The Puzzling Effect of Money Shocks on Interest Rates

Dr. Panita Piya-Oui, Bangkok, Thailand
Dr. O. Felix Ayadi, Fayetteville State University
Dr. Walter J. Mayer, University of Mississippi

Abstract

This study reexamines the controversial impact of changes in the growth rate of money supply on short-term nominal interest rates. Most of the early studies consistently find evidence that support a negative relationship between money shocks and interest rates. This relationship reflects the hypothesized liquidity effect. When the Fed accelerates the growth rate in money supply at given prices, output and inflation, the LM curve shifts, and real balances increase. Consequently, nominal and real interest rates are reduced. The results of the finite lag methods vary from one technique to another. However, the general trend points toward the vanishing liquidity effect. An infinite lag method which assumes a quadratic polynomial lag structure is also applied to data from 1972 though 1989. The results show a slight presence of the liquidity effect. The overall results also indicate that inflation rate as well as the variance of inflation rate slightly influence the relationship described above.

Introduction

Early researchers, through the works of Friedman (1968), Cagan and Gandofi (1969), Gibson (1970) and Cagan (1972), provide a guide as to the pattern of response of interest rates to changes in the growth rate of the money supply. They predict that changes in the growth rate of the money supply could affect nominal interest rates in several ways over time. An increase in the growth rate of the money supply would cause real and nominal rates of interest to fall temporarily due to the liquidity effect. The nominal rate of interest would later rise due to income and expectations effects.

The initial response to an increase in the growth rate of money supply suggests the existence of excess supply of money at existing income, interest rate and price levels. This will cause interest rates to fall to equate demand and supply since prices and income are sticky. For example, if the Fed increases the supply of money by purchasing securities, this will raise banks' excess reserves. Banks will increase their investment in securities and thereby lower the rate of interest in response to the increase in excess reserves. This effect is referred to as the liquidity effect.

Following the liquidity effect is the income effect. The increase in nominal income will lead to an increase in spending and money demand. Consequently, the rate of interest begins to rise. Finally, if the money supply grows in a time of high output, the price expectations of a rising price level for goods and services occur. These price expectations affect the money demand function and consequently lead to an increase in the rate of interest.

The purpose of this paper is to re-examine the effects of monetary policy on interest rates by applying Melvin's methodology to more recent data. Cochrane (1989) observed that all the studies employing pre-1979 data are subject to simultaneous-equations bias, because the Federal Reserve Board smoothed interest-rate fluctuations. Additionally, we intend to apply two other approaches to the same data set. The justification is based on Melvin who shows that the liquidity effect in the 1973-1979 sub-period is shorter than that of the 1951-1972 sub-period. This suggests that the more recent the period, the shorter the liquidity effect, possibly because people in more recent periods are more concerned about the economy and pay more attention to inflation than those in the past. This paper, based on the same approach, will extend the period to include 1980-1989. This study applies three different approaches to three sub-periods: 1972-1989, 1972-1979, and 1980-1989. The first two approaches are finite methods employed by Melvin (1983) and Graham (1986), and, the third is the infinite lag method.

This paper is organized as follows: Section II reviews the previous studies. In section III the data and methodology are presented. The results are presented in section IV while section V contains a discussion of our results.

Literature Survey

Early empirical evidence indicates that the initial decrease in interest rates would last four to nine months before rates start to rise again. However, Mishkin (1981, 1982) found no liquidity effect on quarterly data prior to 1979. Melvin (1983) found results that predict a liquidity effect lasting two months or less. This evidence indicates the existence of little or no liquidity effect. Recent empirical studies by Cochrane (1989) and Grier and Perry (1993) show the existence of a liquidity effect. Thus, the empirical evidence to date has been inconclusive as to the effect of money shocks on the rate of interest. The difference between these results could be due to use of different methodology, functional forms, lag lengths, time periods, and/or relevant variables.

Melvin (1983), tests the relationship between the change in the growth rate of money supply and the change in the interest rates by using the distribution lags over 12 months and 36 months for the period 1951-1979. The commercial paper rate is used as interest rate, and money supply is defined in terms of M_2. The results indicate a shortened liquidity effect, followed by long income and expectation effects, respectively. However, his results for the 1951-1965 and 1966-1979 sub-periods are not statistically significant. But, when 1973 is used as the splitting year, the liquidity effect of 1951-1972 lasts four months, while, the liquidity effect of 1973-1979 lasts for only one month.

Moreover, Melvin finds that economic agents are highly sensitive to high inflation rates, which in turn results in a shortened liquidity effect. He suggests that the coefficients of the explanatory variables be defined as a function of inflation rates with a distribution lag of 12 months. The inflation rate is measured by the rate of change in the consumer price index (CPI). By observing the data from 1951 through 1979, he reports the existence of a short liquidity effect, followed by the income and expectation effects. He, therefore, concludes that the relationship between money supply and interest rates depends on the inflationary environment. The higher the inflation in a particular period, the shorter is the liquidity effect, and consequently, the faster the expectation effect.

Graham (1986), modifies the approach of Melvin and finds evidence relating to the effect of money supply changes on interest rates. He examines monthly data from 1953 through 1979, and the results support Melvin. Graham, further evaluates the beta coefficients as a function of the 12 month distributed lag of the variance of inflation, in addition to the original Melvin model. The evidence supports the hypothesis that the inflationary environment influences the relationship between interest rates and the money supply. However, the inflation rate during 1953-1972, significantly leads to the presence of a longer liquidity effect, in contrast to the findings of Melvin. The variance of inflation in the period, 1973-1979 leads to a reduction in the liquidity effect while inflation rate does not have any impact. Therefore, Graham concludes that the variance of inflation explains the relationship between money supply and interest rates better than the inflation rate does. Both Melvin and Graham apply Ordinary Least Squares (OLS) technique to estimate their equation, thus, ignoring the problems of multicollinearity and autocorrelation.

Since Graham, other researchers have examined the question posed by the liquidity effect of money shocks. Hamlen, Hamlen, and Kasper (1988) used a combination of OLS, the Almon Polynomial, and the Harmonic, and find no liquidity effect. Cochrane (1989) applies the filter technique and finds a negative relationship between money growth rate and interest rate. This evidence supports the presence of a liquidity effect.

Other research works in this area include those of Reichenstein (1987), Sims (1992) Leeper and Gordon (1992) and Grier and Perry (1993). With the exception of Grier and Perry, these researchers found little or no evidence to support the presence of a liquidity effect. Grier and Perry (1993) spurn some of the results of tests that use OLS estimation method. According to them the OLS method fails to model the conditional heteroskedasticity of interest rates. They apply the autoregressive conditional heteroskedaticity (ARCH) models and find a significant liquidity effect.

Christiano and Eichenbaum (1992) apply the vector autoregression (VAR) to both monthly and quarterly data between 1959 and 1990, and find a significant liquidity effect. The unique thing about this study is that it tests a relationship between nonborrowed reserves and the federal funds rate. Grier and Perry (1993) criticize these authors on the ground that they adopt a wrong methodology in testing for the liquidity effect.

Data and Methodology

Data

The monthly three-month Treasury bill rate is used as a measure of interest rate (TB) in all three econometric techniques described below. The percentage change in the monthly consumer price index is used to gauge the inflation rate. Both M_1 and M_2 are used to measure money supply (M_t). The data are collected from the Federal Reserve Bulletin, Economic Report of the President and Business Statistics. The sample period is from January 1972 through November 1989.

Finite Lag Model

The first methodology is the Gibson method, which is also used by Melvin. Three different kinds of models are considered with lag lengths (k) of 12, 16, and 24 months. The models are

$$TB_t = \alpha + \sum_{i=0}^{k} \beta_i \; gM_{t-i} + U_t \qquad (1)$$

$$TB_t = \alpha + \sum_{i=0}^{k} \beta_i \; \Delta gM_{t-i} + U_t \qquad (2)$$

$$\Delta TB_t = \alpha + \sum_{i=0}^{k} \beta_i \; \Delta gM_{t-i} + U_t \qquad (3)$$

where,

k = number of lag lengths
TB_t = interest rate in period t
gM_{t-i} = growth rate in money supply in period t-i
DgM_{t-i} = change in growth rate of money supply in period t-i
DTB_t = change in the interest rate in period t
U_t = the disturbance term in period t

The first model is represented by equation 1. In this model, the 3-month Treasury bill rate is regressed directly on the distributed lag of the growth rate in money supply. In the second model (equation 2), the TB rate is regressed on the distributed lag of *changes* in the growth rate of money supply. Finally, in the third model (equation 3), the *changes* in TB rate is regressed on the distributed lag of *changes* in the growth rate of money supply.

The second methodology is the technique used in the Graham (1986), which is an extension of the approach of Melvin. Melvin observes that the relationship between the expectations effect and increased growth rates in the money supply has some inflationary connotations. Thus, he reformulates the distributed lag equations such that the beta coefficients vary with the rate of inflation. Graham uses another approach in which the beta coefficients depend on the variance of inflation rate.

Our approach follows the foregoing by defining beta coefficients as a function of the level of inflation rate and variance of inflation rate in order to capture the sensitivity of economic agents to inflation in the economy. Thus, we define the following equations:

$$\Delta TB_t = \alpha + \sum_{i=0}^{12}(a + b\,\Delta P_{t-i})\Delta gM_{t-i} + U_t \qquad (4)$$

$$\Delta TB_t = \alpha + \sum_{i=0}^{12}(a + c\,V(\Delta P_{t-i}))\Delta gM_{t-i} + U_t \qquad (5)$$

$$\Delta TB_t = \alpha + \sum_{i=0}^{12}(a + b\,\Delta P_{t-i} + c\,V(\Delta P_{t-i}))\Delta gM_{t-i} + U_t \qquad (6)$$

where,

ΔTB_t = change in the interest rate in period t
ΔP_{t-i} = inflation rate measured in percentage in period t-i
$V(\Delta P_{t-i})$ = variance of inflation rate in period t-i
ΔgM_{t-i} = change in growth rate of money supply in period t-i
U_t = the disturbance term in period t

Equations (4), (5) and (6) are estimated using the estimated generalized least squares (EGLS) technique. The justification is that the EGLS technique is more appropriate than the OLS technique in the presence of autocorrelation. In this paper, we use the following AR(1) process for the error term.

$$U_t = \rho U_{t-1} + \varepsilon_t \qquad (7)$$

where,

e_t = the disturbance term, which is assumed to have zero mean and constant variance.

In Equation 7, when $\rho = 0$, then, there is no autocorrelation, and the OLS is a better method to use because it gives an unbiased, consistent, and efficient estimator. However, when $\rho \neq 0$, meaning autocorrelation exists, the OLS gives an unbiased, consistent, but inefficient estimator, and the test statistic will be invalid. Consequently, the EGLS is a better method to use since the estimators are efficient, although biased and inconsistent, but the test statistic is still valid.

Infinite Lag Model

One problem with a finite lag model is that one does not know if the specified lag length (k) is the appropriate one. If a researcher uses a large k, one stands to lose a large number of degrees of freedom. Therefore, in order to get around this problem, researchers often resort to using an infinite lag model. If the finite lag method is used, the model might exclude some relevant variables causing the estimators to be biased and the test statistics to be invalid. On the other hand, when the infinite lag method is used, although the model might include some irrelevant variables causing the estimators to be imprecise, they are unbiased, and the test statistic is still valid. In this study, the infinite lag model used assumes a quadratic polynomial form, and is a combination of the Almon and the Koyck lag methods. Thus, the beta coefficients are defined as:

$$\beta_i = (\alpha_0 + \alpha_1^i + \alpha_2^{i^2})\delta^i \quad (8)$$

Under the infinite lag model, some constraints are imposed on the beta coefficients, so that they decay as time passes.

$$TB_t = \sum_{i=0}^{infinity} \beta_i \; gM_{t-i} + U_t \quad (9)$$

By substituting equation (8) into equation (9) we obtain the following money supply and interest rate relationship.

$$TB_t = \sum_{i=0}^{2} \alpha_i Z_{it} + \sum_{j=0}^{2} t^j \pi_j \delta^t + U_t \quad (10)$$

where,

$$Z_{0t} = \sum_{i=0}^{t-i} \delta^i \; gM_{t-i}$$

$$Z_{1t} = \sum_{i=0}^{t-i} i \; \delta^i \; gM_{t-i}$$

$$Z_{2t} = \sum_{i=0}^{t-i} i^2 \; \delta^i \; gM_{t-i}$$

δ is a number assumed to have its value defined between 0 and 1. The value of δ is found by the grid search method, and the δ is chosen in order to minimize the residual sum of squares (RSS) of Equation (10).

Results

The application of OLS to Equations 1, 2, and 3 shows significantly low Durbin-Watson statistics. This is evidence for the existence of autocorrelation. Additional tests reveal the presence of first order autocorrelation in the data. In order to deal with the autocorrelation problem, we applied the estimated generalized least squares (EGLS) method. The results of the application of EGLS to Equations 1, 2 and 3 are reported in Tables 1 through 3.

When M_1 is used as the definition of money supply several variations were observed from period to period and from model to model. For example, Table 1 results show the absence of any significant liquidity effect, for all lag lengths and for all sub-periods. The only exception is in the 1980-1989 sub-period with k=12. In this case, there is a liquidity effect that lasts one month, and later followed by both the income and expectation effects. In Table 3, there are a few significant negative coefficients. However, one cannot conclude that the liquidity effect is present. The results with money supply defined as M_2 are not reported here. However, evidence show the absence of any initial liquidity effect.

Tables 4 and 5 contain the results of a different specification of the relationship between interest rate and the growth rate in money supply. The three models in this case define beta coefficients in terms of the level of inflation rate and the variance of inflation rate. During the 1972-1989 period, the variance of inflation has more influence on the relationship between the rate of interest and money supply (Table 4). Similar results are also found for the unreported 1972-1979 sub-period. However, during the 1980-1989 sub-period, the coefficient of variance of inflation is just slightly significant. When money supply is defined as M_2, the results (not reported) show the variance of inflation is positively related to the rate of interest. Only a few of the inflation coefficients are negative. These results are consistent with those found by Graham (1986).

The results of the application of the third methodology are shown in Figures 1, 2, and 3. These figures present graphs plotting the accumulative beta points against time for the three sub-periods. The positive cumulative sum of beta coefficients have risen for 21 months in the 1972-1989 period and for 15 months in the 1972-1979 period before declining. After reaching a peak they start to decline and eventually become negative. This implies that the income and expectation effects precede the liquidity effect. This is contrary to economic theory and inconsistent with the evidence reported by Melvin.

For the 1980-1989 sub-period, negative accumulative beta coefficients occur for about four months, and then begin to rise and eventually become positive. This shows the shortened liquidity effect preceding the income and expectation effects which is consistent with economic theory. However, results of this test do not corroborate those reported by Melvin that more recent period, produces a shortened liquidity effect. In other words, the liquidity effect diminishes with time.

FIGURE 1
CUMULATIVE BETA COEFFICIENTS
USING INFINITE LAG METHOD (1972 - 1989)

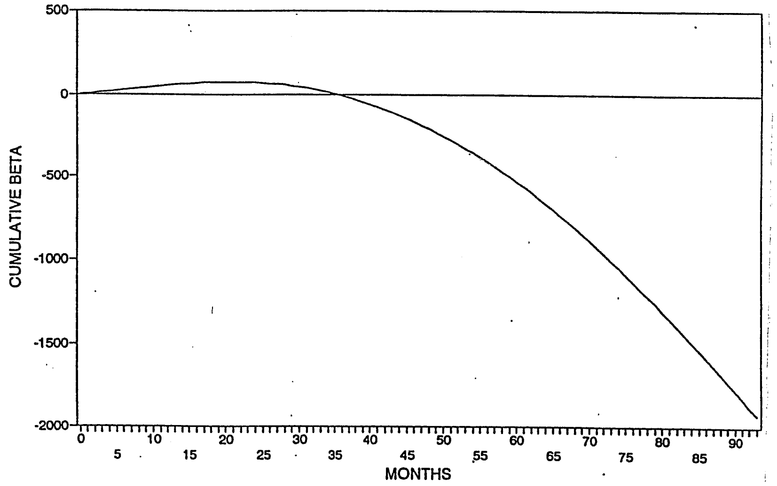

FIGURE 2
CUMULATIVE BETA COEFFICIENTS
USING INFINITE LAG METHOD (1972 -1979)

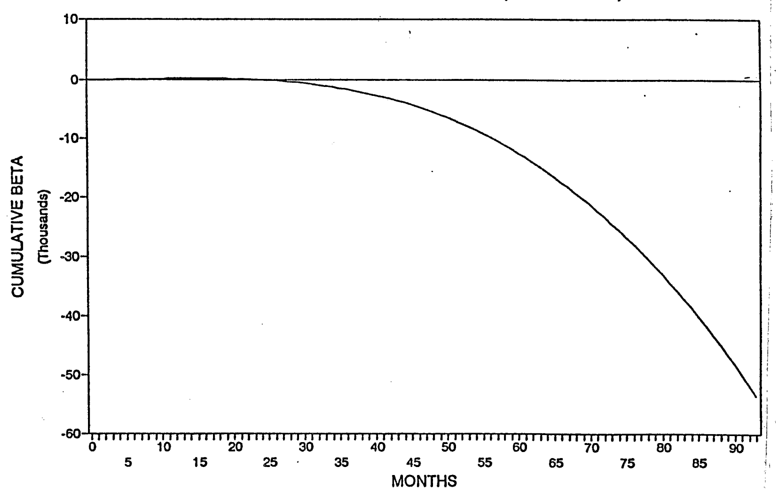

FIGURE 3
CUMULATIVE BETA COEFFICIENTS
USING INFINITE LAG METHOD (1980 - 1989)

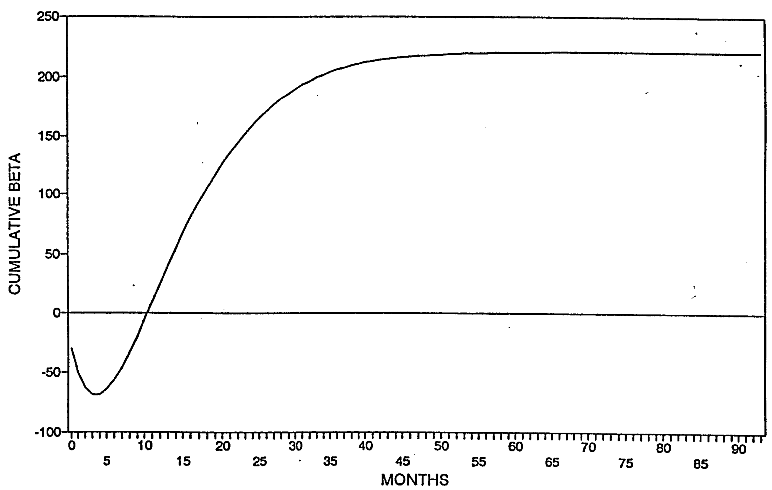

Table 1
EGLS Estimation With Different Number of Lags

$$TB_t = \alpha + \sum_{i=0}^{k} \beta_i gM_{t-i} + U_t$$

	1972-1989			1972-1979			1980-1989		
	k = 12	k = 16	k = 24	k = 12	k = 16	k = 24	k = 12	k = 16	k = 24
a	5.908 *	6.362 *	6.225 *	6.639 *	3.067 *	0.988	8.358 *	8.313 *	8.885
ß0	-6.725	-6.416	-4.101	-0.963	0.256	-6.103	-18.647 *	-14.211	-9.659
ß1	27.413 *	27.224 *	30.490 *	9.162	17.494	0.922	12.912	8.633	-1.072
ß2	26.657 *	34.242 *	38.851 *	9.564	39.162 *	3.239	3.447	-6.155	-10.230
ß3	33.524 *	34.207 *	39.193 *	7.266	46.690 *	-3.660	8.824	-3.457	-2.202
ß4	36.064 *	37.641 *	40.137 *	8.296	60.407 *	4.664	7.006	-2.053	-11.737
ß5	35.423 *	35.518 *	38.627 *	8.813	68.183 *	9.044	7.809	-2.345	-5.560
ß6	31.484 *	30.557 *	35.322 *	4.929	63.879 *	5.347	9.235	-0.899	2.012
ß7	28.121 *	25.900 *	19.088	7.599	64.459 *	-0.456	8.134	1.792	-5.480
ß8	27.724 *	24.856	11.715	6.522	64.062 *	0.413	13.905	9.151	-6.350
ß9	26.193 *	21.889	17.516	10.331	65.714 *	11.972	13.114	11.154	-0.692
ß10	25.642 *	20.777	13.158	7.255	62.914 *	29.866	20.812 *	20.201	5.116
ß11	26.043 *	21.045	8.002	8.922	65.004 *	51.381	18.092 *	15.475	-20.136
ß12	30.918 *	25.099 *	17.662	11.804	64.928 *	81.436 *	28.652 *	23.823	-5.950
ß13		-3.447	-7.372		49.671 *	100.858 *		-3.441	-19.731
ß14		-11.362	-18.379		25.851	98.868 *		3.194	-17.798
ß15		-1.623	-8.767		19.791	106.669 *		3.992	-15.253
ß16		-2.169	-6.414		6.649	98.988 *		-0.900	-5.561
ß17			-4.107			92.245 *			-5.184
ß18			-1.951			90.744 *			-7.399
ß19			11.468			92.894 *			7.213
ß20			20.271			88.332 *			14.320
ß21			10.309			77.538 *			2.545
ß22			13.742			57.215 *			-3.024
ß23			17.511			43.083 *			12.196
ß24			7.035			23.569			-0.573
MSE	0.542	0.543	0.531	0.323	0.315	0.454	0.474	0.452	0.347
R-SQ	0.162	0.188	0.251	0.061	0.193	0.427	0.206	0.152	0.252

NOTES: (1)* indicates significant t-statistic at the 5% level.
(2)Money supply is defined as M1.
(3)U_t follows AR(1)

Table 2
EGLS Estimation With Different Number of Lags

$$TB_t = \alpha + \sum_{i=0}^{k} \beta_i \Delta gM_{t-i} + U_t$$

	1972 - 1989			1972 - 1979			1980 - 1989		
	k = 12	k = 16	k = 24	k = 12	k = 16	k = 24	k = 12	k = 16	k = 24
a	7.856 *	8.115 *	8.157 *	7.257 *	7.358 *	7.227 *	9.064 *	8.809 *	8.179 *
ß0	-16.540 *	-10.899	-8.153	-6.739	-7.372	-7.885	-20.834 *	-17.847 *	-7.030
ß1	-7.914	9.018	15.000	-9.338	-10.435	-10.565	-7.363	-9.907	-10.731
ß2	-6.735	32.181	45.976 *	-6.439	-6.534	-7.628	-18.668	-17.310	-19.311
ß3	-1.501	51.827 *	75.656 *	-7.354	-9.120	-15.696	-25.051	-19.360	-19.722
ß4	3.464	72.126 *	104.682 *	-9.944	-8.189	-24.331	-32.207	-20.956	-25.806
ß5	5.614	89.103 *	130.684 *	-13.179	-6.621	-37.411	-37.585	-15.202	-25.994
ß6	3.001	95.077 *	151.665 *	-20.756	-9.575	-60.664	-39.896	-20.596	-19.798
ß7	-2.903	96.530 *	154.620 *	-25.923	-12.311	-97.031	-40.595	-22.963	-24.137
ß8	-7.724	97.208 *	149.398 *	-29.984	-15.994	-141.462	-34.330	-17.223	-25.127
ß9	-11.683	94.557 *	148.317 *	-28.716	-17.187	-188.971	-27.334	-10.303	-22.941
ß10	-13.279	90.205 *	141.177 *	-27.582	-20.177	-233.972	-14.053	4.880	-17.865
ß11	-11.892	85.593 *	126.775	-22.660	-19.877	-272.300	-4.698	15.037	-29.061
ß12	4.936	88.162 *	123.201	-8.868	-10.471	-291.891	15.277 *	36.364	-28.348
ß13		64.124 *	93.838		-3.856	-296.377		26.545	-42.317
ß14		35.597 *	55.897		-5.971	-295.308		25.716	-55.093
ß15		20.117	28.606		-1.515	-279.993		21.986	-67.393
ß16		7.904	4.428		-0.953	-263.550		14.741	-73.878
ß17			-16.366			-243.702			-79.359
ß18			-33.414			-218.606			-84.495
ß19			-35.380			-185.089			-69.609
ß20			-27.138			-146.699			-50.351
ß21			-26.868			-106.663			-36.599
ß22			-20.520			-70.703			-26.995
ß23			-7.836			-35.981			-9.150
ß24			-2.601			-11.076			-6.341
MSE	0.578	0.554	0.539	0.539	0.349	0.375	0.428	0.412	0.296
R-SQ	0.109	0.172	0.239	0.078	0.085	0.147	0.235	0.196	0.260

NOTES: (1) * indicates significant t-statistic at the 5% level.
(2) Money supply is defined as M1.
(3) U_t follows AR(1).

Table 3
EGLS Estimation With Different Number of Lags

$$\Delta TB_t = \alpha + \sum_{i=0}^{k} \beta_i \Delta gM_{t-i} + U_t$$

	1972 - 1989			1972 - 1979			1980 - 1989		
	k = 12	k = 16	k = 24	k = 12	k = 16	k = 24	k = 12	k = 16	k = 24
a	0.027	0.013	0.013	0.081	0.064	0.040	-0.064	-0.054	-0.059
ß0	-1.349	-1.071 *	2.998	-2.359	2.346	7.973	-14.484	-7.686	0.260
ß1	33.138 *	33.509 *	38.278	4.023	18.326	31.930	18.855	15.809	7.792
ß2	33.296 *	41.805 *	47.897	3.658	37.024	58.338	8.816	1.913	-1.393
ß3	40.687 *	42.528 *	48.619	0.210	40.057	71.366	12.702	7.718	5.225
ß4	43.384 *	46.483 *	50.000	0.099	49.043	91.633	9.392	9.595	-4.226
ß5	42.633 *	44.932 *	48.195	-0.039	53.102	101.949	8.753	12.184	1.609
ß6	38.223 *	39.619 *	45.471	-4.137	49.039	101.284	9.019	11.096	11.403
ß7	34.289 *	34.817 *	29.404	-0.608	51.345	94.732	7.960	11.179	3.386
ß8	33.197 *	33.585 *	21.984	-1.402	51.087	85.918	14.011	16.359	3.685
ß9	30.864 *	30.491	27.174	4.097	54.250	78.223	14.695	16.961	9.039
ß10	30.017 *	29.592 *	23.553	2.309	51.930	67.679	23.737	26.101	13.590
ß11	30.222 *	30.045	18.681	4.597	53.285	53.042	22.686	22.731	-7.247
ß12	30.558 *	29.723	25.019	8.284	50.526	37.502	30.645	27.586	4.514
ß13		0.490	-0.633		34.812	15.870		2.516	-6.762
ß14		-8.395	-12.456		13.747	-12.446		10.437	-5.891
ß15		0.313	-3.177		11.182	-23.530		9.363	-4.504
ß16		-1.182	-1.586		2.372	-39.747		3.932	2.377
ß17			0.704			-46.600			0.472
ß18			1.709			-45.345			-6.408
ß19			14.653			-36.370			8.360
ß20			23.129			-28.236			14.039
ß21			13.539			-18.798			5.665
ß22			16.339			-12.903			3.352
ß23			20.014			1.423			17.681
ß24			6.570			4.683			0.471
MSE	0.527	0.530	0.509	0.238	0.234	0.209	0.432	0.379	0.265
R-SQ	0.169	0.194	0.263	0.085	0.176	0.239	0.247	0.196	0.335

NOTES:
(1) * indicates significant t-statistic at the 5% level.
(2) Money supply is defined as M1.
(3) U_t follows AR(1).

Table 4
Comparison Of (ols) Coefficients Among Three Models (1972 - 1989)

$$\Delta TB_t = \alpha + \sum_{i=0}^{12}(a + b\Delta P_{t-i})\Delta gM_{t-i} + U_t \quad (1)$$

$$\Delta TB_t = \alpha + \sum_{i=0}^{12}(a + cV(\Delta P)_{t-i})\Delta gM_{t-i} + U_t \quad (2)$$

$$\Delta TB_t = \alpha + \sum_{i=0}^{12}(a + b\Delta P_{t-i} + cV(\Delta P)_{t-i})\Delta gM_{t-i} + U_t \quad (3)$$

	(1)		(2)		(3)		
	$\hat{a}$	$\hat{b}$	$\hat{a}$	$\hat{c}$	$\hat{a}$	$\hat{b}$	$\hat{c}$
0	-6.853	2.683	1.179	-64.538	3.305	-2.809	-98.727
1	28.266 *	0.630	39.813 *	-88.742	43.368 *	-10.895	-119.411
2	25.602 *	2.932	44.633 *	-139.806	46.088 *	-11.280	-151.465
3	23.876 *	16.008 *	59.360 *	-237.618 *	47.729 *	4.307	-211.483 *
4	17.373	30.619 *	66.042 *	-298.526 *	39.504 *	20.878 *	-213.603 *
5	15.166	30.977 *	62.025 *	-284.306 *	28.633	24.643 *	-162.185
6	17.311	17.555 *	53.694 *	-248.486 *	22.041	14.126	-104.623
7	19.601	6.616	42.276 *	-184.067 *	15.134	5.407	-49.290
8	19.147	7.926	31.410 *	-65.073	6.357	6.740	39.629
9	22.212 *	3.922	24.363	0.966	5.229	6.258	67.449
10	24.156 *	2.209	24.486 *	5.837	13.598	1.529	37.117
11	26.227 *	1.118	29.172 *	-32.118	22.285	-0.197	12.860
12	29.561 *	2.082	30.212 *	7.627	25.262	1.478	24.069
α		0.070		0.012			0.036
DW		1.789		1.708		1.813	
MSE		0.429		0.447		0.403	
R-SQ		0.292		0.266		0.346	

NOTES: (1) * indicates significant t-statistic at the 5% level.
(2) Money supply is defined as M1.

Table 5
Comparison Of (OLS) Coefficients Among Three Models (1980 - 1989)

$$\Delta TB_t = \alpha + \sum_{i=0}^{12}(a + b\Delta P_{t-i})\Delta gM_{t-i} + U_t \quad (1)$$

$$\Delta TB_t = \alpha + \sum_{i=0}^{12}(a + cV(\Delta P)_{t-i})\Delta gM_{t-i} + U_t \quad (2)$$

$$\Delta TB_t = \alpha + \sum_{i=0}^{12}(a + b\Delta P_{t-i} + cV(\Delta P)_{t-i})\Delta gM_{t-i} + U_t \quad (3)$$

	(1)		(2)		(3)		
	$\hat{a}$	$\hat{b}$	$\hat{a}$	$\hat{c}$	$\hat{a}$	$\hat{b}$	$\hat{c}$
0	-12.268	-3.641	5.679	-112.395	0.326	10.483	-109.264
1	11.706	7.571	25.094 *	-123.318	23.325	-1.606	-199.315 *
2	7.954	0.789	22.323	-184.311 *	22.435	-22.332 *	-177.191
3	11.713	8.569	28.405 *	-160.812	18.461	10.649	-180.588
4	4.626	24.019 *	29.090	-248.450 *	10.436	23.706 *	-158.463
5	1.178	30.560 *	29.539	-238.217 *	9.175	19.632	-128.540
6	3.266	18.565	21.746	-172.850	2.171	7.779	-11.926
7	5.025	5.519	22.001	-139.123	1.044	11.359	0.074
8	10.233	-1.507	17.001	-19.699	5.167	-3.134	59.601
9	11.037	2.714	14.921	-15.417	3.406	1.538	88.751
10	13.715	20.432	23.076	-17.640	9.958	20.189	-13.311
11	15.704	10.860	23.466	-71.745	17.707	4.356	-44.372
12	29.606 *	-3.707	20.204	-17.935	16.861	5.054	-32.227
α	0.014		-0.002			0.026	
DW	1.993		1.775			1.955	
MSE	0.392		0.212			0.144	
R-SQ	0.407		0.333			0.551	

NOTES: (1) * indicates significant t-statistic at the 5% level.
(2) Money supply is defined as M1.

Commentary

The attempt in this paper has been to examine the controversial relationship between changes in the growth rate of money supply and interest rates. Three approaches are applied. The first two approaches are finite lag methods that have been used on a different data set by Melvin (1983) and Graham (1986). The third and new approach is an infinite lag method which combines the Almon and Koyck lag methods. This method is better because the researcher does not have to deal with the problem of lag length specification.

Most of the early studies consistently find evidence supporting a negative relationship between money shocks and interest rates. This relationship reflects the hypothesized liquidity effect. When the Fed accelerates the growth rate in money supply at given prices, output and inflation, the LM curve shifts, and real balances increase. Consequently, nominal and real interest rates are reduced.

Results of the finite lag methods vary from one technique to another. However, the general trend points toward a vanishing liquidity effect. An infinite lag method which assumes a quadratic polynomial lag structure is also applied to data from 1972 though 1989. The results show slight presence of a liquidity effect. The overall results also indicate that the inflation rate as well as the variance of the inflation rate influence the relationship described above.

The atypical results reported in this study have been anticipated by Melvin who concludes that the money-interest relationship changed significantly after 1972. The decade of 1970 - 1980 witnessed a substantial instability and long periods of stagflation (Kaufman, 1992). During this period the gold standard was abandoned, higher energy prices caused by OPEC monopoly pricing existed, higher food prices as a result of poor harvests were present, and President Nixon imposed price and wage controls. Moreover, stagflation brought about a decline in real GNP and exerted pressures on the exchange value of the dollar. Beginning in 1970, the Federal Reserve System changed policy focus several times by targeting the federal funds rate between 1970 and 1979, nonborrowed reserves in 1979 to 1982 and federal funds rate thereafter. Finally, Regulation Q ceiling was removed for short-term CDs in 1970 and this led to a general hike in interest rates.

Based on the foregoing, it is obvious that the economy has become more complex with several macroeconomic factors interacting. Thus, economic theory, based on the Keynesian and the IS/LM framework, used in Melvin's model which assumes a linear and simple one dimensional interaction might not fit the awkward situation. The model might not account for the observed complexities. thus, using the model to explain the current data renders the conflicting and puzzling results obtained in this paper.

Suggestions For Future Research

Since the Federal Reserve changes its policy focus in response to changes in the macroeconomic environment, it will be interesting to separate the sample period into sub-periods that coincide with the changes noted above. For example, one will like to see the relationship between money shocks and interest rates when the Fed's policy focus is on the federal funds rate. Future research should approach the issue in this paper from this direction. Moreover, the problem of autocorrelation and heteroscedasticity in time series should be addressed.

❄❄❄ References ❄❄❄

1. Cagan, P.D., "The Channels of Monetary Effects on Interest Rates," National Bureau of Economic Research, New York, 1972.
2. Cagan, P. and A. Gandofi, "The Lag in Monetary Policy as Implied by the Time Pattern of Monetary Effects on Interest Rates," *American Economic Review*, vol. 59, pp. 277-284, 1969.
3. Christiano, L.J. and M. Eichenbaum, "Liquidity Effects and the Monetary Transmission Mechanism," *American Economic Review*, vol. 82, pp. 346-353, 1992.
4. Cochrane, H. John, "The Return of the Liquidity Effect: A Study of the Short-Run Relation Between Money Growth and Interest Rates," *Journal of Business & Economic Statistics*, vol. 7, pp. 75-83, 1989.
5. Crouch, L. Robert, *Macroeconomics*, Harcourt Brace Jovanovich, Inc.: N.Y., 1972.
6. Friedman, M., "The Role of Monetary Policy," *American Economic Review*, vol. 53 pp. 3-17, 1968.
7. Gibson, W., "The Lag in the Effect of Monetary Policy on Income and Interest Rates," *Quarterly Journal of Economics*, vol. 84, pp. 288-300, 1970.
8. Graham, C. Fred., "A Note on the Vanishing Liquidity Effect of Money on Interest," *Economic Inquiry*, vol. 24, pp. 497-503, 1986.
9. Grier, K., "A Note on Unanticipated Money Growth and Interest Rate Surprises," *Journal of Finance*, vol. 41, pp. 981-985, 1986.
10. Grier, K.B. and M.J. Perry, "The Effect of Money Shocks on Interest Rates in the Presence of Conditional Heteroskedasticity," *Journal of Finance*, vol. 48, pp. 1445-1455, 1993.
11. Hamlen, S.S., W.A. Hamlen and G.M. Kasper, "The distributed Lag Effects of Monetary Policy on Interest

Rates Using Harmonic Transformations with a Pretest," *Southern Economic Journal*, vol. 54, pp. 1002-1011, 1988.

12. Kaufman, G.G., *The U.S. Financial System*, Prentice-Hall, New Jersey, 1992.
13. Lee, Susan, "The Un-managed Economy," *Forbes*, pp. 147-158, 17 Dec. 1984.
14. Leeper, E. and D. Gordon, "In Search of the Liquidity Effect," *Journal of Monetary Economics*, vol. 29, pp. 341-369, 1992.
15. Maddala, S. G., *Econometrics*, McGraw-Hill, Inc., New York, 1977.
16. Melvin, Michael, "The Vanishing Liquidity Effect of Money on Interest: Analysis and Implications for Policy," *Economic Inquiry*, vol. 21, pp. 188-202, 1983.
17. Mishkin, F.S., "Monetary Policy and Long Term Interest Rates: An Efficient Markets Approach," *Journal of Monetary Economics*, pp. 29-55, 1981.
18. Mishkin, Frederic S., "Monetary Policy and Short-Term Interest Rates: An Efficient Markets-Rational Expectations Approach," *Journal of Finance*, vol. 37, pp. 63-72, 1982.
19. Reichenstein, William, "The Impact of Money on Short-term Interest Rates," *Economic Inquiry*, vol. 25, pp. 67-82, 1987.
20. Sims, C.A., "Interpreting the Macroeconomic Time Series Facts: The Effects of Monetary Policy," *European Economic Review*, vol. 36, pp. pp. 975-1000, 1992.
21. Zilberfarb, Ben-Zion, "Interest Rate Determination in a High Inflation Economy," *Journal of Macroeconomics*, vol. 11, pp. 533-549, 1989.