently adhere to the New Classical view that monetary events and policies have no real consequences. This is, after all, the prevailing orthodoxy of central bankers throughout the world.

Countering this view, Friedman and Kuttner boast of the success of pragmatic U.S. monetary policies over the last fifteen years, both absolutely and relative to other countries. Perhaps they lay the praise on a little thick. The great disinflation of 1979–82 may, as they say, have cost no more than estimates of sacrifice ratios of the time, but it cost no less, even though many advocates of resolute, preannounced austerity promised that it would reduce the cost. Some observers saw no need for the continuation of austere monetary goals well into 1982. More recently, the Fed tolerated subpar growth rates for almost four years, from 1989 to 1992.

Yet I generally concur with the authors' opinion that the Volcker and Greenspan FOMCs were successful in fine-tuning their policies to macroeconomic performance, measured by employment and output, as well as prices and inflation. They did not tie themselves to targets for monetary aggregates, nor to any fixed rules. The Taylor-type response functions that explain the federal funds rate in table 1 depict balanced attention to ultimate macroeconomic variables, real and nominal.

The drawbacks of a "price stability only" rule are quite obvious. In the case of the OPEC supply shocks, such a rule would have entailed even higher costs in lost output and jobs than were inflicted by the deep recessions of 1974–75 and 1979–82. In the present case, this would be especially true because, as Friedman and Kuttner explain, the language of the bill would require any increase in the price level to be reversed. Even a monetary stimulus to recovery from an ordinary business cycle recession would be ruled out if it were to raise prices.

If inflation stability were an officially mandated goal, there are two long well known, good reasons for choosing a rate above zero. The first is that it is easier to make the real wage adjustments inevitable in a dynamic economy if real wages can be reduced without lowering nominal wages. The special obstacles to employers' cutting of money wages may seem irrational, but recent research confirms that they still exist. The paper by Akerlof, Dickens, and Perry in this volume offers and tests an ingenious model of asymmetric nominal wage inertia. According to that model, the unemployment cost of inflation stability is significantly higher the lower the long-run inflation rate target, at least for low inflation rates. The argument and the model resemble those of my presidential address to the American Economic Association in 1971.[1]

1. Tobin (1972).

The second reason applies to interest rates, a point made by Takatoshi Ito in the discussion of the paper by Akerlof, Dickens, and Perry. In some business cycles there are times when negative real interest rates on short safe assets may be needed to reverse recessions or to maintain prosperities. This does not imply that real rates on debts with longer maturities and higher risks, the rates relevant to demands for goods and services, need be negative. If trend inflation is zero, given that the nominal federal funds rate cannot be negative, the real rate can never be negative. This constraint on monetary policy would be relaxed if the ongoing trend inflation rate were, for example, 3 percent. This consideration has additional strength because the abandonment of fiscal stabilizers, built-in and discretionary, places the entire burden of countercyclical stabilization on monetary policy.

The Rise and Fall of Monetary Aggregate Targets. Pursuant to Concurrent Resolution 133, the FOMC announced M targets from 1975 through 1986. Resolution 133 is still on the books, but in practice the Fed ceased to take M targets seriously in 1983, formally abandoned M1 in 1987, and explicitly downgraded other M's in 1993. The authors take formal announcements too literally in dating the last year of the money targeting era as 1986, instead of 1982.

The general conclusion of the paper is that the Fed took monetary aggregates seriously when, because of their informational content regarding future values of true ultimate goals (output and prices), the M's were worth taking seriously. Likewise, the Fed stopped taking them seriously in the 1980s, when they no longer conveyed useful information because the demand functions for monetary aggregates had fallen apart.

The authors try to find out whether the FOMC took M targets seriously enough to correct divergences from them, by setting the federal funds rates higher or lower than observations of inflation and unemployment would have called for. The regressions that they compute to explain Federal Reserve settings of policy instruments merit praise for the painstaking use of regressors as the Fed knew them in making policy at each date, not as they are known in revised statistics today. There is not much evidence of the responses that the authors are looking for, except for in the period 1979–82 (table 1). Indeed, the regressions in table 1 give little evidence that the Fed took anything very seriously, except perhaps last period's inflation. I believe that the FOMC did take the macroeconomic variables, real and nominal, more seriously than these regressions show.

The specifications of the Taylor policy response functions in table 1 are questionable. For one reason, in the equations with lagged dependent variables past values of *r* explain too much. True, there is considerable persistence in the federal funds rate, some of it beyond what the persistence of inflation and unemployment would explain. This can be attributed to the reluctance of the FOMC to change its instrument setting very frequently, and especially to reverse course. This reluctance could be modeled by requiring the value of the response function to exceed a threshold before a change in the instrument is voted, and to require a particularly high threshold to justify a policy reversal. The Fed has been fine-tuning, but does not move the funds rate at every meeting.

In table 2 the dependent variable is shifted from the funds rate to an alternative operating instrument, unborrowed reserves. The result is quite interesting. In 1979–82 a positive M1 discrepancy appears to have led to a corrective contraction of unborrowed reserves. In other years before and after, a positive M1 discrepancy was accommodated by new reserve supplies. These results are consistent with the widely held view, supported by the Fed's own statements, that in the period dedicated to disinflation (1979–82) the Fed concentrated on quantitative operating instruments (reserves) and quantitative intermediate goals (monetary aggregates), while in other years their primary operating target was the federal funds rate, and other interest rates and credit market conditions competed with the M's as intermediate goals. During 1979–82, the funds rate was left to the market, and all interest rates became extremely volatile. For symmetry, table 2 might include regressions to test whether different levels of, or changes in, the funds rates made any difference to the dependent variable, unborrowed reserves.

Tables 1 and 2 provide some evidence that the Fed took M targets seriously at times. However, figures 1 and 2, which concern the interest rate equations—no similar calculations are presented for the equations in table 2—say that those years were principally 1979–82, a period for which the equation is misspecified anyway. A lesser bulge appears in 1983–85, when, according to independent information, the M's were already being downgraded.

These bulges are especially apparent in the upper panels of figures 1 and 2. However, as William Brainard has made me understand, the lower panels are the more informative. The Kalman-filtered and Kalman-smoothed interest rate equations are intended to generate the best information, *as of today's date*, on how the Fed had been setting the funds rate, taking account of the possibility that the coefficients of the M error variables could change stochastically over time. There is no reason not to use all the observations to date in making the estimate that is crucial for this procedure, the variance of the regression coefficient's stochastic process relative to that of the regression itself. This is done in the lower panel. As econometric observers in 1996, we have no interest in what the upper panel tells us, namely, how we might have done the estimation if we were confined to observations available years ago.

Things would be different for a different kind of equation. Suppose the model of Fed behavior included Fed estimates of future macroeconomic variables, notably, prices and unemployment. In the absence of direct observations of these estimates—although projections by members of the FOMC appear in the Fed's twice-yearly *Monetary Policy Report to the Congress*—one could estimate such expectations by filtered estimates of the coefficients of relevant macroeconomic equations, using observations available up to each successive date. The time series of those estimates of expectations could then be used as explanatory variables in equations for policy responses by the Fed, estimated on observations for the entire period. Friedman and Kuttner have no forward-looking variables in their Fed policy response equations, and thus no need for "filtered" results like those of the upper panels of figures 1 and 2.

In figures 3–6, the authors report VARs that are designed to measure how informative Fed policymakers could have regarded M1 and M2 to have been at past dates. Presumably filtered estimates of VAR coefficients could have been used in those calculations, but they were not.

The Predictive Content of Monetary Aggregates. The authors then embark on a hazardous course. They seek to evaluate the power of M1 and M2 to predict inflation and real GDP. Friedman and Kuttner are cautious in interpreting their VARs, but unwary readers may easily read too much into them. That is, they may interpret the significant VAR relationships in figures 3 and 4 as causal, whereas the authors intend them only to provide information. A significant relationship means simply that innovations in policy instruments affect the M, on the one hand, and prices and unemployment, on the other, but the effects on money are observable sooner. Maybe so, although a chronological sequence of money-then-prices or money-then-output could reflect reverse causation. An output shock that was unrelated to monetary policy could result in temporally precedent increases in bank assets and deposits. Or an observed change in M could result simply from reshuffling financial assets between banks and the public, and have nothing to do with monetary policy or macroeconomic goals.

The role of M's in monetary policy has always been a source of ambiguity and confusion. Are they links in the transmission chain? Or, are they simply informative precursors of the important macroeconomic variables? Surely the monetarists of the 1960s and 1970s had the former in mind. M was *the* supply of money—just which M, Milton Friedman and his cohorts were not sure. The determination of that M was monetary policy; in the language of 1996 politics, it was what monetary policy was "all about." If, however, the function of M was taken to be merely informative, then its character as "money" was irrelevant, and it had to compete with a host of other leading indicators—nonmonetary statistics such as housing starts, car sales, consumer confidence, new orders, and investment plans. In those ancient times, Benjamin Friedman himself was in the forefront of challengers of the causal and informational importance of monetary aggregates.

I do not understand the logic of the orthogonalization of the four variables in the VARs of figures 3 and 5; in order, real GDP, price, M1 or M2, and the federal funds rate. Should not the last two be reversed, so that intermediate money supplies do not receive credit for explanatory results due to monetary policy (r) itself?

Anyway, I am puzzled by the spikes for the periods of oil shocks in figures 3 and 5. Why should M appear to account for so much of the output and price variance in those particular years? This is the most dramatic instance of a more general puzzle, namely, why the replacement of a small number of observations, as one moves from the sample ending in one terminal year to the largely overlapping sample ending in the next year, makes such a big difference in the percentage of the variance of output and prices that is explained in figures 3 and 5, and in the significance of M1 predictions of the GDP deflator that is shown in figure 4. (This seeming anomaly does not appear in the M2 alternative shown in figure 6.)

Why Money Lost Predictive Power. The conventional version of monetary history is that intermediate monetary targets were good guides to policy until technological, institutional, and regulatory changes undermined the relationships of the M's to output, employment, and prices. In my opinion, the nostalgia is overdone. It was always true that the sovereignty of any of the M's was impaired by their very multiplicity, and by the availability of near-monies and other close substitutes. Nor should it be forgotten that the monetarists assumed constant velocity, denying or ignoring the interest elasticity of demand for money.

Incidentally, in listing the sources of the changes in, and increased unpredictability of, money demand, more weight should be put on legalization of payment of market interest rates on deposits, even on checkable deposits. This brought a one-time increase in money demand, and made the demand less elastic with respect to market interest rates. It also gave depositors less reason for concern about whether they should hold deposits or alternative short-term liquid assets; as a result, their balances can fluctuate considerably before they bother to reallocate them.

Friedman and Kuttner subscribe to the conventional view, but they conscientiously consider it as one of three hypotheses regarding the erosion of money's predictive power. Hypothesis 1 is that the FOMC has successfully fine-tuned money growth so as to stabilize output and prices, leaving no variance in them to be explained. (They dismiss out of hand, as clearly counterfactual, the stronger Panglossian hypothesis 0, that this success would be achieved by eliminating all variance from M itself.) Hypothesis 2 is the conventional view, that money demand has become so unstable that fluctuations in M's no longer anticipate output and prices. And hypothesis 3 is that monetary policy itself has become ineffectual.

The Semistructural VAR Model. Friedman and Kuttner conclude that a semistructural approach is needed to distinguish among the three contesting hypotheses and to resolve other questions regarding macroeconomic shocks and their effects. The four-variable structural VAR system that they adopt is just identified, by assuming that no demand-side disturbances affect real output in the long run, that monetary disturbances have no contemporaneous effects on real output, and that demand for real money balances depends on output and the real interest rate.

This model enables the authors to distinguish among four innovations: aggregate demand shocks to first differences in log real GDP, supply shocks to price differences, money demand shocks to M1 or M2, and monetary policy shocks to the federal funds rate (*r*).

Figures 9 and 10 display time series of the standard deviations of the four shocks, as they would have been estimated by samples of one hundred observations ending at each date. Again, it is hard to understand how big quick changes can occur from one sample to the next, largely overlapping, sample. The sharp rise in the standard deviation of the IS shock in 1980 appears to be idiosyncratic, reflecting the Carter credit controls of that year. The authors take comfort from figure 11, which shows that since 1981, the variability of money demand has risen relative to that of IS shocks, even though this rise has simply restored the relative volatility of the two shocks in the early 1970s. (Recall that Friedman and Kuttner alleged that money demand was very well behaved, back then.)

In the end, the authors are not able to use their semistructural model to analyze the consequences of the proposed congressional mandate to stabilize prices. The preoccupation of the paper with obsolescent M's is mostly beside the point. The relative absence of supply shocks to prices and productivity after 1980 might suggest that the rule would be innocuous in terms of lost output. It would have been helpful if Friedman and Kuttner, on the basis of semistructural VARs estimated from all the observations available up to this date, had reported and plotted time series of all the shocks and their ''effects'' on subsequent inflation and output.

The useful data base of macroeconomic variables as policymakers read them could be used in further research. It could be supplemented by other data on what FOMC members knew or thought they knew: their personal projections of the economy, or forecasts of the Fed's macroeconometric model. Did deviations from expectations held when previous policy decisions were made bring about subsequent policy responses? Other extensions of the data and methodology of this paper might investigate the policy responses, if any, to exchange rates and to fiscal developments.

General discussion: The discussion centered on inflation targeting and the pending Economic Growth and Price Stability Act. Alan Blinder noted that the paper's analysis of monetary targeting had little relevance for inflation targeting, since the latter is a goal and the former an instrument. He reported that the two main arguments made by Washington proponents of inflation-only targeting were, first, that with only one instrument the Fed can pursue only one objective, and second, that money is neutral with respect to real activity over any relevant time horizon. Although he dismissed these arguments and was opposed to making inflation the sole objective of monetary policy, he welcomed the trend toward goal-oriented, rather than instrument-oriented, targets because goal orientation makes central banks more accountable. He noted that the current reporting requirements under Humphrey-Hawkins do little to hold the Federal Reserve responsible for its actions and reasoned that an inflation target together with an output stabilization mandate would greatly increase the Fed's accountability.

The discussion of inflation targeting revisited arguments prominent in the debate over rules versus discretion in the conduct of monetary policy. Robert Hall advocated caution in adopting rules and targets in general, reminding participants that a price stabilization policy may cause severe disruption to the economy when adverse price shocks occur. He observed that rules offer a remedy for the inflationary bias in discretionary monetary policy that would result from time inconsistency, also known as on-the-spot rationality. But he noted that they can also impose large costs, under some circumstances. Even in the absence of explicit price stability targets, the Federal Reserve engineered recessions during the oil shocks of the 1970s in order to reduce inflation, and, Hall reasoned, the recessions would have been much more severe if there had been legislation requiring price stability. He added that similar dangers are inherent in nominal GDP targeting or Taylor-type rules. Hall concluded that the Rogoff strategy of appointing a central banker whose own preferences, relative to society's, place greater weight on inflation stabilization and less on employment stabilization offers the best approach to dealing with the inflationary bias of discretionary monetary policy. And he noted that conservative central bankers, such as Alan Greenspan, have successfully maintained low inflation over the last decade in the absence of explicit rules.

Mark Gertler agreed that U.S. experience over the 1980s and 1990s is consistent with the Rogoff model because both Alan Greenspan and Paul Volker fit Rogoff's description of conservative central bankers.

However, he questioned whether Germany's experience supports the model. Although the Bundesbank had already built a strong reputation as an inflation fighter, in 1980 disinflations produced two painful recessions in Germany. Gertler added that for the time inconsistency story to mean much in the case of the United States, there would have to have been a significant and identifiable gap between the natural unemployment rate and its socially optimal counterpart. In practice, the Fed seems to have little idea of what the national rate is, let alone the socially optimal rate.

James Duesenberry argued that the Fed, and consequently the Rogoff strategy, might be receiving too much credit for the low inflation during the past decade. He reminded the Panel that the recent low inflation rates have been due, in part, to the fortuitous absence of supply-side price shocks since the early 1980s. He reasoned that the persistent preoccupation with inflation among developed countries can be traced back to the 1970s, when a succession of supply-side price shocks led to inflation phobia. This contrasts with the unemployment phobia that existed before the 1970s as an overhang from the Great Depression. Duesenberry concluded that policymakers are repeatedly fighting wars that are long over, and considered this a strong argument against an inflation-only rule for the Federal Reserve.

Gregory Mankiw remarked that while there is a strong presumption of an inflation bias under discretionary monetary policy in a one-shot game environment, it is more realistic to think of the Federal Reserve as facing a repeated game, in which case arguments built around time inconsistency are more complicated. In particular, multiple equilibria are likely in a repeated game environment. The United States is currently at a good reputation equilibrium, but there is no guarantee that it will remain so. Consequently, he regarded the case in favor of rules as quite strong, despite the recent favorable experience without a rule.

In response to questions raised by James Tobin, Friedman reported on experiments with a version of the Taylor rule whereby the federal funds rate responds only when the money aggregate moves outside the growth cone, rather than responding continuously as money growth deviates from the midpoint of the cone, as in standard specifications of the Taylor rule. He reported that estimation results did not change substantially from those reported in the paper.

References

Aizenman, Joshua, and Jacob A. Frenkel. 1986. "Supply Shocks, Wage Indexation and Monetary Accommodation." *Journal of Money, Credit, and Banking* 18(3): 304–22.

Akhtar, M. A., and Ethan S. Harris. 1986. "Monetary Policy Influence on the Economy—An Empirical Analysis." *Federal Reserve Bank of New York Quarterly Review* 11(4): 19–34.

Bean, Charles R. 1983. "Targeting Nominal Income: An Appraisal." *Economic Journal* 93(372): 806–19.

Bernanke, Ben S., and Alan S. Blinder. 1992. "The Federal Funds Rate and the Channels of Monetary Transmission." *American Economic Review* 82(4): 901–21.

Bernanke, Ben S., and Ilian Mihov. 1995. "Measuring Monetary Policy." Working Paper 5145. Cambridge, Mass.: National Bureau of Economic Research (June).

Blanchard, Olivier Jean, and Danny Quah. 1989. "The Dynamic Effects of Aggregate Demand and Supply Disturbances." *American Economic Review* 79(4): 655–73.

Board of Governors of the Federal Reserve System. 1981. *New Monetary Control Procedures*. Washington: Board of Governors of the Federal Reserve System.

Bosworth, Barry P. 1989. "Institutional Change and the Efficacy of Monetary Policy." *BPEA, 1: 1989*, 77–110.

Brainard, William C. 1967. "Uncertainty and the Effectiveness of Policy." *American Economic Review, Papers and Proceedings* 57(2): 411–25.

Clarida, Richard, and Mark Gertler. 1996. "How the Bundesbank Conducts Monetary Policy." Working Paper 5581. Cambridge, Mass.: National Bureau of Economic Research (May).

Debelle, Guy, and Stanley Fischer. 1994. "How Independent Should a Central Bank Be?" In *Goals, Guidelines, and Constraints Facing Monetary Policymakers*, edited by Jeffrey C. Fuhrer. Boston: Federal Reserve Bank of Boston.

Fischer, Stanley. 1990. "Rules Versus Discretion in Monetary Policy." In *Handbook of Monetary Economics*, vol. 2, edited by Benjamin M. Friedman and Frank H. Hahn. Amsterdam: North-Holland.

Flood, Robert P., and Peter Isard. 1989. "Monetary Policy Strategies." *International Monetary Fund Staff Papers* 36(3): 612–32.

Friedman, Benjamin M. 1989. "Changing Effects of Monetary Policy on Real Economic Activity." In *Monetary Policy Issues in the 1990s*. Kansas City: Federal Reserve Bank of Kansas City.

———. 1993. "The Role of Judgment and Discretion in the Conduct of Monetary Policy: Consequences of Changing Financial Markets.'' In *Changing Capital Markets: Implications for Monetary Policy.* Kansas City: Federal Reserve Bank of Kansas City.

———. 1996. ''The Rise and Fall of Money Growth Targets as Guidelines for U.S. Monetary Policy.'' In *Towards More Effective Monetary Policy,* edited by Iwao Kuroda. London: Macmillan (forthcoming).

Friedman, Benjamin M., and Kenneth N. Kuttner. 1992. ''Money, Income, Prices, and Interest Rates.'' *American Economic Review* 82(3): 472–92.

———. 1993. ''Another Look at the Evidence on Money-Income Causality.'' *Journal of Econometrics* 57(1–3): 189–203.

Friedman, Milton. 1953. ''The Effects of a Full-Employment Policy on Economic Stability: A Formal Analysis.'' In *Essays in Positive Economics,* by Milton Friedman. Chicago: University of Chicago Press.

Gali, Jordi. 1992. ''How Well Does the IS-LM Model Fit Postwar U.S. Data?'' *Quarterly Journal of Economics* 107(2): 709–38.

Goldfeld, Stephen M., and Alan S. Blinder. 1972. ''Some Implications of Endogenous Stabilization Policy.'' *BPEA, 3: 1972,* 585–640.

Goldfeld, Stephen M., and Daniel E. Sichel. 1990. ''The Demand for Money.'' In *Handbook of Monetary Economics,* vol. 2, edited by Benjamin M. Friedman and Frank H. Hahn. Amsterdam: North-Holland.

Gordon, Robert. J. 1993. *Macroeconomics,* 6th ed. New York: Harper Collins.

Jordan, Thomas J., and Carlos Lenz. 1996. ''Identification of Macroeconomic Shocks: Variations on the LM-IS Model.'' Unpublished paper. Harvard University (April).

Judd, John P., and John L. Scadding. 1982. ''The Search for a Stable Money Demand Function: A Survey of the Post-1973 Literature.'' *Journal of Economic Literature* 20(3): 993–1023.

McCallum, Bennett T. 1995. ''Two Fallacies Concerning Central-Bank Independence.'' *American Economic Review, Papers and Proceedings* 85(2): 207–11.

McNees, Stephen K. 1992. ''A Forward-Looking Monetary Policy Reaction Function: Continuity and Change.'' *New England Economic Review* (November-December): 3–13.

Miyao, Ryuzo. 1997. ''Does a Cointegrating M2 Demand Relation Really Exist in the United States?'' *Journal of Money, Credit, and Banking* (forthcoming).

Poole, William. 1970. ''Optimal Choice of Monetary Policy Instruments in a Simple Stochastic Macro Model.'' *Quarterly Journal of Economics* 84(2): 197–216.

———. 1994. ''Monetary Aggregates Targeting in a Low-Inflation Economy.'' In *Goals, Guidelines, and Constraints Facing Monetary Policymakers,* edited by Jeffrey C. Fuhrer. Boston: Federal Reserve Bank of Boston.

Posen, Adam. 1995. ''Central Bank Independence and Disinflationary Credibility: A Missing Link?'' *Staff Reports* 1. New York: Federal Reserve Bank of New York (May).

Rogoff, Kenneth. 1985. ''The Optimal Degree of Commitment to an Intermediate Monetary Target.'' *Quarterly Journal of Economics* 100(4): 1169–89.

Romer, Christina D., and David H. Romer. 1989. ''Does Monetary Policy Matter? A New Test in the Spirit of Friedman and Schwartz.'' In *NBER Macroeconomics Annual 1989*, edited by Olivier Jean Blanchard and Stanley Fischer. Cambridge, Mass.: MIT Press.

Sims, Christopher A., James H. Stock, and Mark W. Watson. 1990. ''Inference in Linear Time Series Models with Some Unit Roots.'' *Econometrica* 58(1): 113–44.

Stock, James H., and Mark W. Watson. 1989. ''Interpreting the Evidence on Money-Income Causality.'' *Journal of Econometrics* 40(1): 161–81.

Taylor, John B. 1993. ''Discretion versus Policy Rules in Practice.'' *Carnegie-Rochester Conference Series on Public Policy* 39: 195–214.

Tobin, James. 1970. ''Money and Income: Post Hoc Ergo Propter Hoc?'' *Quarterly Journal of Economics* 84(2): 301–17.

———. 1972. ''Inflation and Unemployment.'' *American Economic Review* 62(1): 1–18.

———. 1983. ''Monetary Policy: Rules, Targets, and Shocks.'' *Journal of Money, Credit, and Banking* 15(4): 506–18.

Walsh, Carl E. 1995. ''Optimal Contracts for Central Bankers.'' *American Economic Review* 85(1): 150–67.

West, Kenneth D. 1986. ''Targeting Nominal Income: A Note.'' *Economic Journal* 96(384): 1077–83.