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The Information Content of the Federal Funds Rate: Is It Unique?

FOR SOME TIME NOW, market analysts and central bankers have relied on interbank loan rates in formulating and evaluating monetary policy. Research aimed at identifying the effects of U.S. monetary policy on economic activity (for example, Bernanke 1990, Bernanke and Blinder 1992, and Kashyap, Stein, and Wilcox 1993) has recently turned to the funds rate as an indicator of (exogenous) monetary policy. To the extent that movements in the federal funds rate reflect policy-induced changes in the supply of reserves rather than changes in demand, movements in the rate can be used as a proxy for Federal Reserve policy. Indeed, by virtue of the Federal Reserve's apparent inclination to employ a federal funds rate targeting procedure either explicitly or implicitly, as documented by Goodfriend (1991), few would deny that the federal funds rate contains important information about monetary policy.

The apparent fascination with the federal funds rate, however, raises a fundamental question—that is, does the funds rate contain unique policy information? The idea that the funds rate contains more information about monetary policy than other market interest rates appears to be motivated by the close connection between policy actions and the funds rate. In addition to altering the flow of deposits and reserves

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among banks, open market operations alter the amount of aggregate reserves available to the banking system. Consequently, such operations produce a temporary deviation of excess reserves from their desired level, inducing a change in the federal funds rate. This view is explicit in Bernanke and Blinder (1992), who state “the federal funds rate should be a better information variable than other market interest rates because it is tied closely to Federal Reserve policy,” (p. 908), and is implicit in Laurent (1988), Cook and Hahn (1989), Goodfriend (1991), and others who seem to place considerable reliance on the federal funds rate over other rates as an indicator of monetary policy.¹

But a priori there is nothing in the way that the Fed conducts open market operations to justify the belief that Fed actions affect one rate more than another. The Fed’s open market operations, carried out in U.S. Treasury securities—often very short-term repurchases (RPs) or matched sale-purchases (reverse RPs)—alter the demand for securities relative to the supply, directly influencing the rates on such securities. As the “checks” associated with the Fed’s operations clear the banking system and banks move to restore their reserve balances to the desired levels, the federal funds rate responds as well.²

More importantly, the characterization that the funds rate is somehow more indicative of the Fed’s actions suggests that (abnormal) profit opportunities are left unexploited. That is to say, it is inconsistent with the notion that financial markets are efficient. By precluding *abnormal* profit opportunities, the efficient-markets hypothesis implies that policy actions will be reflected immediately in all market interest rates.

In this paper we investigate the information content of the federal funds rate. Our central objective is to provide evidence concerning the efficiency of financial markets. We propose several tests of the informational uniqueness of the federal funds rate relative to both the overnight RP rate and the three-month T-bill rate. The results confirm our conjecture about the informational equivalence of market interest rates and, accordingly, add further support to the notion that markets are efficient.

1. TESTS FOR UNIQUE INFORMATION IN THE FEDERAL FUNDS RATE

The general thrust of monetary policy is revealed in speeches of the Chairman and other governors and by occasional announcements, such as those that accompany discount rate changes. The Fed’s intentions with respect to the funds rate are frequently “signaled” to the market by the Trading Desk (Feinman 1993). According to the efficient-markets hypothesis, such information must be reflected equally in all interest rates.

1. Bernanke and Blinder support their claim with their finding (using monthly and weekly data) that the supply of reserves is very elastic. Cook and Hahn and Goodfriend argue that the effects of policy actions are transmitted from the federal funds rate to open market rates in accordance with the expectations theory of the term structure.

2. Of course, the funds rate may respond to expectations of changes in reserve availability before the actual change occurs. But in this case the RP rate would also reflect that information.

Of course, the Fed's well-documented desire to work behind the scene and out of the public's eye (Goodfriend 1986, 1991) suggests that not all policy actions are known immediately to the public. By adhering to "fuzzy" federal funds rate targets (borrowed reserves, free reserves, etc.) the Fed maintains some ambiguity about its policy intentions.³ Consequently, there might be some initial ambiguity about whether an observed change in the funds rate reflects a policy action. Nonetheless, market efficiency implies that interest rates will reflect whatever information is extracted from the observed changes in the federal funds rate.⁴

In what follows, we present evidence on market efficiency based on two types of tests. The first is a test of temporal ordering, called "Granger causality." This test is particularly appealing because it assesses the power of past information contained in one rate to predict another. If the federal funds rate were a better monetary-policy information variable than other interest rates, the federal funds rate would provide information that is useful for predicting market interest rates above that contained in lagged values of those rates. Such a finding, however, would suggest that there are arbitrage opportunities. Thus, under the alternative hypothesis that markets are efficient, unidirectional causality running from the funds rate to other market interest rates is not expected.

The second type of test involves estimating the impact of "surprise" policy actions on the fund rate relative to market interest rates. This type of test is based on the existence of a long-run equilibrium between alternative short-term market interest rates. While interest rates may deviate from their long-run relationship due to idiosyncratic factors, such factors average out over time and arbitrage opportunities guarantee that the long-run relationship is eventually restored. Under the null hypothesis of market efficiency, monetary policy shocks should be uncorrelated with idiosyncratic shocks that temporarily drive short-term interest rates away from their long-run equilibrium levels.⁵ Alternatively, if the funds rate is a better indicator of monetary policy than other interest rates, innovations in policy should be reflected in the funds rate but not in other rates. In this case, policy innovations will be correlated with the deviations of the interest rates from their long-run equilibrium levels.

2. THE EMPIRICAL RESULTS

The empirical analysis uses the federal funds rate and two other interest rates, namely, the rate on overnight repurchase agreements, *RP*, and the rate on three-

3. The "fuzziness" of fuzzy federal funds rate targets need not remain constant over time. For example, the Fed switched from a nonborrowed reserve targeting procedure in October 1982 to a borrowed reserves operating procedure. The evidence (Thornton 1988) showed that even early on the Fed appeared to be targeting the federal funds rate more closely than it was targeting borrowed reserves. More recently, Feinman (1993) has presented evidence that the Fed has increasingly focused on targeting the funds rate within a narrow range despite the fact that the Fed continues to set a target for borrowed reserves.

4. Most Federal Reserve actions that affect the quantity of reserves are directly observed. Those that are not—outright transactions with foreigners—can be estimated.

5. Monetary policy shocks affecting inflation expectations can have differential effects on interest rates; however, the term of the interest rates used here is sufficiently short such that these effects are unlikely to be significant.

month T-bills, TB . Compiled by the Federal Reserve Bank of New York, the rate on federal funds is a weighted average of all daily transactions for a group of federal funds brokers and the overnight RP rate is a weighted average of daily rates for primary government security dealers between the hours of about 8:00 and 10:00 a.m.

A. Some Preliminary Test Results

All three rates exhibit similar time series behavior. Indeed, results of augmented Dickey-Fuller (1979) tests indicate that each is integrated of order one, $I(1)$.⁶ Although the fully secured RP rate generally is below the unsecured federal funds rate, the difference between the rates appears to be bounded, suggesting that the two rates are cointegrated. The similarity between the three-month T-bill rate and overnight funds rate suggests that these rates may be cointegrated as well.

Under the null hypothesis that the federal funds rate is cointegrated with these other rates, there exists a mean-adjusted (indicated by \sim) linear combination of the rates,

$$\alpha \tilde{R}_t^{FF} - \beta \tilde{R}_t^o = u_t, \quad o = RP \text{ or } TB \quad (1)$$

such that the expectation of u_t is zero and its variance is finite. The cointegrating vector $(\alpha - \beta)$, which is unique up to a scale factor, isolates the stationary long-run relationship from the nonstationary common trend. In the empirical analysis that follows, the estimated cointegrating vector is assumed to represent the long-run equilibrium relationship between the federal funds rate and the other market interest rates.

The test for cointegration reported here is that developed by Johansen (1988) and Johansen and Juselius (1990). This test, based on the familiar likelihood ratio principle, can be thought of as a multivariate analogue of the Dickey-Fuller test. The tests are performed separately for three subperiods associated with changes in Federal Reserve operating regimes: the first is the period of federal funds rate targeting prior to the Federal Reserve's October 1979 switch to a nonborrowed reserves operating procedure; the second is the so-called "monetarist experiment" from October 1979 through October 1982; the third is from the Fed's adoption of a borrowed reserves operating procedure until the end of the sample. Because the residuals from estimated cointegrating vectors are used in subsequent tests of market efficiency involving daily and weekly data, tests for cointegration are performed on data at both of these frequencies. One subsequent test involves nonborrowed reserves that are available weekly prior to February 1984 and biweekly thereafter, so the last period is further subdivided at February 1984. The "weekly" data are weekly averages before that date and biweekly averages thereafter. Also, because nonborrowed re-

6. The results are not reported here to conserve space, but are available from the authors upon request. The tests, performed over the entire sample and each of the subperiods shown in Table 1, use a third-order lag. The null hypothesis of a unit root is never rejected at the 5 percent significance level when the level data are used, but is always rejected when the data are differenced.

TABLE 1
TESTS FOR COINTEGRATION BETWEEN THE FEDERAL FUNDS AND OTHER RATES
AND THE RESTRICTION THAT $\alpha = \beta$: DAILY AND WEEKLY DATA

Period	Daily Data				Weekly Data			
	Zero ¹ Cointegrating Vectors		Tests of ² Restriction $\alpha = \beta$		Zero ¹ Cointegrating Vectors		Tests of ² Restriction $\alpha = \beta$	
	RP	TB	RP	TB	RP	TB	RP	TB
1/3/72–10/5/79	69.95*	23.75*	23.35*	12.76*				
			(.91)	(.68)				
1/11/75–10/5/79					45.09*	24.51*	23.01*	12.82*
							(.93)	(.84)
10/8/79–10/5/82	53.24*	27.29*	2.24	3.67	24.76*	25.06*	0.01	3.17
			(.95)	(.84)			(1.00)	(.83)
10/6/82–2/1/84	39.34*	21.57*	2.40	2.15	21.90*	18.25*	0.25	0.17
			(.95)	(1.48)			(.98)	(1.10)
2/2/84–1/29/93					24.72*	11.69	9.64*	7.81*
							(.95)	(.80)
10/6/82–1/29/93	143.34*	51.16*	27.46*	13.50*				
			(.96)	(.88)				

* Indicates significance at the 5 percent level.

¹ The critical value of the statistics at the 5 percent significance level is 17.844 (see Johansen and Juselius 1990).

² The test static is distributed $\chi^2(1)$. The critical value at the 5 percent significance level is 3.84. The number in parentheses is the estimate of μ .

erves are available only beginning in January 1975, the weekly cointegrating vectors are estimated beginning with this date.

The results of this test and estimates of the normalized cointegrating vector, $\mu = \beta/\alpha$, are reported in Table 1.⁷ Consistent with the results of Stock and Watson (1988b), the null hypothesis of zero cointegrating vectors is rejected in favor of the alternative of one cointegrating vector. The only exception was for the T-bill rate in the 1984–93 period. Although the restriction that $\mu = 1$ is rejected more than half of the time, estimates of the normalized cointegrating vector suggest that this restriction does not do too much violence to the data for the RP rate. The estimated roots obtained from applying an augmented Dickey-Fuller test to the residuals are presented in Table 2.⁸ The estimates suggest considerable persistence at both daily and weekly frequencies. However, in all cases the effect of a shock is all but eliminated within a quarter that is the frequency often used in tests of the efficacy of monetary policy based on the federal funds rate as the policy indicator. These estimates suggest that if policy shocks were to affect the structure of rates, the effect should be dissipated in a matter of days or weeks.

7. Despite the fact that federal funds have recently traded at a rate lower than the RP rate, this cointegration relationship holds. Experimentation suggests that the qualitative results are robust to the choice of lag length, but only the tests performed with a fifth-order lag are reported here. Because the federal funds rate is significantly more volatile on settlement Wednesdays and the first and last day of the year than other interest rates (see Garfinkel and Thornton 1992), settlement Wednesdays and the first and last days of the year were deleted for the federal funds rate. Also, estimating the cointegrating vectors with a fully modified Phillips-Hansen (1990) estimator did not change the results qualitatively.

8. Estimates of the root, λ , were obtained from OLS estimates of

$$\Delta \hat{u}_t = \delta \hat{u}_{t-1} + \sum \gamma_{t-j} \Delta \hat{u}_{t-j},$$

where $\delta = \lambda - 1$.

TABLE 2
THE ESTIMATED ROOTS FROM THE ESTIMATED COINTEGRATING VECTORS

Period	Daily		Weekly	
	RP	TB	RP	TB
1/3/72-10/5/79	.870	.968		
1/11/75-10/5/79			.501	.835
10/8/79-10/5/82	.706	.896	.634	.758
10/6/82-2/1/84	.398	.768	-.005	.545
2/2/84-1/29/93			.714	.887
10/6/82-1/29/93	.738	.902		

The estimated roots, λ , were obtained from OLS estimates of $\Delta \hat{u}_t = \delta \hat{u}_{t-1} + \sum \gamma_{t-j} \Delta \hat{u}_{t-j}$, where $\delta = \lambda - 1$.

B. The Results from Granger-Causality Tests

Granger-causality tests were formalized by the following VAR representation:

$$\begin{aligned} R_t^{FF} &= \theta_1(B)R_{t-1}^{FF} + \theta_2(B)R_{t-1}^O + e_t^{FF}; \\ R_t^O &= \theta_3(B)R_{t-1}^O + \theta_4(B)R_{t-1}^{FF} + e_t^O \end{aligned} \quad (2)$$

where $\theta_j(B)$, $j = 1, 2, 3, 4$, are polynomials in the backshift operator B , $Bx_t = x_{t-1}$. The null hypothesis of noncausality of the funds rate to other rates is simply the hypothesis that $\theta_4 = 0$. Rejection of this hypothesis indicates that past realizations of the funds rate contain information that is useful for predicting the behavior of other interest rates. While this result would be consistent with the hypothesis that the federal funds rate contains unique policy information, it could be considered convincing evidence only if the null hypothesis of noncausality from other rates to the funds rate is not rejected. If the hypothesis $\theta_2 = 0$ is rejected, other interest rates also contain information that is useful for predicting the federal funds rate.

While the interest rates are unconditionally $I(1)$ processes, they are cointegrated. Consequently, the Granger causality test results presented here are based on daily and weekly data in levels.⁹ To avoid spurious causality due to an arbitrary choice of lag length (Thornton and Batten 1985), the tests are implemented for all lag lengths up to order twelve. The proportion of the lag space where the respective null hypotheses were rejected at a conventional 5 percent significance level are reported in Table 3. Although the results were somewhat sensitive to the choice of lag length, in all but two cases for the T-bill rate using weekly data the null hypothesis was rejected over a fairly large region of the lag space. One might be inclined to interpret the two instances where there is evidence of unidirectional causality running from the T-bill rate to the federal funds rate as an indication that the longer-maturity T-bill

9. These tests were performed with a constant term and, when the federal funds rate was the dependent variable with daily data, dummy variables for settlement Wednesdays and for the first and last days of the years were included. Although performing the test in levels is appropriate since the coefficients of a VAR in levels can be consistently estimated if the individual $I(1)$ series are cointegrated, the estimator has a nonstandard asymptotic distribution (see Stock and Watson 1988a). Nonetheless, in nearly every case the F -statistics were at least three to four times those required at the usual 5 percent significance level over some part of the lag space. Furthermore, the results from tests using first-difference data leave the results qualitatively unchanged.

TABLE 3
GRANGER-CAUSALITY BETWEEN THE FEDERAL FUNDS AND OTHER RATES

Period	Other Rates Do Not "Cause" FF		FF Does Not "Cause" Other Rates	
	RP	TB	RP	TB
Daily Data				
1/3/72–10/5/79	.82	1.00	1.00	1.00
10/8/79–10/5/82	.63	1.00	1.00	.90
10/6/82–1/29/93	.94	1.00	1.00	1.00
Weekly Data				
1/3/72–10/5/79	.58	.92	1.00	1.00
10/8/79–10/5/82	.34	1.00	1.00	.06
10/6/82–1/29/93	.53	1.00	.86	.06

Proportion of lag space where the respective null hypotheses are rejected at the 5 percent significance level.

rate is anticipating movements in the overnight funds rate. In any case, these instances suggest that the T-bill rate is a better information variable.

More generally, however, the results in Table 3 indicate bidirectional causality between the federal funds and overnight RP and T-bill rates for each of the three subperiods corresponding to different monetary policy operating regimes.¹⁰ Reinforced by the findings of Garfinkel and Thornton (1992) that the funds rate generally does not have more power for predicting key economic variables than does the overnight RP rate, this evidence supports the implication of the efficient markets hypothesis, that the funds rate does not contain unique information.

C. The Results from Tests of the Response to Monetary Policy Shocks

Taking the estimated cointegrating vectors as proxies for the long-run equilibrium relationship between the federal funds rate and the RP and T-bill rates and the residuals as estimates of the idiosyncratic shocks to the markets, we test whether monetary policy shocks are correlated with the idiosyncratic behavior of interest rates. Market efficiency implies that movements in the stationary term u_t in equation (1) should be unrelated to changes in policy. Alternatively, if the funds rate contains unique information about monetary policy, in the sense that policy actions are reflected in it but not in other open market rates, then u_t would be correlated with monetary policy shocks.

Because there is no widely accepted measure of unanticipated monetary policy, ΔMP^u , the tests reported here use several measures, each of which has been shown to be associated with a statistically significant movement in market interest rates: unanticipated changes in nonborrowed reserves, NBR^u , unanticipated changes in the money stock, $\Delta M1^u$, and unanticipated changes in the discount rate, ΔDR^u .¹¹ Un-

10. Despite the fact that federal funds have recently traded at a rate lower than the RP rate, this cointegration relationship holds.

11. For some examples of this evidence and citations to other literature, see Christiano and Eichenbaum (1992a, b) and Thornton (1991, 1992, 1994). NBR should be a particularly good measure of unanticipated changes in monetary policy when the Fed was targeting it, October 1979–October 1982; however, Christiano and Eichenbaum argue that NBR is a good indicator of monetary policy at other times as well.

TABLE 4
THE EFFECT OF MONETARY POLICY ON THE STRUCTURE OF INTEREST RATES:
MARGINAL SIGNIFICANCE LEVELS

Period	ΔNBR^u		ΔDR^u		$\Delta M1^u$	
	RP	TB	RP	TB	RP	TB
1/3/72–10/5/79			.00	.46		
1/11/75–10/5/79	.00	.00				
10/8/79–10/5/82	.42	.75	.63	.75	.50	.76
10/6/82–2/1/84	.73	.93			.69	.71
2/2/84–1/29/93	.25	.88				
10/6/82–1/29/93			.01	.01		

anticipated changes in M1 are the difference between the anticipated changes in money from Money Market Services, Inc., and first-announced changes in M1. Changes in the discount rate, DR , are nontechnical changes, that is, those made for reasons other than to keep the discount rate in line with other market interest rates. These changes are effective upon the Fed's announcement. Nonborrowed reserves are total reserves less seasonal and adjustment borrowing. Unanticipated changes in NBR are estimated from an ARIMA(5, 1, 0) model, a representation judged to be adequate based on the associated Q -statistic. As NBR are available at a weekly frequency prior to February 1984 and at a biweekly frequency thereafter, tests based on this measure of MP^u use weekly averages of daily figures on interest rates calculated to coincide with the NBR dating. Tests involving unanticipated changes in M1 and the discount rate use daily observations. Four lags of the dependent variable were included to account for the persistence in the estimated residuals; however, the qualitative results are relatively insensitive to whether the lags are included.

The results of these tests are reported in Table 4. The results indicate that deviations in the long-run equilibrium relationships between the federal funds and other rates are generally responsive to neither unanticipated changes M1 nor NBR . The exception is the period from 1975 to 1979, when the rate structures appear to respond significantly to unanticipated changes in NBR . However, the very low univariate adjusted R -squares of .020 and .014 for RP and TB rates, respectively, suggests that these results are spurious. This interpretation is reinforced by a crossplot of the data and some sensitivity analysis to extreme observations.¹²

The results obtained using the discount rate appear to be mixed, however. Specifically, the result that discount rate affects the relationship between the federal funds and RP rate during the first period is consistent with the findings of Thornton (1992) that, in contrast to the funds and T-bill rates, the RP rate does not respond significantly to changes in the discount rate prior to October 1979. Nonetheless, the result that discount rate changes are correlated with u_t is not robust. In particular, the statistical significance of discount rate changes on both structural relationships in the last period appears to rest solely on one observation.¹³ Consequently, the evidence

12. These results will be made available to the reader upon request.

13. There were seventeen nontechnical changes in the discount rate during this period. The equations were reestimated seventeen times: each time an observation associated with one discount rate change was

that changes in the discount rate produce a significant response in the structure of short-term interest rates is not particularly compelling.

3. CONCLUDING REMARKS

Market efficiency suggests that the federal funds rate should not contain unique information about monetary policy. Taking as given the possibility that the federal funds rate may be a “good” indicator of monetary policy, the evidence presented here suggests that this rate is no better an indicator of monetary policy than other short-term interest rates—specifically, the overnight RP and three-month T-bill rates. This finding is consistent with the accumulating evidence, discussed by Bernanke (1990), that not only the federal funds rate and the spreads between it and long-term interest rates, but other interest rates and interest rate spreads as well, are good predictors of economic activity. For example, Stock and Watson (1989) and Friedman and Kuttner (1991) identify the spread between the rate on the six-month T-bill and that on the six-month commercial paper as the “best” predictor of aggregate economic variables. By supporting the notion that markets are efficient, our results suggest that the information contained in these rates and rate spreads concerns economic fundamentals. Of course, the evidence presented here says nothing about the transmission of monetary policy. Thus, it is not clear whether their predictive power can be attributed to monetary policy or other fundamentals. Nonetheless, our results underscore the difficulty of interpreting why various interest rates and interest rate spreads have predictive power for economic activity.

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