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A Note on Unanticipated Money Growth and Interest Rate Surprises: Mishkin and Makin Revisited

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THE RELATIONSHIP BETWEEN MONETARY expansion and interest rates has long been an important macroeconomic issue. Friedman [1] hypothesized a dynamic adjustment process where the interest rate initially falls due to a liquidity effect, then gradually rises in response to increased money demand, higher prices, and expectations of higher future inflation. The relative size of these effects and the speed of the adjustment process are empirical questions that have recently received some attention in rational expectations econometric models.

In a recent article Mishkin [5] found that interest rate and money growth surprises have a significant positive correlation. Makin [3] later published a paper where the correlation is negative and significant. Makin explained these contradictory findings as a result of the different method each uses to measure interest rates:

> Mishkin reports a positive relationship between quarterly money surprises and *end-of-period* short-term interest rates.... In contrast, this study employs *period-average* short-term rates as a dependent variable in order to capture the real income impact under way during the quarter before comparison of an actual with an anticipated money supply gives rise to an expectations effect.[1]

Makin implies that his variable is responding to an initial liquidity effect, while Mishkin's interest rate measure is sampled after the Fisher effect begins to dominate. This note updates Mishkin's empirical work through 1984, confirming his original findings and demonstrating that using period-average interest rates does not produce Makin's result. I also show that lagged money surprises have a significant positive impact on rates, a possibility that Mishkin did not investigate. The next section briefly reviews the efficient markets methodology used in Mishkin, comparing it to the specification found in Makin. Then regressions updating Mishkin's results and incorporating Makin's dependent variable are presented. The paper concludes with an attempt to account for the difference in the two paper's results.

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[1] Makin [3, p. 376]. The emphasis is in the original. Makin uses a different rationalization of the negative correlation hypothesis, "The hypothesized negative impact of money surprises on the real rate arises from their positive impact upon real income which in turn elevates real saving and requires a drop in the real rate to produce an equilibrating rise in real investment."

I. The Models

Mishkin's measure of interest rate surprises is the difference between the actual spot rate and the implicit forward rate that is generated from the three- and six-month rates from the previous quarter (RUN).[2] To allow for a possible liquidity premium in the forward rate, Mishkin includes a measure of interest rate variability (R3AD) as an independent variable. Mishkin uses an end-of-quarter rate because, "misleading results can be obtained from efficient markets models using averaged data." Mishkin uses quarterly data from 1959 through 1976 and predicts money growth with a simple AR4 model.[3]

Makin starts with a more traditional model, but econometric problems move him to a complex final specification. Heteroskedasticity of the nominal bill rate and serial correlation of the estimated residuals prompt him to deflate his variables by expected inflation (which is adopted from the Livingston data), and to use an ARMA (1, 1) transfer function estimation of his basic equation which regresses money surprises (generated by an MA8 equation), expected inflation, and inflation uncertainty on the average three-month T-bill rate. Makin uses quarterly data from 1959 through 1981. As shown below, the efficient market specification eliminates the problems that plagued Makin, allowing the use of simpler statistical procedures. Further, simply substituting period-average interest rate measures does not produce a negative interest rate-money surprise correlation, as Makin argues.

II. The Results

Table I reports the extension of Mishkin's results by adding the 32 quarters of 1977:1 (the first quarter) through 1984:4 to the sample.[4] The only qualitative difference is that the interest rate variability measure, R3AD, is now insignificant. Anticipated money growth (DMHAT) is insignificant, as predicted by the efficient markets model, and money surprises (DMR) are positive, significant at the 0.01 level, and of the same order of magnitude as Mishkin reported.[5] The final equation shows that DMR_{t-1} also has a significant positive correlation with RUN. Since the variance of RUN is stable over the sample and the residuals of

[2] With the three- and six-month bill rates given as annualized, bond equivalent yields, the formula for calculating the forward rate is:

$$_{t-1}\text{FR3}_t = \frac{(1 + \text{R6}_{t-1})^2}{(1 + \text{R3}_{t-1})} - 1.$$

See Van Horne [6] for details. The pure expectations theory of the term structure interprets FR3 as the market expectation of the future spot rate. The essence of efficient markets theory is that all relevant and available information is used in forming this expectation.

[3] Mishkin also uses a multivariate forecasting equation with unchanged results. Makin contends that the form of the money growth equation is largely irrelevant.

[4] The results in this paper use a two-step linear estimation procedure of determining unexpected money growth independently of predicting interest rate surprises. This is the method used by Makin. Mishkin uses a simultaneous, nonlinear model.

[5] Mishkin reports coefficients that range from 0.24–0.30. The values of DMR used in this paper are the residuals from an AR7 with trend forecasting model ($R^2 = 0.34$, D-W = 2.04).

Table I

Unanticipated Money Growth and End-of-Quarter Interest Rate Surprises (1961–1984)

Equation No.	Constant	DMHAT	DMR	DMR(−1)	R3AD	$\bar{R}^2$	D-W
1	0.007	0.076	0.227	—	—	0.145	1.77
	(1.63)	(0.99)	(4.15)				
2	−0.004	—	0.226		0.126	0.142	1.81
	(2.13)		(4.11)		(0.75)		
3	−0.003	—	0.232	0.111	—	0.173	1.82
	(2.26)		(4.28)	(2.01)			

t-statistics are in parentheses. The lagged value of DMR in Equation (3) forces the loss of the first observation in the sample.

Table II

Unanticipated Money Growth and Quarterly Averaged Interest Rate Surprises

Equation No.	Constant	DMR	DMR(−1)	DMR(−2)	$\bar{R}^2$	D-W
		A. 1961–1984				
1	−0.003	0.047	—	—	0.002	1.42
	(2.65)	(1.08)				
2	−0.003	0.043	0.143	—	0.100	1.46
	(2.66)	(1.02)	(3.41)			
3	−0.003	0.042	0.147	.063	0.113	1.52
	(2.67)	(1.01)	(3.48)	(1.51)		
		B. 1961–1981				
1	−0.002	0.072	—	—	0.019	1.49
	(1.91)	(1.62)				
2	−0.019	0.096	0.165	—	0.167	1.48
	(1.91)	(2.31)	(3.91)			
3	−0.002	0.098	0.176	0.066	0.183	1.52
	(1.85)	(2.35)	(4.14)	(1.55)		

t-statistics are in parentheses. Each lagged value of DMR used forces the loss of one observation at the beginning of the sample period.

the equations are not serially correlated, this approach suffers none of the problems that afflict Makin's specification.

To test the appropriateness of pooling data from 1961 through 1984, I perform a series of Chow tests on Equation (3). Breaking the sample in half (at 1972:4) at the end of Mishkin's original period (1976:4) and at the famous October 1979 change in Federal Reserve operations produce F-statistics of 2.13, 2.23, and 2.51. These are all below 2.7, the critical value of the F-distribution at the 0.05 significance level with 3 and 89 degrees of freedom, indicating that using this longer sample is appropriate.

In order to investigate Makin's claim that the method of measuring the interest rate determines the sign of unexpected money growth, Table II repeats the experiment in Table I using quarterly averaged interest rates both as the dependent variable and to generate the forward rate. Contemporaneous money surprises are positive and insignificant, while DMR_{t-1} is positive and significant at the 0.01 level. The second set of equations in Table II demonstrates that this result also holds when the sample is cut off at 1981:4, the end of Makin's sample period. Here, the inclusion of DMR_{t-1} produces an equation where both it and DMR_t are significant. While the averaged results are not as "clean" as the original equations (lower R^2 and Durbin-Watson), they clearly still support the proposition of a positive correlation between money and interest rate surprises. The evidence from the efficient markets model unambiguously implies that there is no negative effect of money shocks on interest rate surprises, even on the "average" surprise throughout the current quarter. Thus, Makin's result must be due to his different model rather than to data measurement.

III. Explaining Makin's Results

Besides the effect of money surprises on interest rates, Makin is interested in testing propositions about the effect of expected inflation on nominal and expected real rates of interest.[6] The efficient markets model is not well suited for investigating these questions because the forward rate combines both expected inflation and the expected real rate in a single measure. Makin thus adopts a traditional Fisher-type of model, as described above. However, given that the Livingston data correctly controls for expected inflation, putting it and unexpected money growth on the right side of the equation with the nominal interest rate on the left implies a model where only unexpected money growth can affect the expected real rate of interest. This is clearly not an implication of efficient markets theory, nor of many standard macro models. It is thus reasonable to inquire whether this restriction is supported by the data. In the efficient market tests described above, the expected component of money growth is insignificant, as implied by the theory. Using a time series measure of expected inflation and Makin's complicated estimation technique, I demonstrate in Table III that this is not the case in Makin's model. Here, expected inflation (DPHAT) is measured by the predicted values of an AR5 model with trend ($R^2 = 0.74$, D-W = 2.01). Equation (1) gives the flavor of Makin's results with unexpected money growth negative and significant at the 0.10 level.

However, when the predicted values of money growth are put into the model [Equation (2)], they are positive and significant at the 0.001 level, and the unexpected money growth coefficient becomes positive and significant at 0.05. These last results should be interpreted with caution, partly because I am using a time-series measure of DPHAT rather than the Livingston data, but mainly because the results are extremely sensitive to the estimation method used. Without correcting for heteroskedasticity by deflating the data with DPHAT, only the intercept and the AR1 coefficient are significant regardless of the ARMA correction scheme. Even using this deflation, other simple transfer functions fail

[6] Makin calculates the coefficient on expected inflation that would keep the expected real after-tax rate constant, and then interprets estimated coefficients significantly lower than that as evidence of a Mundell effect where expected inflation systematically lowers the expected real rate.

Table III

Does Only Unexpected Money Growth Affect the Period-Average Expected Real Rate?[a]

Equation No.	Constant	DPHAT	DMR	DMHAT	AR1	MA1	$\bar{R}^2$	D-W
1	0.0023	1.423	−0.041	—	0.97	−0.49	0.96	1.98
	(89.87)	(2.15)	(1.92)		(4.69)	(2.10)		
2	0.0041	0.684	0.103	0.457	0.12	0.86	0.93	1.99
	(1.23)	(9.29)	(2.14)	(5.39)	(6.40)	(7.39)		

When the heteroskedasticity correction of deflating the data by expected inflation is not used, only the intercept and the AR1 coefficient are significant. DPHAT is the predicted component of inflation using an AR5 model with trend. AR1 and MA1 are the first-order autoregressive and moving-average coefficients. t-statistics are in parentheses.

[a] Regressions of average RTB3 from 1961.2–1984.4 using Makin's weighted ARMA (1, 1) technique.

to produce even a restricted equation (DMR only), where unexpected money growth has a significant negative sign.[7] Given these caveats, it does appear that restricting only unexpected money to affect the expected real rate may be inappropriate.

IV. Conclusions

Mishkin's result of a significant positive correlation of unexpected money growth and interest rate surprises is found to still hold after adding the years 1977 through 1984 to the sample. The result "passes" several Chow tests, indicating a degree of temporal stability, and is shown not to depend on whether the interest rate is measured at the end of the quarter or as a period average as Makin claimed. I conjecture that Makin's result is due to an inappropriate restriction in his specification and offer some brief evidence suggesting that this is the case.

[7] I experimented with ARMA (1, 0), (2, 0), (0, 1), and (0, 2) models in addition to Makin's (1, 1) model.

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