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FURTHER EVIDENCE ON THE LIQUIDITY EFFECT USING AN EFFICIENT-MARKETS APPROACH

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BY

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Abstract

The degree to which policy actions of the central bank affect market interest rates has been a much-debated issue in monetary theory. This paper updates and improves upon recent empirical estimates of the effect of monetary policy on interest rates. Interest rates are assumed to be determined in an efficient market in which expectations are formed rationally. Tests of the proposition that unanticipated increases in the money stock are correlated with declines in interest rates are then undertaken. The empirical results provide mixed evidence of the presence of a liquidity effect. One possible explanation for a negative influence of monetary policy on interest rates is that financial deregulation has made money growth a less reliable indicator of inflationary pressures.

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I. INTRODUCTION

Assessing the impact of changes in the growth rate of money on the pattern of nominal interest rate movements has been an important issue in research on the transmission mechanism of monetary policy. Traditional analyses of the effects of an increase in the growth rate of money on nominal interest rates hypothesized a stylized response pattern of an initial decline in interest rates, called the liquidity effect, followed by a rise in interest rates from the combined impact of income and price-expectations effects. The liquidity effect arising from faster money growth reflects the fall in interest rates required to equate the supply of and demand for real money balances following an acceleration in money supply growth. The income effect from an acceleration in money growth refers to the upward pressure on interest rates from a rise in nominal income. The increase in nominal income results from the combined impact of any rise in real money balances and real sector growth generated by the monetary stimulus. The price-expectations effect reflects any altered expectations of the impact of faster money growth on price inflation. Higher price expectations will also tend to push up nominal interest rates. The response pattern of interest rates to a more accommodative monetary policy is thus critically dependent upon the strength of the liquidity effect and the speed of adjustment to the income and price expectations effects.

This paper makes use of a rational-expectations model developed by Mishkin (1983) to update previous empirical work on the liquidity effect. Unlike prior research using this approach (Reichenstein, 1987), we use the correction developed by Murphy and Topel (1985) to account for measurement error. Further, we make use of both seasonally adjusted and unadjusted data. The empirical results indicate the presence of a liquidity effect with seasonally adjusted M1 growth and both adjusted and unadjusted growth in M2. Both adjusted and unadjusted monetary base growth, as well as unadjusted M1 growth, though, fail to show a liquidity effect. We proceed as follows. The first section offers an overview of previous research on the effect of money growth on interest rates. Next, the rational-expectations model developed by Mishkin (1983) is described. Section three contains a description of the data as well as a discussion of the empirical results. The final section presents the conclusions and suggestions for future research.

II. PREVIOUS RESEARCH

A. Early Literature

The early literature on search for a liquidity effect--Friedman (1964), Cagan (1966)--confirmed a fairly long response time of as much as one to two years between the initial decline in interest rates from accelerated money growth and the reversal of this pattern to higher nominal interest rates. Later work by Cagan and Gandolfi (1969) found that interest rates declined for six months following an increase in money growth and thereafter began to rise. Gibson (1970) reported a time lag of between four to nine months between the initial decline and subsequent turnaround in interest rates. The time lag in Gibson's analysis varied with the definition of money and interest rates used in the estimation.

B. Recent Research

More recent empirical work on the relationship between money growth and nominal interest rate changes either finds no relationship between these variables or a considerably shorter adjustment path between the initial decline and eventual rise in interest rates from accelerated money growth. Findings reported by Wilcox (1983), Hoehn (1983), Mehra (1985), and Reichenstein (1987) for the period including much of the decade of the 1970's do not identify a significant negative effect of money growth on interest rates. Other work for the period, including Brown and Santoni (1983), and Melvin (1983), report a temporary, significant decline in interest rates, but the time lag between the initial drop and subsequent increase in interest rates was only one month or less. Melvin's (1983) results indicate that interest rates moved above their original level by the second month after a monetary acceleration.

These more recent studies conclude that the shortened response time to a change in monetary growth reflects the impact of changes in Federal Reserve operating procedures coinciding with the announcement of target growth ranges for money. In addition, arguments are given that agents adjusted their expectations of price movements more quickly during that period of high price inflation. Prior to the high inflation years of the 1970's, policymakers tended to believe that an expansionary monetary policy would significantly lower interest rates for a considerable duration (Guttentag, 1966). In contrast, beginning in the mid-1970's, U.S. monetary policy was formulated more with the view that high interest rates were the result of an accommodative monetary policy that fueled inflationary expectations. As a result, policymakers tended to respond to rising interest rates by lowering money growth. This institutional change induced investors to respond quickly to larger-than-anticipated increases in the money supply by bidding down the price of fixed-income securities in anticipation of subsequent Federal Reserve efforts to decelerate money growth (Roley 1983, 1987).

Estimates of the formation of inflation expectations reported by Blejer (1978), Cornell (1983), and Mehra (1985) indicate that the lag between money growth and inflation also shortened considerably during the 1970's. These studies, together with the work on the theory of rational expectations and market efficiency by Fama (1975, 1976) and Nelson and Schwert (1977), indicate that inflationary expectations can adjust quite rapidly, particularly when the level of inflation is high (Muth 1961, Mishkin 1983). The combined effects of rapid adjustments in inflationary expectations and quick investor response to anticipated changes in monetary policy can offset the short-run liquidity effect. Hence, even in the very short run, the net effect of a change in money growth on interest rates is uncertain.

C. A New Regime?

Most of the recent work from the 1970's through 1983 on the relationship between money growth and interest rates indicates that monetary acceleration has had an essentially neutral impact on short-term interest rates. Since then, however, the relationship may again have changed. In the recent past, it has been argued that financial innovations and deregulation of financial markets have combined to make the monetary aggregates less valuable guides in formulating monetary policy (Judd and Trehan, 1987, Motley, 1988). This breakdown in the money-income and money-price relationships induced the Federal Reserve to alter operating procedures in late 1982 toward greater emphasis on targeting interest rates and away from monetary aggregate targets. Moreover, in 1987 the Federal Reserve declined to specify a target growth range for the narrow M1 aggregate (Friedman, 1988).[1] In addition to this change in operating procedures, the relationship between inflation and money growth also appears to have changed. Since 1983, the rate of inflation has slowed considerably despite accelerated money growth. From 1983 through 1986 inflation averaged 3.2 percent while the average rate of increase in the narrow M1 aggregate, though variable, was 9.8 percent. That compares to average growth in M1 of 6.6 percent from 1979 through 1982, the height of the recent inflationary environment in the U.S. when the CPI recorded average annual increases of approximately 10 percent.

The change in Federal Reserve operating procedures together with the deceleration in inflation may have again altered the response pattern of interest rates to changes in money growth. In an attempt to verify this, we extend the existing empirical work on the relationship between money growth and short-term interest rates through 1986. Following Mishkin (1983), we employ the efficient markets-rational expectations approach. The period examined is from 1959-1986. Different from both Mishkin's (1983) findings for the period 1959-1976, and Reichenstein's (1987) extension of Mishkin's work for the period 1959-1983, the results obtained in this study provide mixed evidence of the existence of a short-run liquidity effect. Results reported on the formation of inflation expectations estimated over the lengthened period, 1959-1986, also indicate that the role of money growth in the formation of inflation expectations may have changed in the 1980's. In contrast with previous findings, including Mishkin (1983), Mehra (1985) and Reichenstein (1987), money growth did not emerge as a significant determinant in the formation of price expectations during the period 1959-1986.

II. THE MODEL

The theory of efficient markets, or rational expectations, postulates that interest rates in financial markets reflect all available information. More formally, the rational expectations hypothesis maintains that the market's subjective probability distribution of any variable is identical to the objective probability distribution of that variable, conditional on all available past information. Under rational expectations, an arbitrage condition exists in that no unexploited profit opportunities exist in financial markets. At the current price, market participants cannot expect to earn a higher-than-normal rate of return by investing in a particular security. To give this hypothesis empirical content, a model of market equilibrium of interest rates is needed.

Following Mishkin (1983), we assume that, for short-term interest rates, the one-period-ahead forward rate equals the one-period-ahead expected short rate plus a risk premium:

$$ {}_{t-1}F_t = E_m(r_t | I_{t-1}) + d_t^s, \tag{1} $$

and

$$ d_t^s = a_0 + a_1 z_t, \tag{2} $$

where:

r_t = one-period short-term interest rate at time t,

${}_{t-1}F_t$ = forward rate for the one-period-ahead rate at time t implied by the yield curve at t-1.

d_t^s = risk premium for ${}_{t-1}F_t$,

z_t = a measure of uncertainty of short-rate movements,

I_{t-1} = information available at t-1.

Combining the arbitrage condition implied by rational expectations with the model of market equilibrium gives the following:

$$ E(r_t - {}_{t-1}F_t - a_0 - a_1 z_t | I_t) = 0, \tag{3} $$

which states that $(r_t - {}_{t-1}F_t)$ is uncorrelated with any past available information. The corresponding efficient-markets model we employ makes use of the liquidity preference approach to money demand, as in Laidler (1985). In this model, interest rates are assumed to be related to money growth as well as to movements in income and prices. Therefore, unanticipated changes in interest rates are hypothesized to be the result of unexpected movements in each of the following variables: money growth; growth in income; and inflation. This leads to the following estimation equation:

$$r_t = {}_{t-1}F_t - a_0 - a_1 z_t + B_m(MG_t - MG_t^e) + B_y(IPG_t - IPG_t^e) + B_p(P_t - P_t^e) + e_t, \qquad (4)$$

where

MG_t, IPG_t, P_t, = growth rates of money, industrial production (as a proxy for income) and prices, respectively,

MG_t^e, IPG_t^e, P_t^e = expected growth rates of money, industrial production and prices, respectively,

B_m, B_y, B_p = coefficients,

e_t = random disturbance term.

As Mishkin (1983) points out, this equation is the efficient-markets analog to the typical money-demand relationship in that it is only when new information hits the market that r_t will deviate from its expected rate. If a liquidity effect is present, then the coefficient on money growth, B_m, is negative. In this case, unanticipated increases in money growth lead, at least in the short run, to declines in interest rates.[2] Further, a liquidity-preference view hypothesizes that the coefficients on the other variables are positive. Unanticipated increases in real income and inflation result in increases in short-term interest rates.

III. EMPIRICAL RESULTS

A. Data

In estimating Equation 4, quarterly data for the time period 1959-1986 are used for the following variables:

r_t = 90-day Treasury bill rate, last day of the quarter,

BASE = growth rate of the St. Louis monetary base, first difference in logs,

M1G = growth rate of M1, first difference in logs,

M2G = growth rate of M2, first difference in logs,

IPG= growth rate of industrial production first difference in logs (as a proxy for real income),

INF= inflation rate, first difference in logs of CPI.

These data are obtained from the Citibase data set.[3] In an effort to determine the extent to which the results are sensitive to the measure of money used, estimates of the parameters of Equation 4 are attempted using the monetary base, M1 and M2. Further, estimates of Equation 4 are also undertaken using seasonally unadjusted data since, as Mishkin (1983, p. 92) points out, it is not clear whether agents use adjusted or unadjusted data in the formation of expectations.[4]

B. Forecasting Equations

The expectations equations are assumed to be rational forecasts obtained from linear forecasting equations. To obtain estimates of the expectations variables, multivariate forecasting equations are formulated using the Granger (1969) concept of predictive quality. That is, each of the variables, BASE, M1G, M2G, IPG and INF was regressed on its own four lags, plus four lags of each of the other variables included in the estimation equation, plus four lags of each of the following variables: unemployment rate (URATE); three-month Treasury bill rate (TBILL): balance of payments on current account (CURACT); growth rate of real federal government expenditures (FEDEXP); high employment budget surplus (DEF); and the growth rate of the market value of government debt in the hands of the public (DEBTG). [5] In choosing these variables, we followed Mishkin (1983) and also the literature on reaction functions (Barth, Sickles and Wiest 1982). That is, these variables appear to have influenced Federal Reserve behavior and would possibly be used in the formation of expectations by economic agents. The four lags of each of these variables were retained in a forecasting equation only if they were jointly significant at the five-percent level. Results from this procedure are reported in Table 1 and Table 2. Since these equations contain lagged dependent variables, the Durbin-Watson test statistic is invalid. Therefore, we employ the test developed by Breusch (1979) and Godfrey (1978), (B-G), to detect the presence of serial correlation. In each case, the forecasting equations are found to possess serially uncorrelated errors. [6]

C. Risk Measure

The measure of uncertainty, z_t, is constructed as the average absolute change in the Treasury bill rate over a number of quarters. Following Mishkin (1983), the difference between the spot and forward rate, $(r_t - {}_{t-1}F_t)$ was regressed on measures of z_t. The best fit was obtained from z_t calculated from twelve previous quarters. The results are given as:

$$(r_t - {}_{t-1}F_t) = \underset{(0.0020)}{-0.000977} - \underset{(0.2627)}{0.56128^*} * z_t \qquad (5)$$

R^2=0.05, D-W=1.54, SSE=0.110, *=significant at the 5% level.

This measure of risk is crude in that it is not based explicitly on any utility-maximizing behavior. Also, it is assumed that the manner in which agents evaluate their risk is constant over time. Therefore, the empirical results which follow are reported both with and without the risk variable included. The results are not substantively affected if this variable is excluded.

D. Results

Equation 4 is estimated using the Barro (1977) two-step procedure which entails using the residuals from the forecasting equations as independent variables in Equation 4. A well-known shortcoming with the two-step procedure is that it fails to account for the fact that the unobservable regressors have been estimated in the calculation of the parameters and standard errors in the second step. As a result, the second-step standard errors and related test statistics are incorrect. Unlike previous research in this area (Rishenstein 1987), we use the procedure developed by Murphy and Topel (1985) to obtain the asymptotically correct covariance matrix, thereby enabling valid statistical inference.[7] Variations of Equation 4 are estimated in an attempt to determine how robust the results are to the particular monetary aggregate chosen and the use of seasonally adjusted versus unadjusted data. Also, in an effort to determine how sensitive the results are to the risk variable, z_t, (SIGMA), we report results both including and omitting this variable. The estimates appear in Table 3 and Table 4.

Both measures of monetary base growth do not indicate the presence of a liquidity effect. When unexpected growth in seasonally adjusted M1 and M2 are used, however, a liquidity effect is indicated. The coefficients on unanticipated money growth are negative and significant. These measures of the money supply give conflicting results when seasonally unadjusted data are used. With data that are not seasonally adjusted, the liquidity effect associated with unanticipated M1 growth is eliminated, while growth in M2 is significantly negatively correlated with interest rate movements. 8

The presence of a significant liquidity effect in some of the models estimated is in contrast to Mishkin (1983) and Reichenstein (1987) both of whom find no significant liquidity effect. Reichenstein estimated his model using monthly data. It could be the case that the Federal Reserve's operating horizon is longer than one month, in which case a significant liquidity effect would not be discovered with monthly data.

It could also be argued that the presence of a liquidity effect is associated with either the change in Fed operating procedures undertaken in late 1979 or the introduction of financial deregulation which occurred at roughly the same time. Chow tests were conducted on the forecasting regressions. It was assumed that a break occurred beginning in the fourth quarter of 1979, to coincide with the change in Fed operating procedures undertaken at that time. It was also around this time that transactions deposits began paying interest nationwide. With both adjusted and unadjusted data, a significant F-statistic of 2.28 and 3.06, respectively, for INF^e indicates a structural change occurred in the decade of the 1980's in the formation of inflationary expectations. [9]

Further evidence that a change in inflationary expectations may have occurred is presented in Table 5 and Table 6. Using a procedure described in

Mehra (1985), the Livingston survey measure of inflationary expectations is regressed against money growth and current and past inflation. We estimate this model over two time periods. The first period is from 1960-1976, and coincides with Mishkin's (1983) study. Over this period, money growth, however defined, is a significant factor in the formation of this measure of inflationary expectations. Moreover, the results are robust with respect to the use of seasonally adjusted versus unadjusted data. Estimates of this model since 1976 indicate that the factors influencing the formation of expectations appear to have changed since the period of Mishkin's (1983) analysis. In this later time period, seasonally adjusted base growth and M1 growth remain significant. With unadjusted data, though, M1 growth is no longer significant. The most consistent pattern is associated with M2 growth. Using both seasonally adjusted and unadjusted data, M2G becomes an insignificant factor in the formation of inflationary expectations. If agents are, at least temporarily, attaching less weight to movements in the broader monetary aggregate when forecasting inflation, the reemergence of a consistent liquidity effect associated with M2 may be due, in part, to a reduced price-expectations effect at work.

Moreover, developments in the implementation of monetary policy in the early 1980's may shed further light on why a liquidity effect is consistently associated with the broader monetary aggregate. In its October, 1982 meeting, the Federal Open Market Committee began to deemphasize the role of M1 in the conduct of policy. This process culminated in the February, 1987 meeting of the Committee at which no target range was established for M1 growth.[10] If the central bank downplayed movements in M1, perhaps market participants did also.

Finally, the presence of a liquidity effect in some of the models estimated does not lead to a policy prescription of easy money growth to lower interest rates. Robinson (1988) finds evidence that unanticipated increases in money growth lead to increases in long-term interest rates. Thus, agents appear to recognize the long-run inflationary consequences of money growth and bid up long-term rates accordingly.

IV. CONCLUSIONS

Using a rational expectations--efficient markets approach, this paper finds mixed evidence of a significant liquidity effect associated with an expansionary monetary policy. Several specifications are estimated in an effort to resolve potential difficulties including: (1) the appropriate measure of money to be used; (2) the use of seasonally adjusted versus unadjusted data; and, (3) the sensitivity of the results to the specification of risk. Unlike previous work employing the two-step procedure, the estimation technique used here accounts for the fact that the unobservable regressors are measured with error, thus allowing for valid statistical inference. In some cases, unanticipated increases in money growth are correlated with declines in short-term interest rates. One possible explanation for the reemergence of a liquidity effect may lie in the changing pattern of expectations formation due to changes in Federal Reserve operating procedures, as well as recent declines in velocity. This negative correlation between unanticipated money growth and short-term interest rates does not argue for a monetary policy of expansion in the hopes of achieving lower interest rates. Such a policy would lead to higher long-term rates.

An interesting extension of the model may lie in a more formal specification of the risk variable. It is somewhat crude to suppose that risk premia are constant over time. Engle (1982) and Engle, Lilien and Robins (1987) offer a technique that allows for nonconstant liquidity or risk premia in an effort to obtain more efficient parameter estimates. Use of the ARCH or ARCM-M models in estimating the effects of policy changes on interest rates would possibly allow for a more formal treatment of time-varying risk premia.

TABLE 1

VARIABLES SIGNIFICANT IN
FORECASTING EQUATIONS
SEASONALLY ADJUSTED DATA
1959-1986

	BASE	M1G	M2G	IPG	INF
	BASE IPG TBILL	M1G IPG INF TBILL CURAC DEF	M2G IPG INF DEBTG	IPG M2G INF	INF IPG URATE TBILL DEF
B-G	1.23	3.03	1.02	0.06	0.47
R^2	0.56	0.57	0.46	0.49	0.81

TABLE 2

VARIABLES SIGNIFICANT IN
FORECASTING EQUATIONS
SEASONALLY UNADJUSTED DATA
1959-1986

	BASE	M1G	M2G	IPG	INF
	BASE IPG TBILL	M1G IPG INF TBILL DEF	M1G M2G IPG	IPG M2G INF	INF IPG TBILL CURAC DEF
B-G	2.59	0.49	2.24	0.16	0.25
R^2	0.93	0.91	0.45	0.46	0.77

TABLE 3

ESTIMATES OF LIQUIDITY EFFECT
SEASONALLY ADJUSTED DATA
1959-1986

Constant	(Base-Base^e)	(IPG-IPG^e)	(INF-INF^e)	SIGMA
-0.0016	-0.3353	0.2978**	0.5285*	-0.4566
(0.0019)	(0.2329)	(0.0688)	(0.2381)	(0.2600)

R^2 = 0.25; D-W = 1.57

Constant	(Base-Base^e)	(IPG-IPG^e)	(INF-INF^e)	SIGMA
-0.0047**	-0.3184	0.2811**	0.5159*	
(0.0010)	(0.2248)	(0.0618)	(0.2323)	

R^2 = 0.20; D-W = 1.51

* = Significance at the 5 percent level
** = Significance at the 1 percent level
Standard errors in parentheses

TABLE 3
(continued)

ESTIMATES OF LIQUIDITY EFFECT
SEASONALLY ADJUSTED DATA
1959-1986

CONSTANT	$(M1G-M1G^e)$	$(M2G-M2G^e)$	$(IPG-IPG^e)$	$(INF-INF^e)$	SIGMA
-0.0018 (0.0020)	-0.3287* (0.1421)		0.3352** (0.0707)	0.5409* (0.2352)	-0.4297 (0.2646)
R^2 = 0.28; D-W = 1.49					
-0.0013 (0.0063)		-0.7010** (0.1611)	0.3585** (0.0654)	0.3671 (0.2215)	-0.5085* (0.2579)
R^2 = 0.37; D-W = 1.55					
-0.0047** (0.0011)	-0.3195* (0.1383)		0.3181** (0.0639)	0.5220* (0.2292)	
R^2 = 0.23; D-W = 1.43					
-0.0047** (0.0011)		-0.5900** (0.1582)	0.3211** (0.0600)	0.3709 (0.2214)	
R^2 = 0.29; D-W = 1.49					

* = Significance at 5 percent level
** = Significance at 1 percent level
Standard Errors in Parentheses

TABLE 4

ESTIMATES OF LIQUIDITY EFFECT
SEASONALLY UNADJUSTED DATA
1959-1986

Constant	$(Base-Base^e)$	$(IPG-IPG^e)$	$(INF-INF^e)$	SIGMA
-0.0017	-0.0058	0.2960**	0.3517	-0.4417
(0.0019)	(0.1789)	(0.0670)	(0.2135)	(0.2571)

$R^2 = 0.24$; D-W = 1.58

Constant	$(Base-Base^e)$	$(IPG-IPG^e)$	$(INF-INF^e)$
-0.0047**	0.0063	0.2781**	0.3175
(0.0010)	(0.1744)	(0.0608)	(0.2083)

$R^2 = 0.19$; D-W = 1.52

* = Significance at the 5 percent level
** = Significance at the 1 percent level
Standard errors in parentheses

TABLE 4
(continued)

ESTIMATES OF LIQUIDITY EFFECT
SEASONALLY UNADJUSTED DATA
1959-1986

CONSTANT	$(M1G-M1G^e)$	$(M2G-M2G^e)$	$(IPG-IPG^e)$	$(INF-INF^e)$	SIGMA
-0.0018 (0.0020)	-0.0599 (0.1250)		0.3074* (0.0711)	0.3614 (0.2129)	-0.4418 (0.2582)
$R^2 = 0.24$; D-W = 1.55					
-0.0019 (0.0020)		-0.4419* (0.1355)	0.3444* (0.0662)	0.3440 (0.2036)	-0.4187 (0.2556)
$R^2 = 0.31$; D-W = 1.57					
-0.0047* (0.0010)	-0.0437 (0.1217)		0.2867* (0.0648)	0.3263 (0.2080)	
$R^2 = 0.19$; D-W = 1.50					
-0.0047* (0.0011)		-0.3821* (0.1320)	0.3166* (0.0598)	0.3189 (0.2000)	
$R^2 = 0.26$; D-W = 1.51					

* = Significance at 5 percent level
** = Significance at 1 percent level
Standard Errors in parentheses

TABLE 5

LIVINGSTON SURVEY MEASURE
AND MONEY GROWTH
SEASONALLY ADJUSTED DATA

INTERCEPT	INF	INF_{t-1}	INF_{t-2}	BASE
		1960-1976		
-0.0025	58.2704**	-30.7434	31.6341**	0.1772**
(0.0028)	(11.0365)	(17.2829)	(10.3315)	(0.0634)

R^2 = 0.95; D-W = 1.97

INTERCEPT	INF	INF_{t-1}	INF_{t-2}	BASE
		1977-1986		
-0.0014	47.6071**	9.3178	-1.1218	0.3370**
(0.0059)	(5.9440)	(9.7346)	(6.3087)	(0.0625)

R^2 = 0.98; D-W = 1.88

** = Significant at 1 percent level.

Standard errors in parenthesis.

TABLE 5 (Continued)

LIVINGSTON SURVEY MEASURE
AND MONEY GROWTH
SEASONALLY ADJUSTED DATA

INTERCEPT	INF	INF_{t-1}	INF_{t-2}	M1G	M2G
		1960-1976			
-0.0013	60.5562**	-27.3662	30.7586**	0.1527**	
(0.0024)	(10.5453)	(17.6174)	(10.3698)	(0.0533)	
R^2 = 0.95; D-W = 1.71					
-0.0078*	68.4426*	-17.3021	13.5770		0.1572**
(0.0033)	(8.7610)	(16.6985)	(11.5258)		(0.0405)
R^2 = 0.96; D-W = 1.92					
		1977-1986			
0.0143	56.6211**	11.7317	-11.8497	0.1352**	
(0.0075)	(8.7899)	(14.8552)	(9.2341)	(0.0638)	
R^2 = 0.95; D-W = 1.11					
0.0175**	56.8365**	7.3490	-12.6372		0.1223
(0.0074)	(9.2101)	(15.2598)	(9.7237)		(0.0716)
R^2 = 0.95; D-W = 1.54					

* = Significant at 5 percent level.
** = Significant at 1 percent level.

Standard errors in parenthesis

TABLE 6

LIVINGSTON SURVEY MEASURE
AND MONEY GROWTH
SEASONALLY UNADJUSTED DATA

INTERCEPT	INF	INF_{t-1}	INF_{t-2}	BASE
		1960-1976		
-0.0027	66.6805**	-45.9772*	40.2247**	0.1568*
(0.0027)	(11.2681)	(18.0876)	(10.6460)	(0.0591)

R^2 = 0.95; D-W = 2.04

INTERCEPT	INF	INF_{t-1}	INF_{t-2}	BASE
		1977-1986		
0.0052	47.3628**	13.5290	-6.3372	0.2491**
(0.0075)	(7.3852)	(11.8755)	(7.7420)	(0.0750)

R^2 = 0.97; D-W = 2.38

* = Significant at 5 percent level.
** = Significant at 1 percent level.

Standard errors in parenthesis.

TABLE 6 (Continued)

LIVINGSTON SURVEY MEASURE
AND MONEY GROWTH
SEASONALLY UNADJUSTED DATA

INTERCEPT	INF	INF_{t-1}	INF_{t-2}	M1G	M2G
		1960-1976			
-0.0010 (0.0025)	70.0757** (11.4292)	-45.4331* (19.3643)	40.8041** (11.2624)	0.1025** (0.0473)	
R^2 = 0.95; D-W = 1.75					
-0.0072* (0.0033)	73.1104** (9.4412)	-29.7924 (18.4728)	22.1375 (12.4311)		0.1366** (0.0393)
R^2 = 0.96; D-W = 1.99					
		1977-1986			
0.0169* (0.0078)	53.3690** (8.7269)	14.8565 (14.6317)	-14.3216 (9.3507)	0.1004 (0.0602)	
R^2 = 0.95; D-W = 1.56					
0.0188* (0.0074)	53.8210** (8.8913)	11.8570 (14.6031)	-14.5882 (9.5782)		0.1034 (0.0696)
R^2 = 0.95; D-W = 1.59					

* = Significant at 5 percent level.
** = Significant at 1 percent level.

Standard errors in parenthesis.

Footnotes

[1] In the fall of 1982, the Federal Reserve switched from targeting nonborrowed reserves to a borrowed reserves target. Such a regime is closely related to targeting the federal funds rate. See Gilbert (1985) and Thornton (1988).

[2] If, however, agents recognize the inflation potential associated with unanticipated money growth, long-term nominal interest rates would increase. See Robinson (1988).

[3] The seasonally unadjusted monetary base measure was obtained from the Federal Reserve Bank of St. Louis.

[4] Seasonally unadjusted data were available for BASE, M1G, M2G and INF.

[5] URATE, TBILL, CURCAT, FEDEXP and DEF are obtained from Citibase. DEBTG represents the market value of privately held gross federal debt as reported in Cox and Lown (1987).

6 The B-G procedure also allows for detection of higher-order serial correlation. Tests for the presence of second-, third-, and fourth-order autocorrelation were also insignificant.

7 Murphy and Topel (1985) show that the covariance matrix obtained from the two-step procedure unambiguously underestimates the standard errors of the consistent second-step estimates. Essentially, the information on the sampling distribution of parameters estimated in the first step is used to adjust the

estimated covariances of the second-step equation.

8 Mishkin (1983, p. 80) points out a potential problem in the models estimated. If the money supply process is not exogenous then these equations suffer from simultaneous equation bias which means the estimates could give misleading impressions regarding the impact of unanticipated money growth on interest rates.

9 Chow tests on the forecasting equations for BASE, M1G, M2G and IPG indicated no structural change in forecasts of these variables.

10 Ostensibly, the reasons given for deemphasizing M1 growth in 1982 were the maturing of a large volume of all saver certificates, plus the scheduled introduction of money market deposit accounts. See "Record of Policy Action of the FOMC: Meeting Held on October 5, 1982," Federal Reserve Bulletin December 1982, pp. 761-766. Financial deregulation was cited as the primary factor in the decision not to specify a target range for M1 growth in 1987. See "Record od Policy Action of the FOMC: Meeting Held February 10-11, 1987," Federal Reserve Bulletin June 1987, pp. 443-451.

Literature Cited

Barro, Robert J. "Unanticipated Money Growth and Unemployment in the United States," American Economic Review 67 (1977) 101-115.

Barth, James R. Robin Sickles and Philip Wiest. "Assessing the Impact of Varying Economic Conditions on Federal Reserve Behavior," Journal of Macroeconomics 26 (1982) 47-70.

Blejer, M.I. "Money and the Nominal Interest Rate in an Inflationary Economy: An Empirical Test," Journal of Political Economy 86 (1978) 529-534.

Breusch, T.S. "Testing for Serial Correlation in Dynamic Linear Models," Australian Economic Papers 17 (1979) 1287-1294.

Brown, W.W. and G.J. Santoni. "Monetary Growth and the Timing of Interest Rate Movements," Federal Reserve Bank of St. Louis Review 65 (1983) 16-25.

Cagan, Phillip. "The Channels of Monetary Effects on Interest Rates," National Bureau of Economic Research, 1966.

_____ and Arthur Gandolfi. "The Lag in Monetary Policy as Implied by the Time Pattern of Monetary Effects on Interest Rates," American Economic Review 59 (1969) 277-284.

Cornell, Bradford. "The Money Supply Announcement Puzzle: Review and Interpretation," American Economic Review 73 (1983) 644-657.

Cox, W. Michael and Cara S. Lown, "The Capital Gains and Losses on U.S. Government Debt: 1942-1987, forthcoming 1989, The Review of Economics and Statistics.

Engle, Robert F. "Autoregressive Conditional Heteroscedasticity With Estimates of the Variance of United Kingdom Inflation," Econometrica 50 (July 1982) 987-1007.

_____, David Lilien and Russell P. Robins. "Estimating Time Varying Premia in the Term Structure: The Arch-M Model," Econometrica 55 (March 1987) 391-407.

Fama, Eugene F. "Short-term Interest Rates as Predictors of Inflation," American Economic Review 65 (June 1975) 269-282.

_____"Inflation Uncertainty and Expected Returns on Treasury Bills," Journal of Political Economy 84 (June 1976) 427-448.

Friedman, Milton. "The Monetary Studies of the National Bureau," The National Bureau Enters its 45th Year, 44th Annual Report, National Bureau of Economic research (1964) 7-25.

Friedman, Benjamin M. "Lessons on Monetary Policy from the 1980's," Journal of Economic Perspectives 2 (Summer 1988) 51-72.

Gibson, William E. "Interest Rates and Monetary Policy," Journal of Political Economy 78 (1970) 431-455.

Gilbert, R. Alton. "Operating Procedures for Conducting Monetary Policy," Federal Reserve Bank of St. Louis Review 70 (1988) 30-54.

Godfrey, L.G. "Testing for Higher Order Serial Correlation in Regression Equations When the Regressors Include Lagged Dependent Variables," Econometrica 46 (1978) 1303-1310.

Granger, C.W.J. "Investigating Causal Relations by Econometric Models and Cross-Spectral Methods," Econometrica 37 (1969) 424-438.

Guttentag, Jack M. "The Strategy of Open Market Operations," The Quarterly Journal of Economics 80 (1966) 1-30.

Hoehn, James G. "Recent Monetary Control Procedures and the response of Interest Rates to Fluctuations in Money Growth," Federal Reserve Bank of Dallas Economic Review (1983) 1-10.

Judd, John P. and Bharat Trehan. "Portfolio Substitution and the Reliability of M1, M2 and M3 as Monetary Policy Indicators," Economic Review Federal Reserve Bank of San Francisco, Summer 1987, 5-29.

Laidler, David E.W. The Demand for Money: Theories and Evidence, 3rd Edition (New York: Harper and Row, 1985).

Mehra, Yash. "Inflationary Expectations, Money Growth and the Vanishing Liquidity Effect of Money on Interest: A Further Investigation," Federal Reserve Bank of Richmond Economic Review 71 (1985) 23-35.

Melvin, Michael. "The Vanishing Liquidity Effect of Money on Interest: Analysis and Implications for Policy," Economic Inquiry 21 (1983) 188-202.

Mishkin, Frederic S. A Rational Expectations Approach to Macroeconometrics: Testing Policy Ineffectiveness and Efficient-Markets Models (Chicago: The University of Chicago Press, 1983).

Motley, Brian. "Should M2 be Redefined?" Economic Review Federal Reserve Bank of San Francisco (Winter 1988) 33-51.

Murphy, Kevin M. and Robert H. Topel. "Estimation and Inference in Two-Step Econometric Models," Journal of Business and Economic Statistics 3 (1985) 370-379.

Muth, John F. "Rational Expectations and the Theory of Price Movements," Econometrica 29 (1961) 315-335.

Nelson, Charles R. and G. William Schwert. "Short-Term Interest Rates as Predictors of Inflation: On testing the Hypothesis That the Real Rate of Interest is Constant," American Economic Review 67 (June 1977) 478-486.

Reichenstein, William. "The Impact of Monetary Policy on Short-Term Interest Rates," Economic Inquiry 25 (1987) 67-82.

Robinson, Kenneth J. "The Effect of Monetary Policy on Long-Term Interest Rates: Further Evidence from an Efficient-Markets Approach," Economic Review Federal Reserve Bank of Dallas (March 1988) 10-16.

Roley, V. Vance. "The Response of Short-Term Interest Rates to Weekly Money Supply Announcements," Journal of Money, Credit and Banking 15 (1983) 344-354.

____"The Effects of Money Announcements Under Alternative Monetary Control Procedures," Journal of Money, Credit and Banking 19 (1987) 292-307.

Thornton, Daniel L. "The Borrowed Reserves Operating Procedure: Theory and Evidence," Federal Reserve Bank of St. Louis Review 70 (1988) 30-54.

Wilcox, James A. "Why Real Rates Were So Low in the 1970's," American Economic Review 73 (1983) 44-53.