Zentrum für Europäische Integrationsforschung
Center for European Integration Studies
Rheinische Friedrich-Wilhelms-Universität Bonn

Robert L. Hetzel

U.S. Monetary Policy and Monetary Policy and the ESCB

Working Paper

B98-09
1998

U. S. Monetary Policy

Robert L. Hetzel
Federal Reserve Bank of Richmond
Post Office Box 27622
Richmond, Virginia 23261

phone: 804-697-8213
fax: 804-697-8255
email: E1RLH01@RICH.FRB.ORG

August 1998

1. Overview

One can readily identify monetary policy actions such as changes in the Federal Reserve's interest rate peg. Identification of monetary policy, where policy is thought of as a strategy for achieving specified objectives, would also be straightforward if the Federal Open Market Committee (FOMC) of the Federal Reserve System used analytical procedures. With analytical procedures, the FOMC would specify an explicit objective function. It would also specify the model it uses to decide changes in its instrument to eliminate misses of the variables in its objective function.

However, the FOMC uses a judgmental framework. It does not make its objectives explicit. Nor does it not conceive of policy as a model-based strategy that constrains period-by-period policy actions. Instead, monetary policy emerges from the concatenation of individual policy actions, each of which appears optimal in the context of current economic activity.

The task of putting FOMC procedures into an analytical framework falls to the economist. However, the correlations one sees in the data between policy variables and macroeconomic variables derive from both monetary policy and the public's behavior. Disentangling the observed correlations requires a model.

Section 2 presents a quantity theory model. Sections 3 and 4 relate the model to FOMC procedures in the 1980s. Section 5 discusses how the FOMC controls nominal expenditure through monetary control. Section 6 examines monetary policy in the stop-go period prior to 1980. Section 7 offers an overview.

The review of FOMC behavior since the early 1980s, presented in Sections 3 and 4, suggests an hypothesis: when the FOMC follows a feedback rule for changing the funds rate designed to stabilize nominal expenditure growth, it also stabilizes inflation. In addition, the rule allows the price system to work to stabilize real expenditure. The paper tests this hypothesis by examining monetary policy in the period from the mid-1960s through the end of the 1970s. In this period, rather than stabilizing nominal expenditure growth, the FOMC followed an activist policy by using variations in nominal expenditure growth alternately to stimulate real economic activity and to restrain inflation.

2. The model

Because the FOMC uses an interest rate peg as its policy variable, a model must allow for endogenous determination of the nominal money stock. The model used here follows the extensions to Sargent and Wallace (1975) that incorporate interest-rate smoothing by the central bank and endogenous money (Barro 1989; Canzoneri, Henderson and Rogoff 1983; Dotsey and King 1983; Goodfriend 1987; Hetzel 1995; McCallum 1981 and 1986; and VanHoose 1989).

The model embodies three key identifying restrictions. First, the price system works to equilibrate macroeconomic activity. That is, after shocks, prices vary to return real variables to well-defined values. Second, the price level is a monetary phenomenon. Specifically, the model distinguishes real from nominal variables. Because the public cares in a fundamental way only about real variables, the central bank must give nominal variables well-defined values. Third, the public forms its expectations in a way that conforms to the monetary policy followed by the central bank. When combined with the distinction between anticipated and unanticipated shocks, the model implies that the central bank cannot control real variables in a systematic manner.[1]

These identifying restrictions play a crucial role in the interpretation of monetary policy. They lead to an understanding of inflation control in terms of monetary control. Such an understanding differs from the real view of inflation control expressed in terms of control of excess capacity in product or labor markets. (For a expression of this view, the NAIRU model of inflation control, see Governor Laurence Meyer, 1997).

The model presents the quantity theory in a way convenient for understanding monetary control when the central bank employs an interest rate peg as its instrument. Equation (1), which results from the substitution of a Lucas supply function into an aggregate demand function, summarizes the determination of the interest rate. It highlights the constraints faced by the central bank in setting an interest rate peg. The price level results from equating equation (2), the public's real money demand function, with equation (3), the nominal money supply function. As summarized in equations (4) and (5), the central bank dominates the behavior of the money supply.

(1) $R_t = (E_t p_{t+1} - p_t) + c_1 - c_2 [p_t - E_{t-1} p_t] + z_t$

with $z_t = \varphi z_{t-1} + q_t \qquad 1 > \varphi > 0$

(2) $m_t^d = p_t + a_1 - a_2 R_t + a_3 [p_t - E_{t-1} p_t] + v_t$

(3) $m_t^s = b_1 + B_t + b_2 R_t$

(4) $B_t^s = B_{t-1} + \theta_0 + \theta_1 [R_t - (E_{t-1} R_t + x_t)] - \theta_2 [B_{t-1} - E_{t-2} B_{t-1}]$

(5) $L = \alpha\, E[R_t - E_{t-1} R_t]^2 + \beta\, E[p_t - E_{t-1} p_t]^2 + \gamma\, E[(E_t p_{t+1} - p_t) - \pi^*]^2$

$0 < c_1, c_2, a_1, a_2, a_3, b_1, b_2, \alpha, \beta, \gamma$

All variables are in logarithms, except R_t. E_t is the expectations operator; the subscript is the time period in which the expectation is formed. E is an unconditional expectations operator.

[1] As a guide to U.S. monetary history, the model is deficient in several respects. The mechanism by which it generates monetary nonneutralities, monetary misperceptions, cannot explain Milton Friedman's empirical observation that shocks to aggregate nominal demand impact on output before prices. It also cannot explain the duration of recession. For these reasons, economists have turned more recently to sticky-price models. (See the survey in Goodfriend and King, 1997). Also, the model does not incorporate learning about changes in the monetary regime. However, the model imposes enough structure to elucidate the major features of monetary policy.

R_t = nominal interest rate

p_t = price level

$E_t p_{t+1}$ = period t expectation of period t+1 price level

$E_t p_{t+1}$ - p_t = expected one period ahead inflation rate

$E_{t-1} p_t$ = period t-1 expectation of period t price level

p_t - $E_{t-1} p_t$ = contemporaneous price level forecast error

m_t = money

B_t = monetary base

π^* = trend inflation targeted by the central bank

q_t, v_t, and x_t are serially- and mutually-uncorrelated random variables

$c_1 - c_2 [p_t - E_{t-1} p_t] + z_t$ = real rate of interest

$c_1 + \varphi z_{t-1}$ = natural rate of interest

$E_{t-1} R_t = \pi^* + c_1 + \varphi z_{t-1}$ = trend inflation + natural rate of interest = nominal natural rate

$E_{t-1} R_t + x_t = [\pi^* + c_1 + \varphi z_{t-1}] + x_t$ = central bank reference rate

Equation (1) expresses the nominal interest rate as the sum of expected one period inflation $[E_t p_{t+1} - p_t]$ and the real rate $[c_1 - c_2 [p_t - E_{t-1} p_t] + z_t]$. The contemporaneous price-level forecast error $[p_t - E_{t-1} p_t]$ reflects an aggregate supply function that makes the supply of output vary positively with price level prediction errors. The public puts a large part of unanticipated increases in real output into saving, which lowers the real rate of interest. The FOMC constrains changes in its rate peg to be unidirectional over significant periods of time. This practice suggests the positive serial correlation in the error z_t of (1).

In (2), money demand depends positively on the price level and real output and negatively on the interest rate. In (3) money supply depends on the monetary base. The (log) of the money-base ratio is b_1 and $b_2 R_t$ expresses its interest sensitivity.

Equation (4) shows the policy actions of the central bank. When it operates with an interest rate peg, R_t becomes its instrument. Equation (4) could be rearranged to put R_t on the left side to highlight this operating procedure. However, in a fiat-money regime, the central bank is the institution possessing the monopoly over monetary base creation. Even if the central bank uses a rate peg, at a fundamental level, it still exerts its influence through control over the time-series behavior of the base.

As written, (4) shows how the central bank determines the time-series behavior of the monetary base through its choice of the θ parameters. The parameter θ_0 sets the trend growth of the base (and money). Under the model assumption that the trend rate of output growth is zero, θ_0 is also the trend rate of inflation p. The parameter θ_1 determines the extent to which the central bank constrains fluctuations of the interest rate to move around an implicit reference rate. (With $x_t = 0$, θ_1 measures interest rate smoothing by the central bank.) The θ_2 term measures the extent to which the central bank offsets the innovation in the monetary base it allowed in the prior period by constraining fluctuations in the interest rate. The θ_2 parameter determines the degree of drift in prices. (See Goodfriend 1987, Hetzel 1995, and VanHoose 1989.)

Equation (5), a loss function, expresses the monetary policy of the central bank. The " and (terms express a desire to minimize financial market volatility. The " term captures an objective to limit fluctuations in money-market rates. The (term captures an objective to limit bond-rate fluctuations, which requires limiting changes in the public's inflation forecasts. The $ term summarizes the objective of minimizing output fluctuations, which requires avoiding price-level forecast errors.

Assuming rational expectations, one can use equations (1)-(4) to solve for the endogenous variables of the model as functions of the θ parameters. One then substitutes these solutions into the loss function (5). Given its preferences as represented by the ", $, (parameters, the central bank chooses the θ parameters to minimize its loss function (Hetzel 1995).

By using a funds rate peg as its instrument, the central bank sets the market rate, R_t.[2] The reference rate, $E_{t-1}R_t + x_t$, is not observed. It is the value toward which the central bank pulls the market rate through unanticipated money creation. For example, when the reference rate lies below the market rate, $x_t > 0$, the central bank creates money to depress the market rate.

What must the central bank do to avoid imparting inflationary shocks to the economy? It must set its rate peg equal to the prior period's expectation of the nominal rate, $E_{t-1}R_t$. From (1), $E_{t-1}R_t$ possesses two components. One is $c_1 + \varphi z_{t-1}$, the natural rate (the sustainable real rate), which holds in the absence of price level forecast errors and transitory real shocks. The other component is the public's unconditional expectation of inflation, which under rational expectations equals the central bank's target for trend inflation ($\pi^* = \theta_0$).[3] In sum, the central bank must set its rate peg equal to the

[2] The value of the peg can change within the period t. The length of the period depends upon the length of time over which an unanticipated change in the price level affects real variables. In the 1960s and 1970s, the US was making the final transition from a commodity to a fiat currency monetary regime. The former regime still exercised enough influence that the public believed the inflation rate would behave like a stationary time series. For this period, the time period t can be thought of as one year.

[3] In a Barro-Gordon (1983) world of time inconsistency, where the central bank's preferred inflation target is not credible, the public's expectation of trend inflation may depend upon a variety of political factors beyond the control of the central bank. One can consider the common expression about central banks "fighting inflation" in

nominal natural rate.[4],[5]

Although a central bank can use a rate peg as its instrument, in a significant sense, it cannot control the interest rate. First, it cannot control the natural rate. Second, the central bank must set its rate peg equal to the natural rate plus the public's expectation of trend inflation, which is determined given its target. These constraints are fundamental: the central bank must respect them to give nominal variables well-defined values (Hetzel 1995 and McCallum 1986). Within the confines of these constraints, the central bank can moderate fluctuations of the interest rate. However, it can do so only by allowing unanticipated monetary emissions. If it does not subsequently offset them, it will introduce drift into the price level.

It is useful to distinguish between policy-maintaining and policy-altering changes in the rate peg. With the former, the central bank keeps the interest rate peg equal to the nominal natural rate specified for an unchanged trend rate of inflation. With the latter, the central bank moves the market rate relative to the nominal natural rate and actively creates changes in money that alter inflation. For example, for $x_t > 0$, the central bank pulls the rate peg down through surprise money creation that lowers the real rate of interest.[6]

The model illustrates the problem of identifying monetary policy. One could estimate a regression like (4) to derive estimates of the θ parameters chosen by the central bank. The estimated θ parameters, however, do not describe monetary policy as expressed by the loss function, (5). They are a mixture of the structural parameters from the behavioral relationships of the public, (1) and (2), and the structural parameters from the loss (policy) function of the central bank, (5). For example, to minimize its loss function, the central bank chooses θ_1 equal to

(6) $\hat{q}_1 = -(a_2 + b_2) + \frac{a}{b} c_2 (1 + a_3) + [1 + a\,(\frac{1}{g} + \frac{c_2^2}{b})]\frac{(1+c_2)s^2_{v-x}}{(1+a_3)s^2_q}$, where σ^2_{v-x} and σ^2_q are, respectively, the variances of monetary and real shocks (Hetzel 1995). In order to derive the policy function of the central bank (the α, β, γ parameters) one must know the model of the economy (the a, b and c parameters).

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this context. At first glance, the expression seems odd. Central banks create inflation. Does the expression mean the central bank is somehow fighting itself? It probably means that the central bank's desired inflation rate is not credible, and it must take actions ("fight") to lower the public's expectation of inflation to an acceptable level.

[4] To avoid drift in the price level due to the monetary emissions that arise from real shocks with an interest rate peg, the central bank must also set $\theta_2 = 0$.

[5] The term is from Friedman (1969).

[6] Because x_t by definition captures unanticipated changes, an effort by the central bank to impart serial correlation to surprise money creation would fail. It would alter the inflation rate through a change in θ_0 and π^*.

3. Nominal expenditure targeting and the nominal natural rate

In using the model to understand FOMC procedures, it is useful to ask first what the FOMC must do to stabilize inflation in the absence of private-sector shocks, given that it employs an interest rate peg. To avoid injections of money that force changes in the price level, the FOMC must set its funds rate peg equal to the nominal natural rate - the natural rate plus the rate of inflation expected by the public. This task has two parts. First, the FOMC must keep the real funds rate equal to the natural rate.

Second, it must keep the inflation premium in the funds rate equal to the inflation rate expected by the public. Because the FOMC determines trend inflation, it determines both the inflation premium in the funds rate and expected inflation. The FOMC will maintain equality between the latter two variables by keeping them both equal to the inflation rate it considers acceptable. Thus, in maintaining equality between its funds rate peg and the nominal natural rate, the FOMC tracks the natural rate and sets the inflation premium.

With shocks, a funds rate peg will result in the periodic injection or absorption of the monetary base, which will produce a change in the price level. The FOMC must have a policy about price-level drift. Given the FOMC's target for inflation and its policy toward price-level drift, faced with the shocks that impinge upon the economy, the public can form an expectation of the future price level. With a rate peg, the central bank determines the behavior of nominal variables not through exogenous control of money, but rather by tying down the public's expectation of the future price level.[7]

The most consistent characteristic of monetary policy is "leaning against the wind." The FOMC raises (lowers) its rate peg when economic activity and inflation strengthen (weaken). “Lean-against-the-wind” can be characterized as a feedback procedure running from nominal expenditure growth to a funds rate instrument. How does this procedure equate the funds rate and the nominal natural rate? It does so as a consequence of varying the funds rate in a way that stabilizes nominal expenditure growth.

As described above, the task of equating the funds rate and the nominal natural rate possesses two components. These two components can be related to the two components of nominal expenditure growth: real expenditure growth and inflation. The FOMC's implicit target for nominal expenditure growth possesses two components: sustainable real expenditure growth and acceptable inflation. By targeting nominal expenditure growth, the FOMC changes the funds rate when real expenditure growth deviates from its sustainable rate and when inflation deviates from its acceptable rate. The first kind of change causes the real funds rate to track the natural rate. The second keeps

[7] Given this expectation, an arbitrary change in the contemporaneous price level produces a change in a relative price: the contemporaneous price level relative to the expected future price level. That change creates an excess demand for money that restores the contemporaneous price level to a determinate equilibrium value (Hetzel 1988 and 1995).

the inflation premium in the funds rate equal to the inflation rate expected by the public by keeping both equal to the FOMC's inflation target.

Consider the first kind of funds rate change, for example, an increase in response to a rise in real expenditure growth. A rise in nominal expenditure growth due to a rise in real expenditure growth relative to its sustainable value indicates that the real rate implicit in the FOMC's funds rate peg lies below the natural rate. Changes in the growth rate of real expenditure will be positively correlated with changes in the natural rate if shocks to the economy are either aggregate demand or permanent supply shocks.

Consider now the second kind of funds rate change, for example, an increase when inflation rises. A rise in nominal expenditure growth due to a rise in inflation relative to the FOMC's implicit target also indicates a divergence between the real rate implicit in the funds rate peg and the natural rate. Furthermore, the divergence will widen if the rise in inflation produces a rise in expected inflation that depresses the real rate implicit in the funds rate peg. Changes in inflation will produce positively correlated changes in expected inflation if the public forms its expectations partly on the basis of realized inflation rates. Given that the FOMC does not announce its inflation target and given the inflation drift of stop-go monetary policy, it is likely that in the 1980s the public revised its expectations of inflation at least partly in line with observed inflation.

An increase in the funds rate peg in itself sends a signal that the FOMC is unwilling to accommodate the new, higher inflation rate. That signal helps to prevent a rise in expected inflation and the inflation premium in the interest rate. Also, the FOMC observes the bond rate for signs of an increase in expected inflation. If the FOMC is going to return the inflation rate to its original, lower value, it must raise the funds rate by more than any increase in expected inflation the rise in actual inflation may have produced. If bond rates have risen, the FOMC raises the funds rate until it has reversed the rise in bond rates. That is, it eliminates any increase in the inflation premium incorporated into the bond rate.

4. Leaning against the wind

This section supports the characterization of FOMC procedures in the 1980s as feedback control of nominal expenditure growth with a funds rate instrument, supplemented by a responsiveness to bond rate behavior. The FOMC does not make its targets explicit. However, since July 1979, at their February and July meetings, FOMC members have submitted predictions of growth rates for nominal and real output, inflation, and unemployment, which the chairman presents at his Humphrey-Hawkins testimony before Congress. The predictions are presented as a range, which includes a smaller range called the central tendency. The midpoint of the central-tendency range for nominal output growth can serve as a benchmark against which the FOMC measures the strength of the economy. Although, FOMC members do not prepare their predictions with the idea that they will be used as targets, predictions are necessarily contingent on the monetary policy they expect to be adopted. In this sense, the suggested benchmark represents an acceptable outcome to the majority that can be used as a proxy for targeted values.[8]

In Figure 1, the solid line is the midpoint of the central tendency range of FOMC members' predictions of nominal GDP growth presented in the most recent Humphrey-Hawkins testimony. The dashed line shows Board staff (Greenbook) predictions of the quarterly annualized growth rate of nominal GDP made prior to FOMC meetings.[9] Figure 2 shows deviations between the predicted and benchmark growth rates in Figure 1 (the dashed minus the solid line). These deviations proxy for misses of nominal GDP growth from the FOMC's implicit target. Figure 2 plots these misses with changes in the FOMC's funds rate peg.[10]

In principle, Figure 2 should measure changes in the funds rate relative to a path assumed for the forecasts. Imagine that the FOMC conceives of monetary policy as a contingent plan. It would then set a path for nominal expenditure growth equal to the sum of the trend and cyclical components of real expenditure growth plus an objective for inflation. Achievement of the desired growth in nominal expenditure would be contingent on realization of the assumed funds rate path. As long as nominal expenditure grew as anticipated, the FOMC would move the funds rate along this path. To eliminate deviations of nominal expenditure from its desired path, the FOMC would move the funds rate relative to its path.

The FOMC does not discuss such a path and Board documents do not reveal the funds rate path assumed in Greenbook forecasts. This lack of knowledge would be important if the FOMC could make reasonably accurate forecasts of nominal GDP growth based on an assumed path for the funds rate. That is, the path would be important if the FOMC used feed-forward rather than simple feedback control procedures. However, evidence on the accuracy of Greenbook forecasts indicates that they contain useful information about the contemporaneous quarter as long as some hard data are available for that quarter, but very little useful information about future quarters.[11] FOMC procedures are

[8] For 1980 through 1997, the correlation between four-quarter forecasts of nominal output growth in the Greenbook for the February FOMC meeting and the Humphrey-Hawkins figure used as a proxy for the FOMC's objective for nominal output growth is .94. Over a four-quarter time horizon, nominal output growth is under the control of the FOMC to a significant extent. The agreement between Board staff and FOMC member "forecasts" indicates broad underlying agreement on the acceptable outcome for nominal output growth.

[9] For a discussion of FOMC procedures and documents, see Lombra and Moran (1980).

[10] The prediction is for the quarter in which the FOMC meeting occurred if the meeting is in one of the first two months of a quarter and for the subsequent quarter if the meeting is in the last month of a quarter. There were 11 FOMC meetings in 1980 and 8 per year thereafter. The funds rate peg is the value the Open Market Desk expected to prevail at the beginning of the first full reserve settlement period following an FOMC meeting and is taken from the Desk's annual reports. Because the Greenbook remains confidential for five full calendar years after FOMC meetings, the graphs end with 1991.

[11] See Joust and Stekler (1997). Hetzel and Olmem (1997) examine how well the Greenbook forecasts "final" GDP figures, that is, the figures released at the end of the third month in the quarter following the forecasted quarter. For the period January 1980 through December 1996, for Greenbook forecasts of annualized quarterly growth rates of GDP (GNP before December 1991) made in the third month of the quarter preceding the

therefore aptly characterized as simple feedback control. The FOMC moves its funds peg away from its prevailing value (subject to smoothing constraints) on the basis of the deviation of contemporaneous nominal expenditure growth from target.

The triangles of Figure 2 correspond to episodes when the FOMC raised the funds rate in the absence of economic strength relative to the Humphrey-Hawkins benchmarks. The triangles of Figure 3, which shows the bond rate, correspond to those on Figure 2. As indicated by Figure 3, these episodes reveal increases in bond rates that the FOMC interpreted as evidence of a rise in inflationary expectations (Goodfriend 1992).[12] They identify policy actions that exerted an independent impact on the real interest rate. At these times, the FOMC departed from its lean-against-the-wind procedures by raising the funds rate despite the absence of unusual strength in the economy. Instead of tracking the real rate, the FOMC induced a temporary rise in it. Funds rate changes were policy-altering.

Figure 2 shows a positive correlation of changes in the FOMC's funds rate peg with misses between predicted nominal GDP growth and the Humphrey-Hawkins benchmark. From the February 1983 FOMC meeting through the December 1992 meeting, the correlation between funds rate changes and misses from target of nominal output growth calculated from Greenbook predictions is .49. One can also construct a target path in level form for nominal output that is the analogue of the target growth rates shown in Figure 1. The target level rises from the level of nominal output in the fourth quarter of the preceding year at a rate given by the midpoint of the FOMC's central tendency range for four-quarter nominal output growth announced at the previous Humphrey-Hawkins hearings. The correlation between the resulting differences in predicted and targeted levels of nominal output and changes in the funds rate is .58 over the period 1983 through 1991.[13]

Table 1 shows a regression of the changes in the funds rate of Figure 2 on this latter measure of the difference between the predicted and benchmark level of nominal output. It also includes intermeeting changes in the 30-year Treasury bond rate the day before the FOMC meeting. As shown, for the period from February 1983 through December 1991, there is a positive correlation of changes in the FOMC's target for the funds rate with both nominal output misses and changes in the 30-year

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forecasted quarter, the standard deviation of the forecast errors is 2.8. That is, a 95 percent confidence interval would be 5.6 percentage points. Replacing these forecasts of the succeeding quarter with a naïve forecast, taken as the forecasted value of the contemporaneous quarter made at the same time, yields predictions almost as accurate. With the naïve forecast, the standard deviation of the forecast errors is 3.0.

[12] The FOMC operates with discretion in a political system that regularly pressures it for an expansionary policy. As a result, the FOMC must worry about its credibility to control inflation. In Goodfriend’s terminology, in the 1980s, the FOMC periodically had to put down "inflation scares."

[13] The end of 1982 marks the end of the nonborrowed-reserves procedures adopted October 1979. Also, the initial period of Volcker's tenure as chairman, August 1979 through 1982, can be thought of as the final stop phase of the preceding stop-go period. In this sense, 1983 marks the year the FOMC moved toward stabilizing nominal expenditure growth. (The generalization holds relative to the earlier period as monetary policy was moderately expansionary in the mid-1980s and moderately contractionary toward the end of the 1980s.) 1991 is the last year for which Greenbook predictions are available.

bond yield.[14]

A measure of capacity utilization could add explanatory power to the regression explaining changes in the funds rate peg. For example, real expenditure might grow at an unexpectedly high rate without a decline in measures of excess capacity. The FOMC might then conclude that it had underestimated the sustainable rate of growth of real expenditure and not raise its rate peg. Comments by Chairman Greenspan suggest that the FOMC watches the National Association of Purchasing Manager's supplier delivery index as a measure of excess capacity.[15] However, including such a variable did not improve the fit of the regression in Table 1.[16],[17]

Figures 2 and 3 summarize policy actions for the period 1980 through 1992. Monetary policy has altered in one important respect since the early 1990s: the FOMC has increased its traditional reluctance to make changes in its rate peg that might need to be reversed shortly. Faced with, say, incipient unsustainable strength in economic activity, the FOMC waits before raising its funds rate peg

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[14] Mehra (1997) documents the increased responsiveness after Paul Volcker became Fed chairman of the FOMC to bond yields as measures of expected inflation offers. In his abstract, he states, "In the pre-1979 period, when the bond rate rose above the one-period inflation rate, actual inflation accelerated. In the post-1979 period, however, the bond rate reverted back and actual inflation did not accelerate. Thus, the bond rate signaled future inflation in the period before 1979, but not thereafter. The results here indicate that in the period after 1979 Fed policy prevented any pickup in inflationary expectations (evidenced by the rise in the bond rate) from getting reflected in higher actual inflation."

[15] In response to a question by Senator Bingaman, Chairman Greenspan [U.S. Congress, 3/20/97] responded: "Maximum sustainable growth requires . . . definition. It would require us to define where we would be when serious pressures on resources began to emerge. In other words, when we began to see that manufacturers were having difficulty meeting their delivery schedules, and, therefore, the lead times on the deliveries to customers would stretch out. . . . they don't have enough facilities to produce."

[16] The R-squared of the regression of Table 1 did not improve when the variable was included both as a first difference and as the difference between its value and the benchmark level of 50.

[17] A number of factors lower the correlation between changes in the funds rate and misses of predicted expenditure growth from the Humphrey-Hawkins benchmark. However, none conflict with the idea that the FOMC targets nominal expenditure growth. 1) The FOMC does not adjust the funds rate immediately in response to weakness or strength in economic activity because it tries to avoid short-run reversals of its rate peg. 2) The proxy for the FOMC's target for nominal output growth is imperfect. Also, the target can vary in an ongoing way. If nominal expenditure growth differs from its benchmark because of special factors, the FOMC may not alter the funds rate. 3) The FOMC need not accept Board staff forecasts. Regional Bank presidents especially rely on a wide variety of anecdotal information in assessing the strength of the economy. The two most important sources for this information are regional surveys reported in the Beige Book and monthly roundtable discussions on regional economic conditions with the Banks' directors.

4) The FOMC's decision about the funds rate peg involves discrete changes, while target misses evolve continuously. 5) Many factors involving the timing of funds rate changes introduce noise. For example, the chairman typically only agrees to change the funds rate when he has enough of a consensus among voting FOMC members to avoid a significant number of dissents. The chairman tries to time changes in the funds rate peg so that they look right in light of incoming data on the economy, for example, by having a decrease follow release of a weak payroll employment number. 6) When the FOMC has moved the funds rate, it may wait for a while to watch for an effect on the economy. 7) The proxy used for the FOMC's nominal output target weighs equally all FOMC members' predictions instead of recognizing the dominant role of the chairman. Fed chairmen may alter the FOMC's implicit target for nominal output growth tactically and without explicit statement in response to ongoing changes in the political environment.

until sufficient time has elapsed to determine that the strength is permanent.[18] For example, the economy grew strongly in 1996Q2 (real GDP grew at an annualized rate of about 6 percent), but the FOMC waited for information on 1996Q3 before raising the rate peg. When growth moderated, the FOMC kept its rate peg unchanged.[19] Increased credibility has made this wait-and-see practice possible. Much of that credibility came from stability of inflation. CPI inflation averaged 2.9 percent from 1991 through 1996, with the highest annual rate 3.3 percent in 1996. "Wait-and-see" requires that markets believe the FOMC will raise its rate peg by enough to contain inflation if incipient strength in economic activity turns out to be persistent rather than transitory. The FOMC in fact did so in 1994. In contrast, in the pre-1980 period, the FOMC also practiced wait-and-see, but was unwilling to raise its rate peg sharply enough to prevent drift in inflation.[20]

The hypothesis advanced here is that the FOMC causes the funds rate peg to equal the nominal natural rate by stabilizing the growth rate of nominal expenditure. In doing so, it eliminates money supply shocks. Furthermore, the rate peg eliminates money demand shocks. In the absence of monetary shocks, the observed economy would approach a real business cycle model. The relationship between the real interest rate and fluctuations in growth rates of real expenditure would then offer information about the structure of the economy independent of monetary complications. However, even if the U.S. has moved a considerable distance toward such a world, interest-rate smoothing by the FOMC still causes term-structure effects. That is, rate smoothing decreases volatility of rates at the short end, but then must increase volatility at the long end.

Figure 4 illustrates these points. It shows the 30-year bond rate lagged 4 quarters (with an inverted scale) and the four-quarter rate of growth of real GDP.[21] Increases (decreases) in the bond

[18] In this sense, the FOMC has increased the extent to which it smoothes interest rates. However, such smoothing is different than the kind discussed in Poole (1970). With the latter, the central bank sets its rate peg initially at a value such that expected future changes are zero and then limits the magnitude of changes until it gains sufficient additional information to determine whether the shocks impinging on the economy are real or nominal. Smoothing as practiced by the FOMC does limit short-lived fluctuations in short-term interest rates. However, on those occasions when emerging strength in economic activity turns out to be permanent rather than transitory, the FOMC must raise its rate peg by more than if it had raised the peg promptly. The FOMC takes out high frequency movements in short-term rates, but imparts additional volatility at lower frequencies.

[19] The FOMC smoothes in this way to avoid political criticism. If it were to raise its funds rate peg in response to incipient strength in economic activity and that strength subsequently dissipated, it would have to reverse the initial rise. Politicians would then criticize the Fed for killing off economic growth.

[20] It is unclear how much of the increased credibility resides with the Fed as an institution as opposed to the person of its chairman, Alan Greenspan. If the FOMC pursued analytical procedures, with explicit goals and an articulated strategy for achieving those goals, then the public would associate the low inflation of the 1990s with the Fed as an institution and with its procedures. However, the chairman embodies the judgmental procedures of the FOMC. To a significant extent, each new chairman must reestablish the credibility of his commitment to low inflation.

[21] The graph is from Brinner and Wyss, 1997. A graph with a ten-year real bond rate looks about the same when the real rate is measured as the ten-year Treasury constant-maturity rate minus the predicted ten-year inflation rate from the Philadelphia Fed Survey of Professional Forecasters. The implication is that in the 1990s changes in real rates rather than inflation expectations have been the primary determinants of fluctuations in bond rates.

rate restrain (stimulate) real growth. Given the recent stability the FOMC has imparted to nominal expenditure growth, Figure 4 shows how the real rate of interest equilibrates real sector shocks. However, “wait-and-see” smoothing affects the behavior of the term structure. For example, when the economy strengthened in 1996Q2 and the strength turned out to be transitory, bond yields rose and then fell with no change in the rate peg. In contrast, when the economy strengthened in 1994 and the strength turned out to be sustained, bond rates rose but the FOMC’s rate peg ultimately rose more.

A key characteristic of monetary policy since the early 1980s has been the stability of the FOMC’s implicit target for nominal expenditure growth, as measured by the midpoint of the central tendency range presented by the chairman during his February Humphrey-Hawkins testimony. This benchmark figure moved down in three stages. From 1980 to 1985, it averaged about 9 percent, with a range of 2.75 (minimum of 7.75 and maximum of 10.5 percent). From 1986 to 1990, it averaged about 6.5 percent, with a range of 1.5 percent (minimum of about 5.5 and maximum of 7 percent). From 1991 to 1997, it averaged about 5 percent, with a range of 1.25 percent (minimum of 4.5 and maximum of 5.75 percent).

Actual nominal output growth moved down irregularly in the 1980s as the FOMC moved to lower inflation (Figure 5). Apart from 1991, which was a year of recession, the 1990s exhibit considerable stability. Annual figures for nominal GDP growth from 1990 through 1997 moved closely around the 5 percent average figure. The annual figures from 1990 to 1997 are, respectively, 5.6, 3.0, 5.5, 5.0, 5.9, 4.6, 5.1, and 5.9 percent.[22]

The FOMC used a Friedman k-percent rule, but for nominal expenditure, not money. If money demand is unstable or highly interest elastic, then monetary policy provides nominal stability by stabilizing the growth of nominal expenditure rather than money. By stabilizing growth of nominal expenditure, the FOMC allows the price system maximum latitude to stabilize real growth.[23]

5. Control of nominal expenditure

As described above, nominal expenditure growth is an indicator variable. Deviations of nominal expenditure growth from its implicit target (sustainable real expenditure growth plus targeted inflation) signal deviations of the funds rate peg from the nominal natural rate.[24] Nominal expenditure

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[22] The result has been considerable stability of inflation. In 1983, the year-over-year annual rate of CPI inflation (excluding food and energy) was 4.0 percent. The greatest subsequent deviations occurred in 1984 and 1990, when inflation rose to 5.0 percent, and 1994, when it fell to 2.8 percent. Over the 13 year period from 1983 to 1996, the range of annual inflation rates was only 2.2 percentage points.

[23] However, by operating with a rate peg, even though the FOMC follows a procedure that causes the real funds rate to track the economy’s equilibrium real rate, the FOMC can take credit for the self-equilibrating character of the economy.

[24] Given the model, nominal expenditure growth is not an intermediate target. One of its components, real expenditure growth, cannot be controlled systematically by the FOMC, and the other component, inflation, is an

growth is also an objective. Given the trend rate of growth of real output, nominal expenditure growth determines inflation. Nominal expenditure growth and inflation are interchangeable FOMC objectives.

FOMC control of nominal expenditure growth can be understood in terms of the monetary determinants of nominal expenditure.[25]

Rearrange equation (2), with $m^s = m^d = m_t$, to get

$$(7)\ m_t + [a_2 R_t - v_t] = p_t + a_1 + a_3 [p_t - E_{t-1} p_t] .$$

Equation (7) is the equation of exchange (in logarithmic form). Velocity, the bracketed left-hand-side term, varies with the interest rate and with random shifts in money demand. The right-hand side is nominal expenditure: the price level times real expenditure. In (logarithmic) first differences, (7) is

$$(8)\ \Delta m + \Delta V = \Delta y ,$$

where Δm, ΔV, and Δy are percentage changes in money, velocity, and nominal expenditure. Nominal expenditure depends upon the combined effect of Δm and ΔV. Changes in money depend upon the difference between the rate peg and the reference rate $[R_t - (E_{t-1} R_t + x_t)]$ and upon expected inflation. Changes in velocity depend upon the level of the interest rate R_t and shifts to money demand.[26]

The regression of Table 2 gives empirical content to velocity. It predicts changes in M2 velocity by changes in the opportunity cost of holding M2, measured as the commercial paper rate minus the own rate on M2 (R - RM2).[27] A weighted average of the contemporaneous and lagged

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objective.

[25] The FOMC need not understand its procedures in terms of money creation or monetary control. It need not (and generally does not) take the behavior of money into consideration when setting its funds rate peg. Monetary acceleration does indicate a divergence between the funds rate and the nominal natural rate. However, because of noise in the monetary aggregates, such as changing seasonals, and because of the variability of money demand, identifying a change in the trend rate of growth of money requires a considerable period of time (generally about six months). Most of the changes the FOMC makes in its rate peg are policy-maintaining changes that involve tracking fluctuations in the natural rate of interest. For such changes, the FOMC relies on data on the real economy.

[26] Before 1981, the interest inelasticity of M1 demand meant that in predicting nominal expenditure one could use the behavior of the quantity of M1 while ignoring the behavior of M1 velocity. With the introduction nationwide of interest-bearing checking accounts in 1981, M1 demand became interest elastic and this simplicity disappeared. Unlike M1, the M2 demand function remained stable (Hetzel and Mehra 1989). However, because of the high interest elasticity of M2 demand, in relating the behavior of M2 to nominal expenditure, one must account for the behavior of its velocity. For example, as interest rates rise in economic recovery, initially, much of the expansionary impact of monetary policy comes from rising velocity (Hetzel 1992).

[27] For a fuller discussion, see Hetzel (1992). Following Friedman and Schwartz (1982, Section 6.6.3), the regression uses percentage changes in nominal output (GDP) to capture the nominal yield on physical assets.

change in the opportunity cost variable, with the estimated coefficients from the regression used as weights, shown in (9), yields predicted changes in M2 velocity.

(9) $\Delta V[\Delta(R_t - RM2_t)] = 1.12\ \Delta(R_t - RM2_t) + 1.22\ \Delta(R_{t-1} - RM2_{t-1})$

Equation (8) becomes operational as a predictor of nominal expenditure by using actual changes in M2 for Δm and predicted changes in M2 velocity, from (9), for ΔV.

The dashed line in Figure 5 shows the resulting measure of the monetary determinants of nominal expenditure. The solid line shows actual percentage changes in nominal GDP growth. Although the actual series exhibits greater cyclical amplitude, the two series generally move together. Their common movement demonstrates the stability of the public's demand for M2, apart from the period 1991 to 1994 when the M2 demand function shifted leftward.[28] The correspondence between drops in the dashed line and business cycle troughs, denoted by T, reveals that weakness in the monetary determinants of nominal expenditure corresponds to troughs in real economic activity. This correspondence, however, does not reveal the direction of causation.

Identifying when money constituted an independent disturbance requires determining when shocks produced divergences in the two sides of (7) at the prevailing price level. The price level had to adjust when the central bank created money by setting its rate peg below the nominal natural rate. The empirical hypothesis advanced here is that this situation occurred when the FOMC imparted a persistent inertia to its rate peg relative to changes in the growth rate of nominal expenditure.

The preceding sections applied a model to the record of monetary policy actions to infer the character of monetary policy in the period following the early 1980s. It concluded that the FOMC followed a simple feedback procedure for controlling nominal expenditure growth with a funds rate instrument. Stabilizing nominal expenditure growth caused the FOMC to vary its funds rate peg in a way that tracked the nominal natural rate, thus providing for the monetary control necessary to stabilize inflation. The variability in inflation prior to the early 1980s allows a test of this characterization of monetary policy. Did the FOMC employ procedures for setting its funds rate peg in the earlier period that reversed the key characteristics of the later procedures?

Two key changes occurred. First, in the early 1980s, the FOMC quickened the response of changes in the funds rate to changes in nominal output growth. Over the period 1983Q1 through 1992Q4, the correlation between quarterly percentage changes in the funds rate and quarterly

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The estimation ends in 1990 to avoid the leftward shift in M2 demand produced by the rise in bond and stock mutual funds (Hetzel and Darin 1994). As shown in Figure 5, the pre-1990 M2 demand function ceased shifting leftward after 1994.

[28] The issue of whether money demand is stable is different from the assumption of the model in section 2 that the price level is a monetary phenomenon. Given the latter assumption, regardless of the stability of money demand, the central bank controls the price level through procedures that provide for monetary control.

percentage changes in contemporaneous nominal output and nominal output lagged one and two quarters is, .48, .61 and .36, respectively. In contrast, over the period 1966Q1 through 1979Q4, these correlations (.16, .43 and .26, respectively) fall off, especially the contemporaneous correlation.[29] Second, in the early 1980s, the FOMC began to interpret increases in bond rates as evidence of a rise in inflationary expectations, which moved it to raise its funds rate peg. In contrast, prior to the 1980s, the FOMC at times interpreted a rise in bond rates in itself as evidence that monetary policy had become tighter. (See, for example, FOMC Memorandum of Discussion, 3/9/71, pp. 266-7.) The following section summarizes the stop-go monetary policy that began in the mid-1960s.

6. Stop-go monetary policy

Over the period 1965 through the end of the 1970s, monetary policy earned the appellation "stop-go" from the FOMC's alternate concentration on reducing inflation and stimulating economic activity. The following empirical review attempts to identify this pattern. Identification of the influence of monetary policy in economic time series requires both a model and empirical observations about policymaking. Identification makes use of the model exposited earlier, where attempts by the monetary authority to limit increases in interest rates resulting from strength in economic activity result in monetary accelerations and inflation, and conversely for weakness in economic activity. Identification also makes use of the documented reluctance of the FOMC to raise its funds rate peg during periods of economic recovery and to lower the peg at the onset of periods of economic weakness.

The data examined below do not allow identification of an FOMC reaction function, which would reveal FOMC targets for real output growth and inflation and the response of the funds rate peg to misses in these targets. However, the data do reveal significant interest rate smoothing by the FOMC over the business cycle. That smoothing was the counterpart of an activist monetary policy of manipulating nominal expenditure. During economic recovery, through the monetary acceleration produced by restraining increases in its funds rate peg, the FOMC engendered relatively high rates of growth of nominal expenditure in an attempt to stimulate real output growth. Conversely, during economic decline, through the monetary deceleration produced by restraining declines in its funds rate peg, the FOMC engendered relatively low rates of growth of nominal expenditure in an attempt to lower inflation.

[29] The correlations for 1993Q1 to 1997Q4 (-.14, .29 and .26) revert to the earlier pattern. The low contemporaneous correlation reflects a return to "wait and see" rate smoothing, as explained above. However, in the later period, the FOMC has maintained the confidence of the markets that if incipient strength turns out to be permanent rather than transitory, it will raise the funds rate by whatever amount necessary to prevent a rise in inflation. The increased credibility has also caused the FOMC to interpret increases in bond rates as increases in the real rate rather than the inflation premium.

Figures 6, 7 and 8 display data available to the FOMC at the time of its meetings.[30] Figure 6 plots the most recent annualized three-month M1 growth rate available to the FOMC at the time of its meetings and fits a step function to this series. It also plots the funds rate following the meeting. Figure 7 plots the most recently available figure for the annualized three-month rate of CPI inflation and the unemployment rate. Figure 8 plots the most recently available figure for the three-month growth rate of industrial production and the real rate of interest. The latter is calculated as the commercial paper rate minus the inflation rate predicted by the staff of the Board of Governors in the Greenbook, which is circulated prior to FOMC meetings. (The real rate series starts in November 1965 when Greenbook forecasts begin.)

Figures 6, 7 and 8 divide the four go-stop cycles of the period from 1965 through 1981 into three phases. Phase 1 demarcates those intervals over which the FOMC placed a higher priority on encouraging real growth than on controlling inflation. The FOMC kept its funds rate peg at a level that produced a monetary acceleration. Phase 1 became phase 1a when the FOMC became willing to raise its rate peg. In phase 1a, strengthening real growth and rising inflation caused the FOMC to raise the funds rate peg, but not by enough to prevent continued high money growth.

By the end of phase 1a intervals, inflation had become the predominant concern of the FOMC. Phase 1a became phase 2 when M1 growth began to fall. In phase 2, the FOMC initially maintained a high funds rate peg despite monetary deceleration and a decline in economic activity. By the end of phase 2, the FOMC had become more concerned with deteriorating real growth than inflation. Phase 2 became a new phase 1 when the FOMC began to lower the funds rate.

Table 3 summarizes the information contained in Figures 6, 7 and 8.[31] Again, phase 1 demarcates intervals over which the FOMC was concerned primarily with the real sector rather than inflation. In all phase 1 intervals except the second, where growth of industrial production fell sharply, the unemployment rate was at a level considered unacceptable (col. 10). (In Figure 7, the dashed axis marks 4 percent unemployment, which was equated with full employment until the mid-1970s.) Growth of industrial production fell from the preceding phase (col. 7). The inflation rate either remained low or declined until well into the phase (cols. 8 and 9).

In phase 1, the FOMC kept the funds rate at a level that produced a monetary acceleration. The funds rate fell over the duration of phase 1 except in the first phase, which is anomalous as the first phase of the four go-stop cycles (col. 3). The average funds rate also fell relative to the prior phase 2 (col. 2), as did the real rate of interest (col. 5). During phase 1, M1 growth, expressed as a step function, rose (col. 12). Over the four phases, it rose on average by 5.2 percentage points.

Phase 1a started when the FOMC became willing to let the funds rate rise. It marked a transitional phase in FOMC priorities away from real growth and toward inflation. The unemployment

[30] An appendix describing the construction of the data series and listing the data is available from the author.

[31] An appendix, available from the author, provides a detailed analysis.

rate either reached or moved toward cyclical lows (col. 11). Industrial production grew strongly and growth rates rose relative to phase 1 (cols. 6 and 7). Over the course of phase 1a intervals, inflation rose strongly (col. 9). (The exception is the third phase 1a, April 1971 to March 1973, in which price controls constrained the rise in inflation until the end. In April 1973, the FOMC saw inflation soar.) During phases 1a, the FOMC began to let the funds rate rise, but not by enough to let the real rate of interest rise appreciably (col. 5). Nor did the funds rate rise enough to constrain the monetary acceleration begun in phase 1.

During phase 2 intervals, the FOMC concentrated on reducing inflation. They started when M1 growth began to fall. The unemployment rate remained relatively low in phase 2 (cols. 10 and 11). Industrial production grew strongly at the beginning, but declined as the phase progressed and fell relative to phase 1a (col. 7). Inflation rose in phase 2 (cols. 8 and 9). (In the fourth phase 2, it declined after rising sharply, but remained high.)

The funds rate and real rate rose in phase 2 (cols. 2, 3 and 5). (The exception was the very short phase 2 from July 1966 to October 1966, where the Board of Governors pressured banks into rationing credit quantitatively rather than through a rise in interest rates.) The M1 step function fell strongly at the beginning of all phase 2 intervals (col. 12). The decline in economic activity toward the end of phase 2 caused the FOMC's priority to shift away from inflation. The stop phase then became the next go phase 1 when the FOMC began to lower the funds rate.

Table 4 shows the lags in the significant turning points in the series, marked by the dots on the figures. The lags of the second cycle are typical. On March 1969, the FOMC saw the three-month M1 growth rate decline, and the M1 step function moved down from 6.5 to 2 percent. The FOMC then saw three-month growth rates of industrial production turn down in September 1969 and become negative in November. The funds rate did not peak until January 1970, and the real rate peaked the same month. Note also that the real rate reached its peak 4 months after the peak in growth of industrial production. The inflation rate peaked only in June 1970.

The lags just detailed are evidence of a monetary policy that imparted considerable inertia over the business cycle to the short-term rate of interest. The identifying assumptions used to extract the influence of policy from the data are a combination of the model exposited in Section 2, which allows for short-run monetary nonneutralities, and the empirical observation that during this period the FOMC postponed lowering its interest-rate peg in response to weakening economic activity out of a concern for inflation.[32]

Identification of monetary policy is valid only if the model is valid. A quantity-theory model that allows for nonneutrality of money does explain the lags shown in Table 4 in a straightforward way.

[32] For example, in 1967 and the first half of 1968, Chairman Martin had resisted raising interest rates despite strong real growth and rising inflation because he had wanted to encourage Congress to pass the income tax surcharge, which he believed would cool off the economy and inflation. After the passage of the surcharge in June 1968, he lowered the funds rate. Despite the tax hike, the economy continued booming. In early 1969, Martin raised rates and intended keep them high until inflation disappeared.

As shown, across the four cycles, first, the rate of growth of M1 peaked, then the rate of growth of industrial production, and then the funds rate and the real rate. As a result as these lags, there is an initial negative correlation between changes in the rate of growth of industrial production and the real rate (the former falls while the latter continues rising). Then, after the real rate peaks, the two series are positively correlated (both fall). Monetary nonneutrality in the form of a liquidity effect explains the initial negative correlation. In contrast, a model that does not allow for monetary nonneutralities must assume that the nature of the shock affecting the economy changed to get the observed change in the sign of the correlation between changes in growth of industrial production and the real rate. And even then, such a model must still explain the turning points in money.

Of course, the data on lags do not themselves reveal the causal relationships assumed above. In particular, the above explanation attributes causal significance to the fact that peaks in M1 growth preceded peaks in the real rate. That is, a monetary deceleration produced a rise in the real rate. One could instead assume that the real rate is entirely determined by real factors and the behavior of the real rate causes M1 growth. In that event, the relevant timing relationship would run from the trough in the real rate to the peak in M1 growth. The rise in the real rate would then cause the subsequent fall in M1 growth.

The argument in favor of the prior explanation that assigns causal significance to money depends upon the empirical assumption that the FOMC put inertia into changes in the funds rate over the stop-go period. With inertia in the funds rate and a rising equilibrium real rate of interest, prior to the peak in M1 growth, the real funds rate would tend to fall below the equilibrium real rate. That is, the FOMC's funds rate peg would be too low. That relationship should produce a monetary acceleration. But instead, money growth peaked and a monetary deceleration occurred.

With two empirical supplements, the quantity-theory model of Section 2 predicts the monetary accelerations and decelerations of the stop-go period. The first is the empirical observation of cyclical interest rate smoothing by the FOMC described above. The second is the empirical hypothesis that changes in the rate of growth of nominal output relative to the funds rate indicate discrepancies between the nominal natural rate and the funds rate.

Figure 9 shows the inertia in the funds rate relative to changes in nominal output growth (GDP) and the associated monetary accelerations and decelerations (quarterly data from 1997 time-series). Arrows connect turning points in nominal output growth and the funds rate running from peak to peak and trough to trough. Table 5 shows dates of the turning points in nominal output growth and the funds rate and the lags in quarters. It also shows the associated shift in the M1 step function.

Two short-lived, low M1 steps break the pattern of steady monetary acceleration in phases 1a shown in Figure 6. As only temporary interruptions to sustained monetary stimulus, they could have been submerged in the broader high M1 steps. Nevertheless, as individual episodes, they illustrate the relationship between money growth and the funds rate relative to the nominal natural rate. The first aberrant low M1 step runs from October 1971 to February 1972.[33]

In late 1970 and early 1971, the FOMC pushed the funds rate down sharply to 3.5 percent in March 1971 (Figure 6). From February through June 1971, the real commercial paper rate averaged only .3 percent (Figure 8). M1 growth surged into low double-digits in this period (Figure 6). Over the longer period from November 1965 through January 1971, the real interest rate averaged 2.9 percent. The only previous period of comparably low real rates had been July 1967 to November 1967, when real rates had averaged 1.4 percent. M1 growth also surged into the low double digits in this period.

President Nixon imposed wage and price controls on August 15, 1971. The announcement of controls produced a widespread expectation of a reduction in inflation, captured in Board staff forecasts. With little change in the funds rate, the real rate rose from .8 in July to 3.3 percent in September. At the same time, M1 growth fell sharply. The FOMC pushed the funds rate down to 3.25 in February 1972, and the real rate fell to zero. M1 then grew rapidly in 1972. It seems clear that the policy actions of this period, both funds rate changes and the announcement effects of wage and price controls, moved the real funds rate relative to the economy's natural rate and generated large fluctuations in money growth.

The second low M1 step to interrupt a sustained period of high M1 growth was from December 1978 to April 1979 (the figures are dated as seen by the FOMC, Figure 6). Inflation rose rapidly in 1978, from a low near 4 percent in the beginning of the year to 12 percent in July. The foreign exchange value of the dollar fell sharply. In response, the FOMC raised its rate peg from 6.75 in January to almost 10 percent in November 1978. The real rate rose from zero in April and May to 2.5 percent by December 1978. M1 growth fell from 9 percent over the period January through September 1978 to less than 5 percent from October 1978 through February 1979.

Early in 1979, the Board staff predicted a recession, and the FOMC retreated from further funds rate increases. As inflation rose again in 1979, expected inflation rose. With an unchanged funds rate, the real interest rate fell to zero in April 1979 and M1 growth rose back to double digits. The FOMC began to push the funds rate up again in August when Paul Volcker became Fed chairman.

One could argue that monetary restriction began in December 1978, followed by a short-lived relapse. For that reason, Figures 6a, 7a and 8a offer two alternative dates for the peak in M1 growth: November 1978 and October 1979. The first offers a better explanation for the growth of industrial production, which fell after April 1979, but revived in early 1980. The Carter credit controls, imposed in March 1980 and abandoned in July 1980, add a short-lived bust-boom cycle that obscures the longer phase of disinflation. On March 15, 1980, the Fed implemented the credit control program and pushed the funds rate up to 17.8 percent. At its May and July meetings, the FOMC saw 3-month M1 growth rates fall to zero, and the funds rate fell to 9 percent following the July meeting. The abandonment of

[33] The dates correspond to the period over which the FOMC saw M1 growth as low as shown in Figure 6. The actual period of low M1 growth was from August 1971 to December 1971.

the controls in July led to a resurgence of money growth - the M1 step function rose to 14.5 percent over the August to December 1980 period. Growth rates of industrial production declined and then rose dramatically with the imposition and lifting of the credit controls.

Over the longer period, the funds rate rose steadily and peaked at 20 percent in May 1981 (Figure 6a). The M1 step function fell to 1.9 percent from February through December 1981.[34] July 1981 is a peak in the business cycle.

7. A summary of monetary policy

The paper uses a quantity-theory model to summarize monetary policy. The price level emerges out of the interaction between a nominal money supply function (whose behavior is dominated by the central bank) and a real money demand function (whose behavior is dominated by the public). The model makes a basic assumption about the rationality of individuals: their well-being depends upon real, not nominal, variables. Because the central bank ultimately controls only the monetary base, a nominal variable, and because the public cares about real variables, within an appropriate time horizon, the public rather than the central bank determines real magnitudes, such as the real quantity of money and real expenditure. The central bank determines nominal magnitudes, especially the price level. To do so, it must control a nominal variable.

On the money demand side of price level determination, the public controls a real variable - the ratio of nominal expenditure to money holdings (the velocity of money). While the public controls the ratio, the central bank can control either the numerator or denominator, but not both independently. Depending upon its procedures, the FOMC exercises proximate control either on the numerator or denominator. Under actual procedures, the FOMC sets an interest rate peg. It is convenient to discuss its procedures under two alternative assumptions: no shocks and shocks.

With a rate peg and no shocks, the FOMC acts most directly on the rate of growth of nominal expenditure. Real variables determine the rate of growth of real expenditure. The rate of growth of nominal expenditure equals this real growth plus the public's expectation of inflation, which is determined by the FOMC. The public then demands nominal money balances commensurate with nominal expenditure growth. Given its rate peg, the central bank accommodates the public's demand for nominal money. Changes in that demand reflect changes in nominal expenditure, changes in the opportunity cost of holding money such as changes in interest rates, and random changes. (The denominator adjusts to the numerator in the velocity of money ratio.)

The assumption of no shocks means that the central bank is not itself a source of disturbances. For this assumption to hold, in setting its rate peg, the central bank must set the implicit real rate peg equal to the natural rate (the sustainable real rate). This requirement endows current

[34] Figures are for the shift-adjusted M1 used by the FOMC. See Bennett, 1982. Figure 6a does not show M1 growth for 1982, as the nationwide introduction of NOW accounts breaks the continuity of the M1 demand function by making it more interest elastic.

procedures with their characteristic flavor. The FOMC devotes most of its effort to gathering and assessing current information on the strength of real economic activity in order to make the funds rate peg track the natural rate. The FOMC must also keep the public's expectation of inflation equal to the inflation rate it considers acceptable. That acceptable rate determines the inflation premium in the interest rate so that the FOMC's rate peg equals the nominal natural rate – the natural rate plus the public's expectation of inflation.

Shocks arise when the rate peg set by the FOMC is inconsistent with the nominal natural rate. Historically, this inconsistency arose when the FOMC failed to move its funds rate peg in a way that stabilized growth of nominal expenditure. For example, in the stop-go period, when real expenditure strengthened early in the recovery phase of the business cycle, the FOMC limited increases in its rate peg by allowing monetary acceleration. In this instance, nominal expenditure must adjust to the increase in money. The numerator adjusted to the denominator in the velocity of money ratio.

A key quantity theory assumption is that the functional forms for nominal money supply and demand differ. In the above example, the nominal money supply function, which depends upon the difference between the FOMC's rate peg and the nominal natural rate, shifts rightward relative to the public's nominal money demand schedule, which depends upon the level of the interest rate. Because the public ultimately cares only about real variables, the adjustment to the increase in money cannot take the form of an increase in real expenditure and real money. The price of money, the inverse of the price level, must fall.

The FOMC must have some policy (articulated or implicit) about the extent to which to allow the random monetary emissions produced by shocks to affect permanently the price level. At one extreme, it can add a random walk component to prices. At the other extreme, it can maintain the price level over time around a fixed trend line. In the former case, determination of the price level entails FOMC manipulation of two nominal variables: the public's expectation of trend inflation and changes in monetary aggregates (the monetary base and money). Current FOMC procedures determine the trend rate of inflation as the difference between the trend rates of growth of nominal and real expenditure, with the former primarily dependent upon the public's expectation of inflation. The price level emerges out of trend inflation and the degree of drift the FOMC allows in the price level.

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Appendix: Tables and Figures

Table 1. FOMC Reaction Function, February 1983 to February 1997

$\Delta FR = .24*MISS + .33*\Delta BR + \hat{u}$
(6.1) (5.2)

CRSQ = .43 SEE = .27 DW = 1.6 DF = 112

Notes: ΔFR is first differences of the FOMC's target for the funds rate immediately following an FOMC meeting. MISS is the level of nominal output predicted in the Greenbook minus the quarterly benchmark level derived by applying the midpoint of the central tendency range for nominal output growth announced at the most recent Humphrey-Hawkins hearings to the prior year's fourth quarter value of nominal output. If the FOMC meeting falls in the first two months of a quarter, the predicted value is for the contemporaneous quarter. If the meeting falls in the final month of a quarter, the predicted value is for the subsequent quarter. ΔBR is first differences of the 30-year bond rate as of the day preceding the FOMC meeting.

CRSQ is the corrected R-squared; SEE the standard error of estimate; DW the Durbin-Watson statistic; and DF degrees of freedom. Absolute value of t-statistics in parentheses. Estimation is by OLS.

Table 2. M2 Velocity Regression, 1950 to 1990

$\Delta \ln V_t = 3.4*Korea + 2.3\ \Delta(R_t - RM2_t) + .54\ \Delta^2 \ln GDP_t + {}_t$
(3.9) (8.2) (6.4)

CRSQ = .76 SEE = 1.5 DW = 1.7 DF = 37

Notes: Observations are annual averages. V is the ratio of GDP (gross domestic product) to M2; R is the 4-6 month commercial paper rate; RM2 is a weighted-average of the own rates of return paid on components of M2; Korea is a shift dummy with the value 1 in 1951, 1952 and 1953 and zero otherwise. Before 1959, M2 is M4 in Table 1 of Friedman and Schwartz (1970). ln is the natural logarithm; Δ is the first-difference operator and Δ^2 the second-difference operator.

The financial market opportunity cost variable $(R_t - RM2_t)$ is entered with one contemporaneous and one lagged term. The estimated coefficients are, respectively, 1.12 and 1.22. Otherwise see notes to Table 1.

Table 3: The Funds Rate Target Set by the FOMC and Economic Data Seen by the FOMC at Its Meetings

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
			int.									Δ M1	M1 step
	FR	Δ FR	Δ FR	RR	Δ RR	IP	Δ IP	CPI	Δ CPI	U	Δ U	step	date
PHASE 1													
Cycle 1 (12/64-11/65)	4.1		.1			7.5		1.8		4.7		2.8	10/65
Cycle 2 (11/66-11/67)	4.4	-1.1	-1.5	2.3	- .1	-.3	-9.0	2.9	-.4	3.9	0	7.5	2/67
Cycle 3 (2/70-3/71)	6.2	-2.7	-5.0	3.0	-1.2	-6.0	-8.5	5.5	-.5	5.1	1.5	5.3	4/70
Cycle 4 (8/74-4/77)	6.0	-3.9	-7.5	- .1	-3.0	.3	-2.2	7.6	-2.3	7.6	-2.7	5.2	4/75
PHASE 1a													
Cycle 1 (12/65-6/66)	4.8	.7	.7	2.8		9.1	1.6	3.1	1.3	3.9	- .8		
Cycle 2 (12/67-3/69)	5.9	1.5	2.5	2.3	0	4.9	5.2	4.4	1.5	3.6	- .3		
Cycle 3 (4/71-3/73)	4.9	-1.3	3.0	1.4	-1.6	5.2	11.2	3.5	-2.0	5.7	.6		
Cycle 4 (5/78-10/79)	8.2	2.2	7.9	.7	.8	5.0	4.7	9.3	1.7	6.2	-1.4		
PHASE 2													
Cycle 1 (7/66-10/66)	5.5	.7	0	2.4	- .4	8.7	- .4	3.3	.2	3.9	0	-7.4	6/66
Cycle 2 (4/69-1/70)	8.9	3.0	.6	4.2	1.9	2.5	-2.4	6.0	1.6	3.6	0	-4.6	3/69
Cycle 3 (4/73-7/74)	9.9	5.0	6.0	2.9	1.5	2.5	-2.7	9.9	6.4	4.9	-.8	-4.9	3/73
Cycle 4 (11/79-5/81)	14.2	6.0	7.5	3.7	3.0	.2	-4.8	12.4	3.1	7.0	.8	-8.2	10/79

Notes: Observations are averages across phases of the data used in Figures 6, 7 and 8, that is, data available to the FOMC at the time of its meetings. FR is the funds rate; RR the real rate of interest; IP the rate of growth of industrial production; U the employment rate; and M1 the monetary aggregate M1. Δ indicates the change from one phase to the next. "int Δ FR" is the change in the funds rate from the first to last date of the phases. "M1 step date" is the date of the last observation of the preceding step. The "Δ M1 step" date 4/70 is the rise from the 4/69-4/70 step to the 3/72-3/73 step. The "Δ M1 step" dated 3/73 is the fall from the 3/72 - 3/73 step to the 10/74-4/75 step. The "M1 step" dated 4/75 is the rise from the 10/74-4/75 step to the 5/77-11/78 step. The "Δ M1 step" dated 10/79 is the fall from the 5/79-10/79 step to the 2/81-12/81 step.

Table 4: Turning Points and Lags in Data seen by the FOMC

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
								Lags in Months		
Peaks	M1	Ind.	Funds	Real	U		M1-	M1-	M1-	IP-
Troughs	Step	Prod.	Rate	Rate	Rate	Inflation	IP	FR	CPI	RR
P (1)	6/66 (6.4)	9/66(10.0)	10/66(5.6)	1/67(3.8)		12/66(4.3)	3			4
T (2)	2/67(-1.0)	5/67(-6.4)	11/67(4.0)	11/67(1.2)		1/68 (3.1)	3	9	11	6
P (2)	3/69 (6.5)	9/69 (8.4)	1/70 (9.2)	1/70 (5.3)	1/70 (3.4)	6/70 (6.5)	6	10	15	4
T (3)	4/70 (2.0)	1/71(-16.4)	2/72 (3.3)	1/72 (0)	6/72 (5.9)	2/73 (3.2)	9	22	34	12
P (3)	3/73 (7.3)	10/73(5.9)	7/74 (13)	7/74 (4.1)	11/73(4.5)	12/74(13.9)	7	16	7	9
		9/74(2.6)					11			
T (4)	4/75(2.4)	4/75(-32.5)	3/77 (4.6)	7/77 (-1)	6/75 (9.2)	2/77 (4.0)	0	23	22	27
P (4)	11/78(7.6)	4/79 (3.5)	5/81 (20.0)	5/81 (9.4)	4/80 (6.2)	4/80 (19.6)	5	31	18	25
	10/79(10.1)	3/80 (2.4)					5			

Notes: The dates (month/year) correspond to significant turning points in the series shown in Figures 6, 7 and 8, that is, in data available to the FOMC at the time of its meetings. The numbers in parentheses are the values at those turning points. For each of the 4 cycles shown in Figures 6, 7 and 8, the "Lags in Months" observations show the lags, respectively, between turning points in M1 growth and industrial production growth (IP), in M1 growth and industrial production growth (IP), in M1 growth and the funds rate (FR), in M1 growth and inflation (CPI), and industrial production growth and the real rate of interest (RR).

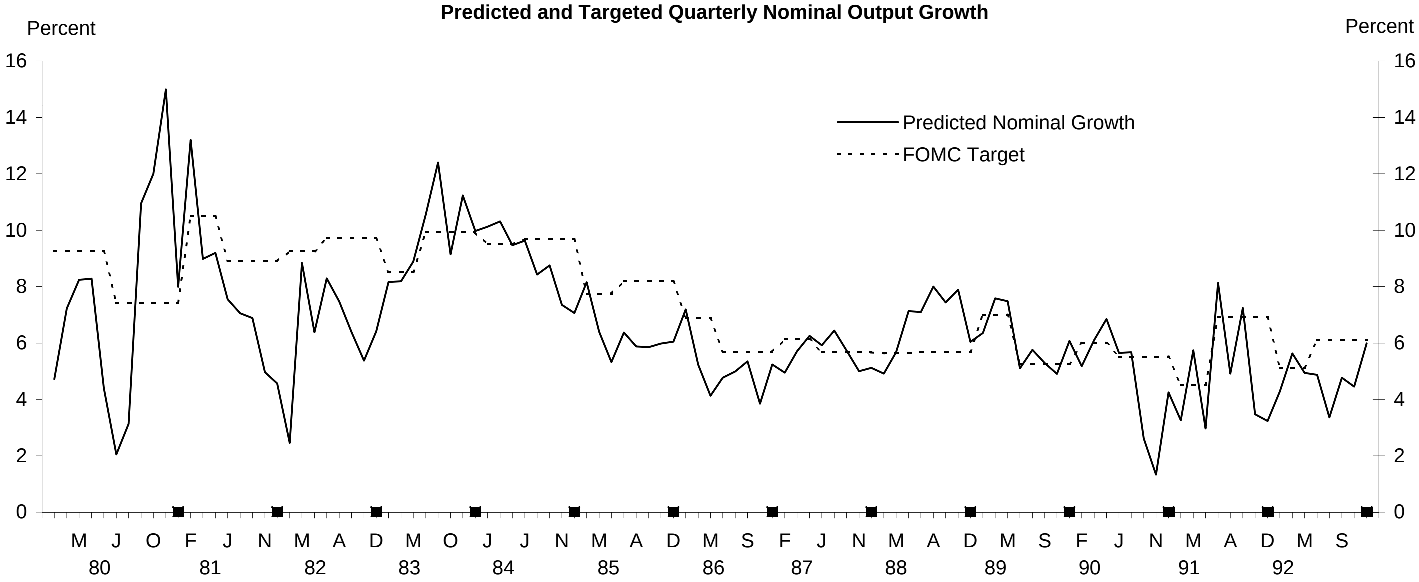
Table 5: Step Function, Nominal Output Growth and the Funds Rate

	Nominal GDP Peak, Trough	Funds Rate Peak, Trough	Lag in Quarter	Change in M1 Step
P	1966 Q1 (12.8%)	1966 Q4 (5.6%)	3	-5.2
T	1967 Q2 (3.1%)	1967 Q4 (4.2%)	2	5.2
P	1969 Q1 (10/7%)	1969 Q4 (8.9%)	3	-4.2
T	1970 Q4 (1.4%)	1972 Q1 (3.5%)	5	5.3[1]
P	1973 Q4(13.2%)	1974 Q3 (12.1%)	3	-3.7[2]
T	1975 Q1 (2.4%)	1977 Q1 (4.7%)	8	4.5[3]
P	1980 Q1 (11.5%)	1981 Q3 (17.6%)	6	-3.3[4]

[1]From 1969Q2-1970Q2 step to 1972Q1-1973Q1 step
[2]From 1972Q1-1973Q1 step to 1974Q2-1975Q1 step
[3]From 1974Q2-1975Q1 step to 1976Q4-1978Q4 step
[4]From 1976Q4-1979Q3 step to 1979Q4-1981Q4 step

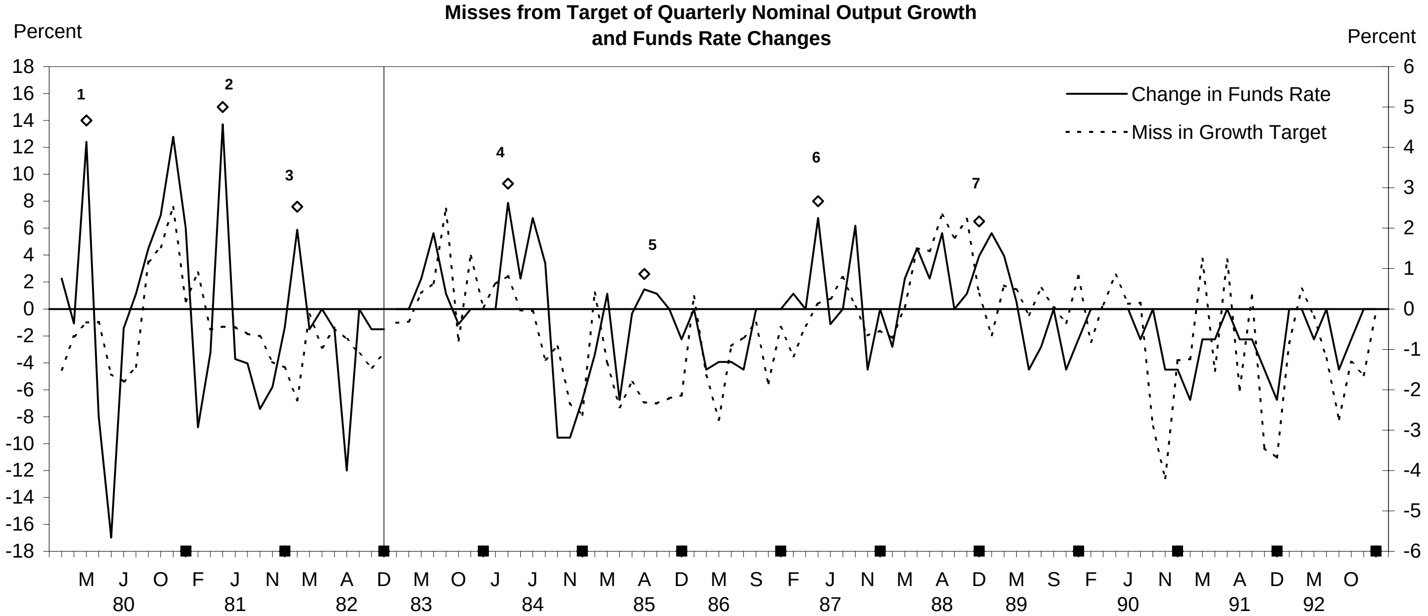
Notes: The dates correspond to the turning points in the series shown in Figure 9, which uses currently available time series. The numbers in parentheses are the values at those turning points. The lags show the quarters elapsed from turning points in nominal GDP growth and the funds rate. The "change in M1 Step" refers to the difference between the M1 steps shown in Figure 9.

Figure 1
Predicted and Targeted Quarterly Nominal Output Growth



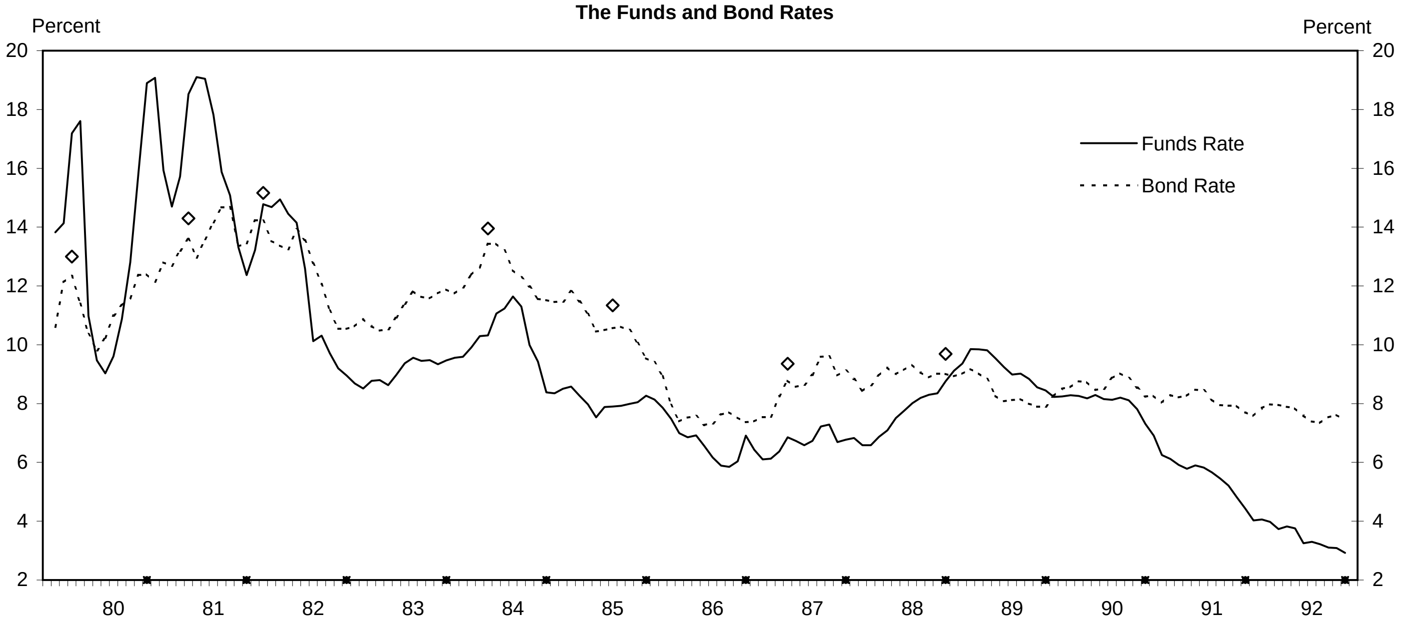
Notes: Predicted nominal output growth is an estimate of the annualized quarterly rate of growth of nominal output (GNP) available at FOMC meetings. If an FOMC meeting is in one of the first two months of a quarter, the prediction is for the contemporaneous quarter. If the meeting is in the last month of a quarter, the prediction is for the succeeding quarter. Predictions are from the Greenbook. Targeted nominal output growth is the midpoint of the central tendency range of fourth quarter to fourth quarter growth rates predicted by FOMC members and presented at the February or July Humphrey-Hawkins Hearings. As of the July FOMC meeting, the target is inferred from the revised central tendency range for yearly growth and from estimated growth over the first two quarters. Observations correspond to FOMC meetings and letters indicate month in which the FOMC meeting was held. Heavy tick marks indicate a December meeting.

Figure 2
Misses from Target of Quarterly Nominal Output Growth and Funds Rate Changes



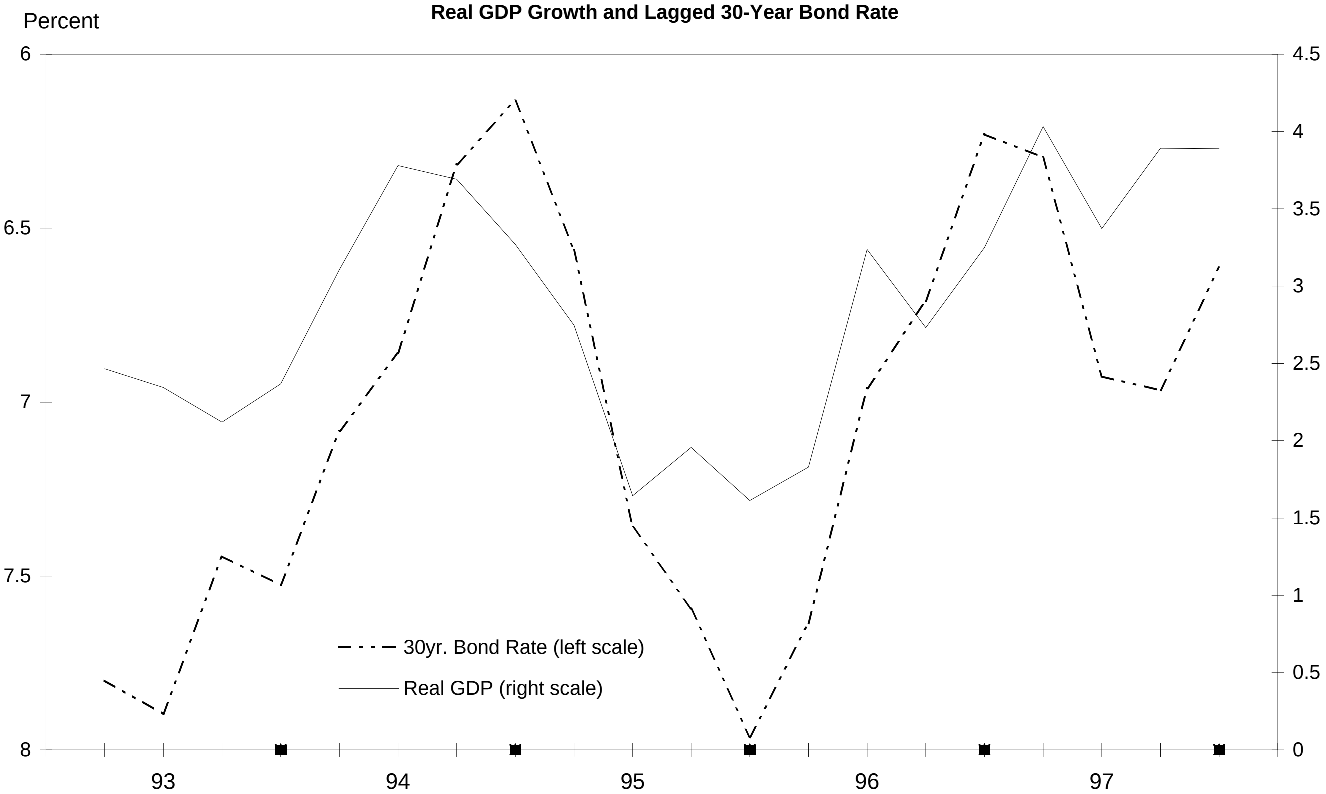
Notes: Misses from target are the differences between the predicted and targeted values shown in previous figure. Left scale is for the 1980-1982 period. Right scale is for the subsequent period. Through the October 1981 FOMC meeting, the funds rate is the actual average value in the first full statement week following an FOMC meeting. Thereafter, it is the value determined by the FOMC at its meetings. Changes in the funds rate are multiplied by three. Diamonds mark the following dates: 1) March 1980, 2) May 1981, 3) February 1982, 4) May 1984, 5) August 1985, 6) May 1987, and 7) December 1988. Heavy tick marks indicate December FOMC meeting.

Figure 3
The Funds and Bond Rates



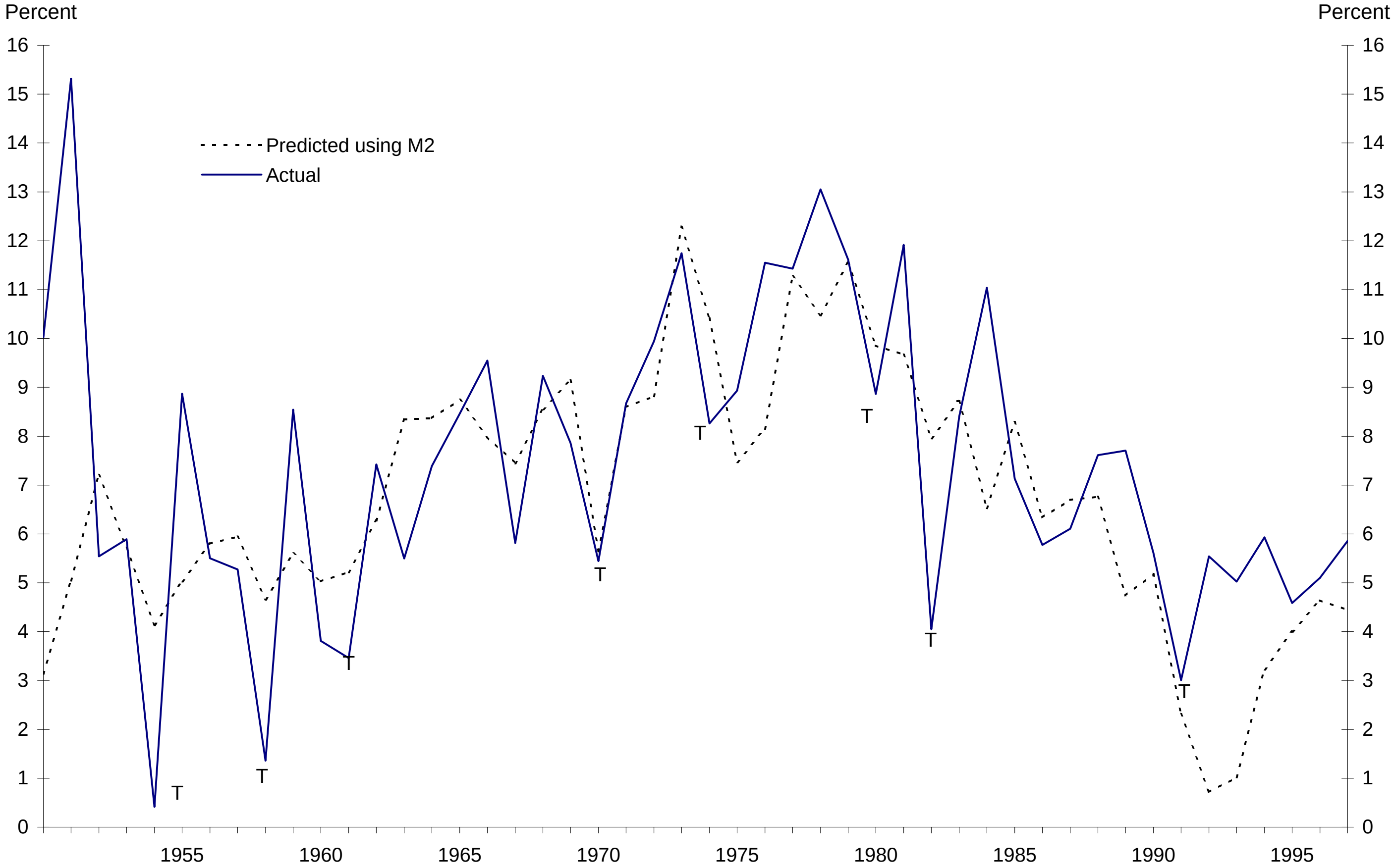
Notes: monthly observations of the funds rate and the 30-year bond rate. Diamonds mark the following dates: March 1980, May 1981, February 1982, May 1984, August 1985, May 1987, and December 1988. Heavy tick marks indicate December.

Figure 4
Real GDP Growth and Lagged 30-Year Bond Rate



Notes: Real GDP growth is quarterly observations of 4-quarter percentage changes in real GDP. The bond rate is lagged 4 quarters and graphed with an inverted scale. Heavy tick marks indicate last quarter of year.

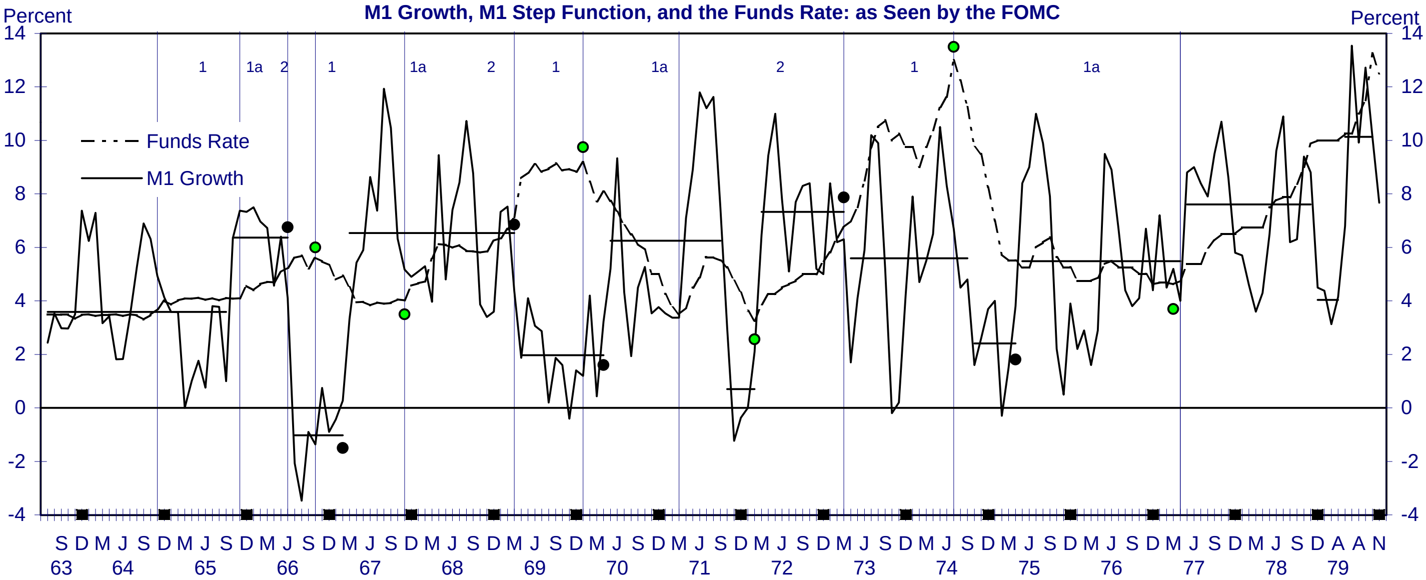
Figure 5
Annual Nominal Output Growth
Actual and Predicted Using M2



Notes: Predictions of nominal output growth are from the M2 indicator variable $\Delta m + \Delta v^p$, where Δm is the percentage growth in M2 and Δv^p is the predicted percentage growth in M2 velocity due to changes in the financial market opportunity cost of holding M2. Actual nominal output growth is the percentage change in GDP. Ts mark business cycle troughs: 1954, 1958, 1961, 1970, 1975, 1980, 1982, and 1991.

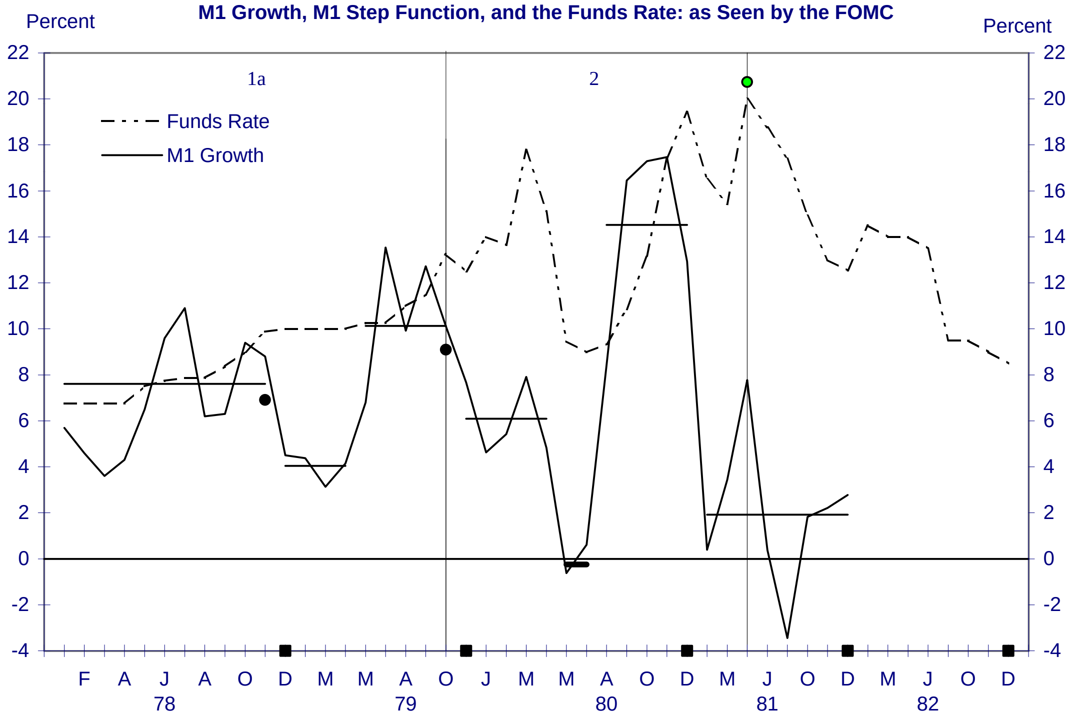
Figure 6

M1 Growth, M1 Step Function, and the Funds Rate: as Seen by the FOMC



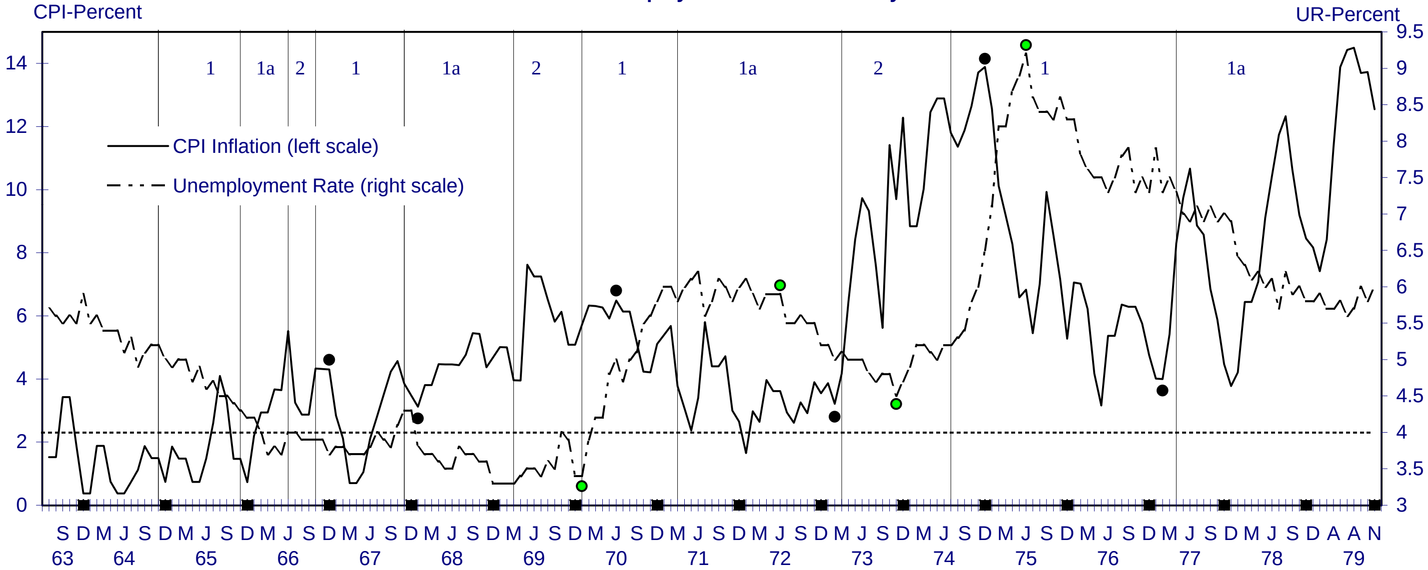
Notes: Data correspond to monthly FOMC meetings. M1 growth is the three-month annualized growth rate ending in the month prior to an FOMC meeting available to the FOMC at the time of its meetings. The M1 step function is fitted to this series. For the dates 7/30/63 through 10/20/70 and for 11/20/79, the funds rate is the actual average value in the first full statement week following an FOMC meeting. Otherwise, it is the value set by the FOMC at its meeting. Dark dots mark changes in M1 steps. Cross-hatched dots mark significant turning points in funds rate series. If two FOMC meetings occur in a month, the first is used. For 1979, the observations correspond to the nine FOMC meetings. Heavy tick marks indicate last FOMC meeting of the year.

Figure 6a
M1 Growth, M1 Step Function, and the Funds Rate: as Seen by the FOMC



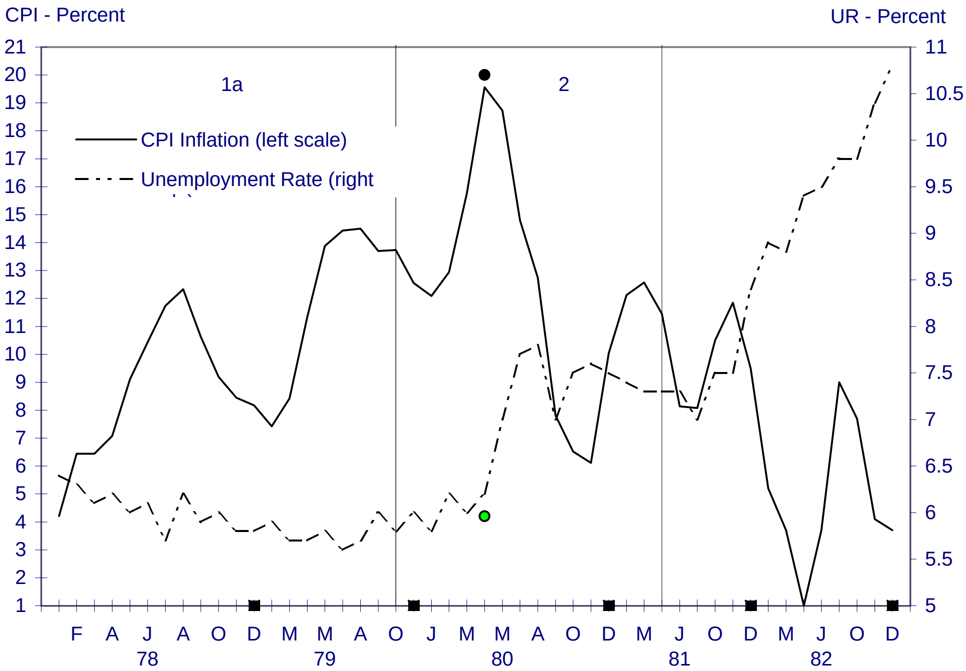
Notes: For the dates 11/20/79 through 10/6/81, the funds rate is the actual average value in the first full statement week following an FOMC meeting. Otherwise, it is the value set by the FOMC at its meeting. M1 is shift-adjusted M1 for 1981 (Bennett 1982). Otherwise, see notes to Figure 6.

Figure 7
Inflation and the Unemployment Rate: as Seen by the FOMC



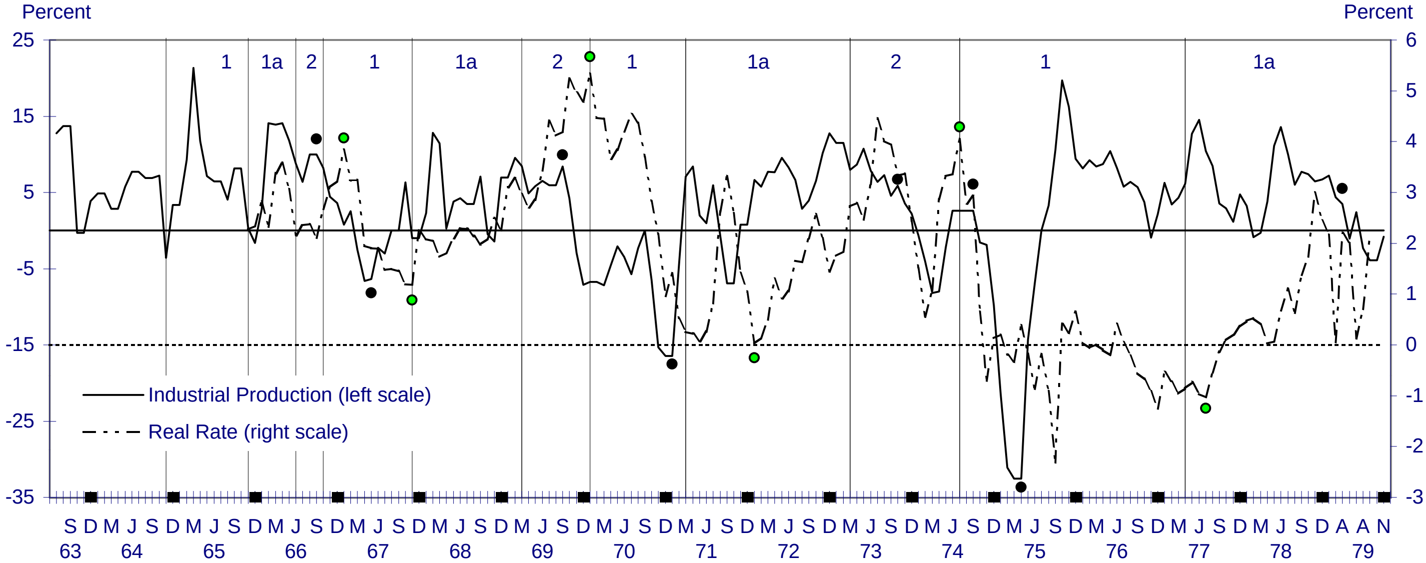
Notes: Data correspond to monthly FOMC meetings. Inflation is the most recent three-month annualized growth rate of the CPI (generally ending in the month two-months prior to an FOMC meeting) available to the FOMC at the time of its meeting. The unemployment rate is the most recent rate (generally in the month prior to an FOMC meeting) available to the FOMC at the time of its meetings. Dark dots mark significant turning points in the CPI series; cross-hatched dots in unemployment series. The dashed line is at four percent. If two FOMC meetings occur in a month, the first one is used. For 1979, observations correspond to the nine FOMC meetings. Heavy tick marks indicate last FOMC meeting of the year.

Figure 7a
Inflation and the Unemployment Rate: as Seen by the FOMC



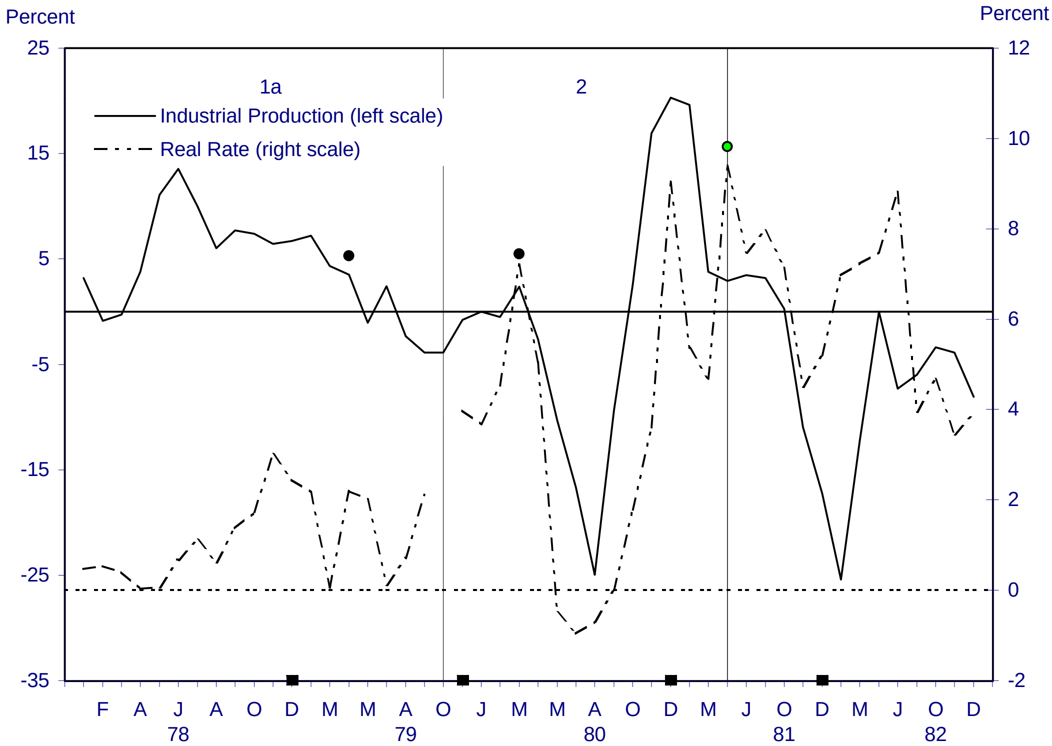
Notes: Data correspond to FOMC meetings. See notes to Figure 7.

Figure 8
Growth in Industrial Production and the Real Rate of Interest: as Seen by the FOMC



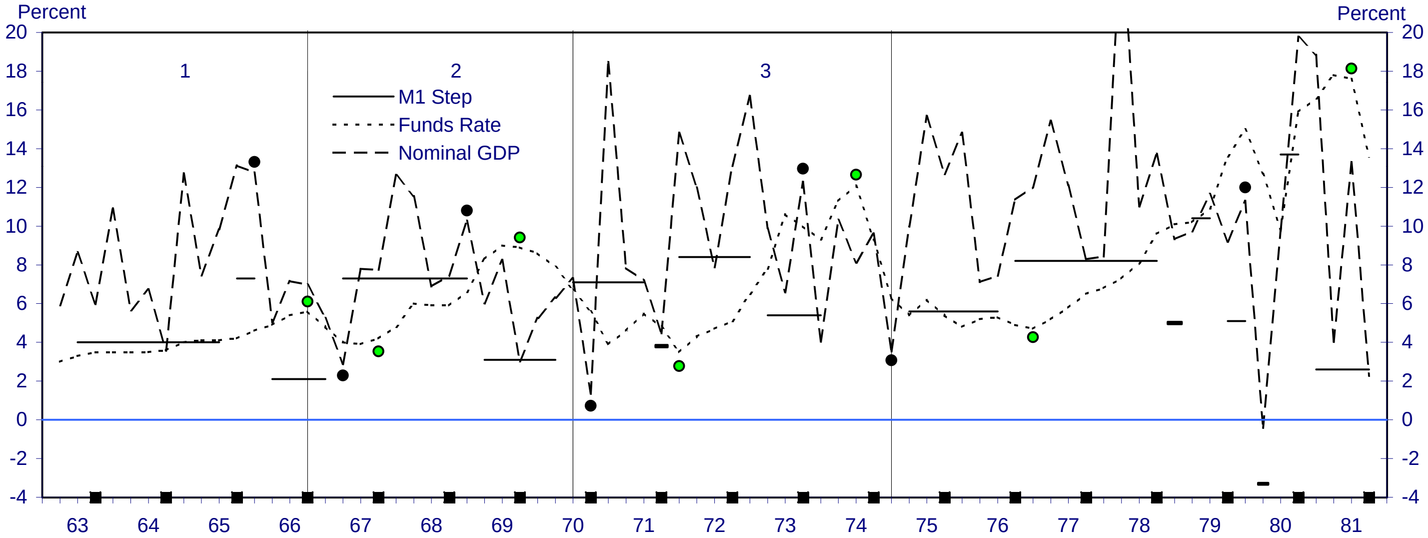
Notes: Data correspond to monthly FOMC meetings. Growth in industrial production is the most recent three-month annualized growth rate (generally ending in the month prior to an FOMC meeting) available to the FOMC at the time of its meetings. The real rate of interest is the commercial paper rate minus Board of Governors staff forecasts of inflation contained in the Greenbook. If two FOMC meetings occur in a month, the first is used. For 1979, the observations correspond to the nine FOMC meetings. Dark dots mark significant turning points in industrial production series; cross-hatched dots in real rate series. Heavy tick marks indicate last FOMC meeting of the year.

Figure 8a
Growth in Industrial Production and Real Rate of Interest: as seen by the FOMC



Notes: October 1979 real rate observation is missing as there was no Greeenbook (Board staff inflation forecast) for that FOMC meeting. Otherwise, see notes to figure 8.

Figure 9
Nominal Output Growth, the Funds Rate and M1 Step Function



Notes: Quarterly observations of annualized, quarterly nominal GDP growth and the funds rate. Data are currently available time series. The M1 steps are an average of the annualized quarterly M1 growth rates. M1 is "shift adjusted" M1 for 1981. Dark dots mark changes in nominal output growth. Cross-hatched dots mark significant turning points in funds rate. Heavy tick marks indicate fourth quarter.

Monetary Policy and the ESCB

What should the ESCB adopt as its operational procedures for implementing MP? The current debate has been put in terms of inflation targeting versus money targeting. The debate appears trivial. The ESCB will start with an inflation target, and it will then use an interest rate as its instrument.

However, as emphasized by Milton Friedman, a central bank cannot control inflation directly. Once actual inflation deviates from target, bringing it back to target is costly. For example, in early 1969 the FOMC raised its interest rate peg sharply to lower inflation. Not until two years later, in summer 1971, did inflation begin to fall. The ESCB should then use various variables as information variables that tell it when to change its rate peg so that it can maintain inflation on target. If money demand is stable, the central bank can use the information contained in the behavior of money to help in setting its interest rate peg.

The actual debate therefore appears to be over whether the ESCB should communicate to the public like the Bank of England or like the Bundesbank. Of course, the debate has been a formal debate, rather than a substantive one. The ESCB will look like the Bundesbank.

The Bundesbank has demonstrated the usefulness of money targets as a way of communicating to the public. Money targets convey to the public the fact that the central bank controls only paper money creation, or its modern-day equivalent: the electronic money on the books of banks. Central banks do not create wealth. Therefore, their ability to control real economic activity is limited.

However, money growth is generally not in itself a complete guide to the impact of monetary policy, considered as the nominal (dollar) expenditure of the public. Money targeting by itself has only rarely constituted an operational set of monetary policy procedures. One reason is that money demand is highly interest sensitive. As a consequence, at times when interest rates change, much of the impact of monetary policy on the expenditure of the public occurs through changes in velocity rather than through changes in the quantity of money.

For example, in the US in the decade of the 1980s, M2 growth was fairly stable. Much of the variation in the nominal expenditure of the public came from changes in velocity that in turn derived from the change in market interest rates, which affected the cost of holding M2. Also, because of the interest sensitivity of money demand, the behavior of money often offers a poor mechanism for communicating to the public the need for changes in the central bank's interest rate peg. For example in 1994 in the US, it was clear that interest rates had to rise. Because the rise in interest rates raised M2 velocity, M2 had to grow at a low level for a while to maintain moderate growth of dollar expenditure. So money growth was low while the FOMC was raising the funds rate.

The ESCB should establish a hierarchy of variables „in between" its instrument (the repurchase rate) and its objective (a stable price level or a low inflation rate). It should set a benchmark for the trend rate of growth of money. Like the inflation target set now by the Bundesbank Bank, it should be a point target based on an estimate of the trend rate of growth of velocity and real output. This long-run money target would be useful for communication. It would explain to the public how the CB, as the creator of money, ultimately dominates all other influences on the price level and controls the price level.

However, by itself, the long-run money target is not likely to explain much of the variation in the central bank's rate peg. By itself then, it could appear more as a smokescreen than a useful means of communicating. The ESCB should formulate two informational variables to guide the setting of its interest rate peg.

First, it should specify a value for money growth, adjusted for changes in velocity that can be predicted from the behavior of interest rates. If money demand is stable, misses in this variable offer information on the likely dollar expenditure of the public. However, the ESCB must collect data on the interest rates paid on the components of the monetary aggregate it will target (M3). The behavior of velocity depends upon the difference between market rates and the own rate on money.

Second, the ESCB should specify a value for the rate of growth of nominal expenditure. If money demand is unstable, the ESCB would use this variable exclusively as a guide to setting its repurchase rate. Both these variables are nominal. Therefore, their use in the policy process can be explained within the common analytical framework of the quantity theory.

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ISSN 1436 - 6053

Zentrum für Europäische Integrationsforschung
Center for European Integration Studies
Rheinische Friedrich-Wilhelms-Universität Bonn

Walter-Flex-Strasse 3
D-53113 Bonn
Germany

Tel.: +49-228-73-1732
Fax: +49-228-73-1809
www.zei.de