The Impact of New Economic Information on the Volatility Of Short-Term Interest Rates

By V. Vance Roley and Rick Troll

The sharp rise in the volatility of interest rates since late 1979 is widely recognized. One factor contributing to the increase in volatility may have been the Federal Reserve's change in its monetary-control procedures on October 6, 1979. Until then, the Federal Reserve focused on the control of short-term interest rates in an effort to achieve monetary growth objectives. Since late 1979, however, it has focused on the availability of reserves to financial institutions.' As a consequence, short-term interest rates have been allowed to vary over a wider range than they were before. It is not surprising, then, that short-run movements in interest rates have been more pronounced.

A previous article in this *Review* examined the effect of the change in the Federal Reserve's operating procedures on interest-rate volatility.[2] That article focused on the increase since October 1979 in fluctuations in interest rates following weekly announcements of changes in the money supply. These announcements, which are made by the Federal Reserve every Friday, provide new information about money supply developments that participants in financial markets use in adjusting their assessments of the current availability of reserves, the future course of monetary policy, and possibly inflation. For example, the announcement of a larger than anticipated change in the money supply may lead market participants to expect a change in the Federal Reserve's monetary policy that will affect interest rates. In anticipating the change in policy, market participants may then take actions that lead immediately to movements in interest rates.

The previous article found that the change in operating procedures had contributed to the rise in interest-rate volatility because the change

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[1] For descriptions of the operating procedures adopted by the Federal Reserve on October 6, 1979 and comparisons with the previous approach, see J. A. Cacy, "Monetary Policy in 1980 and 1981," *Economic Review*, Federal Reserve Bank of Kansas City, December 1980, pp. 18-25, and Board of Governors of the Federal Reserve System, "Monetary Policy Objectives for 1981," February 1981.

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[2] V. Vance Roley, "Weekly Money Supply Announcements and the Volatility of Short-Term Interest Rates," *Economic Review*, Federal Reserve Bank of Kansas City, April 1982, pp. 3-15. For a more technical analysis, see V. Vance Roley, "The Response of Short-Term Interest Rates to Weekly Money Announcements," Working Paper No. 1001, National Bureau of Economic Research, October 1982.

encouraged market participants to respond more to a given money supply announcement. This article extends the previous analysis by examining the impact on interest-rate volatility of factors in addition to money supply announcements, such as new information on economic performance and announcements of changes in the Federal Reserve's discount rate. Also, in contrast to the previous study, which focused on interest-rate volatility immediately after money supply announcements, this article examines the impact on total interest-rate volatility.

The first section discusses alternative theories relating to the effects of new economic information on short-term interest rates. The volatility of announced changes in money, inflation, and economic activity, and the associated interest-rate volatility before and after October 1979, are discussed in the second section. The third section empirically examines the relationship between announced changes in money, inflation, and economic activity and fluctuations in interest rates to determine if increases in the responses to these announcements have significantly contributed to the rise in total interest-rate volatility. The main conclusions of the article are summarized in the final section.

THEORETICAL CONSIDERATIONS OF ECONOMIC INFORMATION AND INTEREST RATES

In discussing theories about the relationship between interest rate movements and new economic information, this section first reviews the usual rationale for the positive relationship between interest rates and unanticipated announced changes in the money supply found in other studies. Then, the effect of announced changes in the discount rate on short-term interest rates is considered. Finally, the possible effects of data announcements concerning inflation and economic activity are discussed.

Money supply announcements

Announcements of larger than anticipated increases in the money supply have been observed to result in increases in short-term interest rates. The most frequent explanation of this positive relationship is based on the notion that the change reflects market participants' anticipations of both current and future Federal Reserve actions.[3] Because market yields already reflect expectations of future announced changes in money, and hence the future course of Federal Reserve actions, only unanticipated changes in the money supply should affect interest rates after a money supply announcement. If the announced money supply is greater than anticipated, for example, market participants may expect higher short-term interest rates if they believe the Federal Reserve will attempt to offset the increase by reducing the growth of bank reserves. Because of this changed assessment, market participants' actions will cause interest rates to increase immediately.

Even if market participants do not expect the growth of bank reserves to slow in response to an unanticipated increase in the money supply, short-term interest rates may nevertheless rise under a reserve-aggregate approach to monetary control. Because of the lagged reserve accounting framework the Federal Reserve uses

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3 Jacob Grossman, "The Rationality of Money Supply Expectations and the Short-Run Response of Interest Rates to Monetary Surprises," *Journal of Money, Credit, and Banking,* November 1981, pp. 409-24; Thomas Urich and Paul Wachtel, "Market Response to the Weekly Money Supply Announcement in the 1970s," *Journal of Finance,* December 1981, pp. 1063-72; and Thomas Urich, "The Information Content of Weekly Money Supply Announcements," *Journal of Monetary Economics,* July 1982, pp. 73-88. For an alternative view stressing the role of expected inflation, see Bradford Cornell, "Money Supply Announcements and Interest Rates: Another View," Working Paper No. 1-82, Graduate School of Management, University of California at Los Angeles, March 1982.

in imposing reserve requirements, the current demand for reserves depends on deposits in the statement week ending on Wednesday of the previous week. Thus, announcement of a higher than expected change in the money supply may cause investors to increase their assessment of the aggregate demand for reserves. In turn, if investors expect the supply of reserves to remain unchanged for the rest of the current statement week, short-term interest rates will be expected to rise to equilibrate supply and demand in the reserve market.[4]

Discount rate announcements

Another announcement related to Federal Reserve policy involves changes in the discount rate. Under the pre-October 1979 operating procedures, discount rate changes typically lagged behind market yields. Moreover, the federal funds rate—which the Federal Reserve influenced in implementing monetary policy—conveyed more timely signals about the current interest-rate implications of monetary policy.

In principle, the discount rate becomes more important in implementing monetary policy under the reserve-aggregate approach to monetary control adopted in October 1979.[5] Changes in the discount rate may have an immediate effect on short-term interest rates. This is because the incentive for depository institutions to meet their reserve needs at the discount window depends importantly on the spread between the federal funds rate and the discount rate. Under the lagged reserve accounting system, depository institutions' demand for reserves in the current week is essentially fixed. The Federal Reserve then determines the mix between reserves supplied through open market operations—nonborrowed reserves—and reserves supplied through the discount window. To the extent that the Federal Reserve maintains its nonborrowed reserve objective, an increase in the discount rate initially creates a disincentive for depository institutions to borrow at the discount window. Since the supply of nonborrowed reserves is fixed, depository institutions seeking to meet their reserve needs in the federal funds ,market drive the funds rate up. Under these circumstances, the funds rate and other short-term interest rates move with a change in the discount rate.

Inflation announcements

At least three channels may link announcements of inflation data, such as changes in the consumer (CPI) and producer (PPI) indexes, to movements on short-term interest rates. First, if the indexes are higher than anticipated, market participants may revise their assessments of current inflation upward and lenders, in turn, may demand an increased inflation premium to restore the real, or inflation adjusted, return on loans to previous rates. Thus, any rise in expected inflation may cause nominal interest rates to rise.[6]

Second, if the announced inflation level

[4] Carl E. Walsh, "The Effects of Alternative Operating Procedures on Economic and Financial Relationships," Research Working Paper No. 82-08, Federal Reserve Bank of Kansas City, September 1982.

[5] See, for example, Gordon H. Sellon, Jr., "The Role of the Discount Rate in Monetary Policy: A Theoretical Analysis," *Economic Review,* Federal Reserve Bank of Kansas City, June 1980, pp. 3-15; and Gordon H. Sellon, Jr., and Diane Seibert, "The Discount Rate: Experience Under Reserve Targeting," *Economic Review,* Federal Reserve Bank of Kansas City, September/October 1982, pp. 3-18.

[6] For further discussion of this effect, see Thomas Urich and Paul Wachtel, "The Effects of Inflation and Money Supply Announcements on Interest Rates," mimeo, Graduate School of Business Administration, New York University, August 1982.

causes a reassessment of current and future inflation, market participants may also revise their assessments of the current and future demand for money. This result may follow because the demand for nominal money balances depends on the price level.' In turn, under the reserve-aggregate approach to monetary control, any change in the forecast of money demand has immediate implications for interest rates. For example, an increase in the expected demand for nominal money balances due to higher expected inflation may cause market participants to increase their assessments of the future demand for bank reserves. Interest rates may then rise to equilibrate the demand for and supply of reserves. Under the pre-October **1979** operating procedures, short-run fluctuations in money demand were typically at least partially offset, implying that unanticipated announced changes in inflation should have been associated with somewhat more moderate short-run movements in interest rates.

Third, if market participants think the Federal Reserve responds directly to inflation, there may be another channel in which interest rates respond to unanticipated announced changes in inflation. If the Federal Reserve reacts to price data as well as money supply data, unanticipated changes in inflation could be associated with movements in short-term interest rates. This channel would appear to have been potentially more prevalent under the pre-October **1979** policy regime, since the emphasis on monetary control appeared to be somewhat less than in the three years since.

Economic activity announcements

Unanticipated announced changes in economic activity, such as announcements of

the unemployment rate and industrial production, may have both indirect and direct effects on interest rates. In terms of a possible indirect effect, announcements that cause investors to reassess the current and future strength of the economy may, in turn, cause market participants to revise their assessment of the current and future demand for money, as money demand is thought to vary positively with real income. Unanticipated increases in real activity may be associated with higher interest rates, then, if investors increase their assessments of the future demand for bank reserves. As before, this effect could be more prevalent under the reserve-aggregate approach to monetary control.

Directly, interest rates may change in response to unanticipated announced changes in economic activity if market participants think the Federal Reserve reacts to such announced changes. If Federal Reserve policy changes in response to new information not only about the money supply but also about economic activity, interest rates may move immediately on release of the new information. Again, this channel appears more plausible under the pre-October **1979** policy regime.

Effects of the change in operating procedures

In the previous study, the October **1979** change in operating procedures was found to coincide with a sharp increase in the responsiveness of short-term interest rates to unanticipated announced changes in the money supply. In terms of announcements concerning discount rate changes, inflation, and economic activity, only changes in the discount rate should have had unambiguously larger effects since October **1979.** If market participants use new information about inflation and economic activity to infer changes in the demand for money and hence the demand for bank reserves and

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7 See, for example, Stephen M. Goldfeld, ''The Demand for Money Revisited,'' *Brookings Papers on Economic Activity,* No. 3, 1973, pp. 577-638.

future Federal Reserve actions, the interest-rate response to these announcements may have also increased since October 1979. However, if the Federal Reserve reacted directly to the new information before October 1979 but not afterward, the response of short-term rates may have diminished. Thus, interest-rate fluctuations in response to these announcements may have contributed to the rise in the volatility of interest rates since October 1979, or they may have detracted from the rise.

VOLATILITY OF ANNOUNCEMENTS AND SHORT-TERM INTEREST RATES SINCE 1977

This section examines the performances of economic data announcements and short-term interest rates over the last five years. Market expectations taken from a survey are then used to construct a series representing the market's forecast error associated with each announcement. As discussed in the previous section, the forecast error, or surprise, is pivotal in estimating the market's response to any particular announced measure of economic performance.

Volatility of economic data announcements

The volatility of announced measures of economic performance were compared for two periods. The first period begins on September 29, 1977, the day the survey discussed below was initiated, and ends on October 5, 1979, the day before the Federal Reserve announced its shift to a reserve-aggregate monetary-control procedure. The second begins on October 8, 1979 and ends on October 15, 1982.

Throughout both periods, the CPI, the PPI, and the industrial production index were released monthly on various days of the'week. The unemployment rate was usually released on the first Friday of each month. All four indicators provide information about economic activity during the preceding month.

The M1 money supply was used in monitoring the effects of money announcements. This choice was due to the importance of M1 to Federal Reserve policy in the two periods. During the first period, weekly money announcements were made on Thursdays. Throughout most of the second period, announcements were made on Fridays and also pertained to a redefined M1.[8]

Table 1 summarizes statistics for the volatility of data announcements and interest rates for the two periods. The first panel of the table reports the mean and the standard deviation, which is a measure of volatility, for the various measures of economic activity.[9] Average announcements for the measures of economic activity reflect business conditions in each period. For example, during the second period, which spanned the two most recent recessions, industrial production declined on average and the average unemployment rate rose 1.7 percentage points above the average for the first period. The recent moderation in inflation is reflected in lower average PPI increases in the second period, while CPI increases were virtually un-

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[8] Old M1 differs from the current definition mainly in that it excluded ''other checkable deposits'' at depository institutions. In 1980 and 1981 the present M1 was referred to as MI-B. During 1981, MI-B was adjusted by the Federal Reserve to reflect the introduction of nationwide NOW accounts. Money data used here for 1981 correspond to nonshift-adjusted MI-B. While the target range for shift-adjusted MI-B was emphasized by the Federal Reserve, the announced weekly changes in MI-B for this period were not shift adjusted.

[9] The mean of a data series $X_t(t=1,\ldots,N)$ is defined as

$$\text{Mean} = \bar{X} = (1/N) \cdot \sum_{t=1}^{N} X_t$$

The standard deviation is defined as

$$\text{Standard Deviation} = [(1/N\text{-}1) \cdot \sum_{t=1}^{N} (X_t \text{-} \bar{X})^2]^{\frac{1}{2}}$$

Table 1
SUMMARY STATISTICS FOR DATA ANNOUNCEMENTS
AND INTEREST RATES SINCE 1977

Period*	Mean		Standard Deviation		Root-Mean-Square Error	
	I	II	I	II	I	II
Information Announcements?						
MI changes	.296	.435	2.080	2.680		
Percentage change in CPI	.775	.778	.266	.409		
Percentage change in PPI	.800	.658	.343	.513		
Percentage change in industrial production	.329	−.376	.622	1.199		
Unemployment rate	6.044	7.767	.393	1.180		
unanticipated Component‡						
M1 changes	−.398	.201			1.584	2.154
Percentage change in CPI	.032	−.011			.146	.253
Percentage change in PPI	−.004	−.064			.264	.318
Percentage change in industrial production	−.018	−.076			.424	.542
Unemployment rate	−.084	−.031			.189	.228
Changes in 3-Month Treasury Bill Yield§	−.007	−.022			.099	.317

*Period I starts on September 29, 1977, and ends oh October 5, 1979.
 Period II starts on October 6, 1979, and ends on October 15, 1982.

†Data sources for information announcements are as follows:

M1 = weekly change in the narrowly defined money stock, in billions of dollars (Source: Board of Governors of the Federal Reserve System, H.6)
CPI = percentage change in the consumer price index (Source: Bureau of Labor Statistics)
PPI = percentage change in the producer price index (Source: Bureau of Labor Statistics)
Industrial Production = percentage change in the industrial production index (Source: Board of Governors of the Federal Reserve System, the *Federal Reserve Bulletin)*
Unemployment = percentage of labor force unemployed (Source: Bureau of Labor Statistics)
‡Difference between announcements and market expectations, where expectations are measured by the median of the market survey (Source: Money Market Services, Inc.)
§Daily change in the bid quotation for the 3-month Treasury bill yield in percentage points (Source: Board of Governors of the Federal Reserve System, H.15)

changed from the first period. In contrast, M1 increases averaged higher in the second period. This difference was due partly to a redefinition of the narrow monetary aggregate to include NOW accounts, which affected announced money changes only in the second period.[10] All series, however, were markedly more volatile in the second period than in the first. For example, the standard deviation for the unemployment rate increased from 0.393 percentage points in the first period to 1.180 in the second. These figures imply that 95 percent

[10] For more information on the impact of NOW accounts on the monetary aggregates see Bryon Higgins and Jon Faust, "NOW's and Super NOW's: Implications for Defining and Measuring Money," *Economic Review,* Federal Reserve Bank of Kansas City, January 1983, pp. 3-18.

of the time the unemployment rate would be expected to be within plus or minus 0.786 percentage points of its first-period mean, while the corresponding interval in the second period increased to plus or minus 2.36 percentage points. These statistics underscore the increased variability in economic activity during the second period.

Unanticipated changes in announcements

While the series describing economic performance have shown more volatility recently, this rise does not necessarily imply increased variability in the associated changes in interest rates. As discussed earlier, if all available information is used efficiently in determining short-term interest rates, rates should respond only to unanticipated portions of the announcements.

Thus, in examining the rise in interest-rate volatility, the volatility of unanticipated announced changes in economic data, as opposed to actual announced changes, should be considered. The second panel of Table 1 reports the mean and volatility of unanticipated changes in data announcements. Unanticipated changes are defined as the announced change, minus the change a survey showed market participants expecting." As indicated in the table, the volatility of unanticipated changes, measured by the root-mean-square error, which is similar to the standard deviation statistic, was much greater in the second period than in the first.[12]

Volatility of short-term interest rates

To the extent that increased uncertainty about the economy may be expected to cause larger movements in interest rates when new information is received, interest rates should be more volatile on announcement days in the second period than in the first period. In turn, increased interest rate volatility on announcement days, all other things equal, implies greater volatility in interest rates overall. The volatility of the 3-month Treasury bill yield is documented in Chart 1, where the root-mean-square error of daily changes in the Treasury bill yield are plotted on a monthly basis from September 1977 to October 1982. A marked increase in interest-rate volatility is evident after October 1979. Where volatility ranged from 2.6 to 20.5 basis points in the earlier period, the range for the later period was 16.6 to 56.4 basis

Chart 1
MONTHLY VOLATILITY OF 3-MONTH TREASURY BILL YIELDS

Root Mean Square Error

Pre-October 1979 | Post-October 1979

(y-axis: .60, .50, .40, .30, .20, .10, 0)

(x-axis: 1977, 1978, 1979, 1980, 1981, 1982)
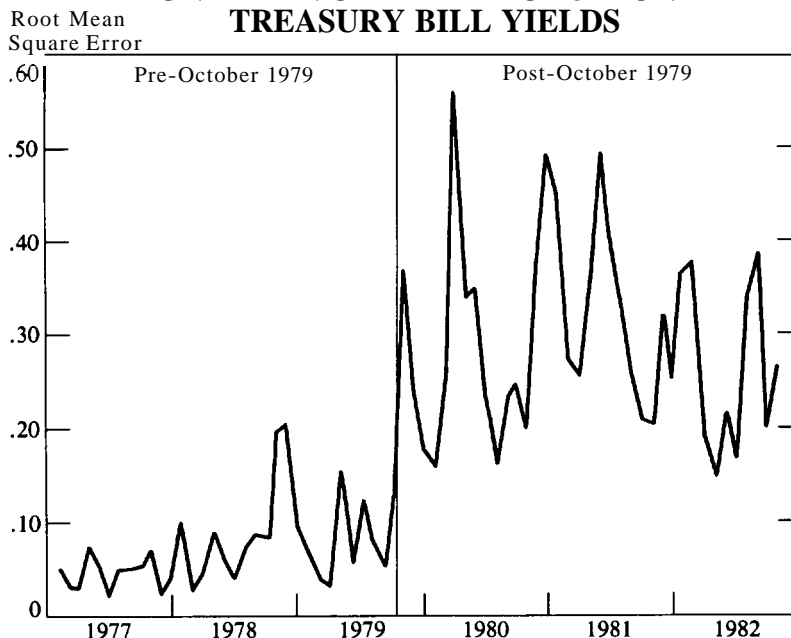
points, a substantial increase.[13]

This increase in interest-rate variability may also be seen in the last panel of Table 1. In the first period, the root-mean-square error of the daily change in the 3-month Treasury bill was about 10 basis points. This value rose to about 32 basis points in the second period, more than three times the value in the first.

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[13] For the daily change in the 3-month Treasury bill yield, $\Delta R_t(1,\ldots,N)$, the statistics are computed as

$$\text{Mean} = (1/N) \cdot \sum_{t=1}^{N} \Delta R_t$$

and

$$\text{Root-Mean-Square Error} = \left[(1/N) \cdot \sum_{t=1}^{N} (\Delta R_t)^2\right]^{1/2}$$

It should be noted that some "daily" changes span weekends and holidays. In addition, the daily changes were computed for the same bill issue by adjusting for Monday and Tuesday bill yields generally representing different issue dates.

IMPACT OF UNANTICIPATED CHANGES IN DATA ANNOUNCEMENTS

Summary statistics in the previous section indicated that interest rates have become more volatile since the Federal Reserve switched to a reserve-aggregate approach to monetary control. At the same time, the volatility of the unexpected component of data announcements also increased. If the interest-rate response to a surprise of a given size remained unchanged, part of the rise in interest-rate volatility can be attributed to the increased magnitude of unanticipated changes in data announcements. An additional part of the rise in interest-rate volatility may be due to an increased market reaction to a given surprise. The relationship between surprises in economic releases and changes in short-term interest rates was examined empirically to determine the relative importance of these two factors. The model used

Table 2
MARKET'S RESPONSE TO THE UNANTICIPATED COMPONENT OF ECONOMIC DATA ANNOUNCEMENTS*

Estimated Period	Unanticipated Change in:							Day of the Week Dummies					Summary Statistics		
	PPI	CPI	IP	UNEM	M1	DISC	SUR	MON	TUE	WED	THU	FRI	$\overline{R}^2$	SE	DW
9/29/77-10/05/79	.0222	-.0940	.0949	-.1121	.0158	.0969	—	-.0087	-.0302	-.0175	-.0041	.0288	.048	.0962	1.60
	(.0750)	(.1421)	(.0524)	(.1264)	(.0061)	(.0570)		(.0102)	(.0096)	(.0096)	(.0095)	(.0098)			
10/08/79-10/15/82	.1971	.1838	.0696	-.2291	.1038	.5416	.0317	.0529	-.0425	-.0382	-.0450	-.0280	.151	.2923	1.76
	(.1619)	(.1948)	(.0982)	(.2258)	(.0114)	(.0862)	(.0550)	(.0246)	(.0240)	(.0234)	(.0237)	(.0239)			

*The equation is estimated in the form:

$$\Delta R_t = c_1 UPPI_t + c_2 UCPI_t + c_3 UIP_t + c_4 UUNEM_t + c_5 UM1_t + c_6 UDISC_t + c_7 USUR_t + d_1 MON_t + d_2 TUE_t + d_3 WED_t + d_4 THU_t + d_5 FRI_t + e_t$$

where the U's indicate that only the unanticipated components of the data announcements are included, and the $c_j (j = 1,...,7)$ and $d_k (k = 1,...,5)$ are estimated coefficients. Also, numbers in parentheses are standard errors of estimated coefficients.

ΔR_t = daily change in the 3:30 p.m. bid quotation for the 3-month Treasury bill yield in percentage points

PPI = producer price index

CPI = consumer price index

IP = industrial production index

UNEM = unemployment rate

M1 = narrowly defined money stock

DISC = basic discount rate

SUR = surcharge discount rate

e_t = random error term

$\overline{R}^2$ = multiple correlation coefficient corrected for degrees of freedom

SE = standard error

DW = Durbin-Watson statistic

in the empirical work is discussed next, followed by the presentation of the estimation results.

The model

An efficient-markets model was used to examine the relationship between the receipt of new economic information and changes in interest rates. The model assumes market participants use all the information available to the public efficiently in determining interest rates in the money market. The yield on 3-month Treasury bills before an announcement of economic data should reflect the market's expectation concerning the announcement.

There are two primary implications of the efficient-markets model in this application. First, daily changes in the 3-month Treasury bill yield should depend on only information investors obtained between the closing quotations at the end of successive business days. As a consequence, the market's best forecast of the next day's closing yield is the observed yield at the close of the current business day. Second, any information obtained after the closing quotation should influence the 3-month yield on the following business day, but information already known by market participants should not. Thus, any new information obtained from an economic release or any announced change in the discount rate may affect the Treasury bill yield immediately. Together, these considerations imply that daily movements in the Treasury bill yield depend on unanticipated changes in economic data releases plus a ran-

dom error term." In brief, the model relates changes in the 3-month Treasury bill yield to the unanticipated component of new information.

Response of Treasury bill yields to information in economic releases

The model described above was used to investigate the response of short-term interest rates to the release of economic information. Daily data were used in estimating responses both before and after the Federal Reserve changed its operating procedures. All the economic data were used as originally announced, not as they were later revised.

The estimates reported in Table 2 measure the daily change in the 3-month Treasury bill yield in response to the unanticipated components of economic data announcements. For example, in the first period, from September 29, 1977 to October 5, 1979, a $1 billion surprise in the announced money supply caused the Treasury bill yield to increase an average of 0.016 percentage points, or 1.6 basis points. The first-period response to a 1 percentage point surprise in producer prices caused the Treasury bill yield to change an average of 2.2 basis points. Response to announcements of changes in consumer prices, unemployment, and industrial production can be interpreted similarly. The coefficient corresponding to the discount rate measures the market's reaction to an announcement of a 1 percentage point change in the discount rate.

With only one exception, the estimated coefficients for the measures of economic activity and inflation indicate the market responses to surprises in announcements move in the same direction as predicted. However, only the first-period response to unanticipated changes in industrial production had a statistically significant effect on Treasury bill yields.[15] The estimated response to a 1 percentage point surprise in the announced change in industrial production was a 9.5 basis point change in the Treasury bill yield. The response for a similar surprise in the second period, from October 8, 1979 to October 15, 1982, was nearly the same magnitude, but it was insignificant. This result suggests that as reducing inflation became the dominant objective of economic policy, market participants may have placed less emphasis on changes in real economic activity. To the extent that this was true, an increase in the effect of inflation surprises might be expected in the second period. However, inflation surprises were estimated to have no significant effect on Treasury bill yields in either period.

Movements in Treasury bill yields associated with releases of information on monetary policy were significant in both periods. As found in other studies, the market response to unanticipated changes in the money supply increased after the Federal Reserve changed its operating procedures.[16] Where Treasury bill yields moved only an average 1.6 basis points in response to a $1 billion surprise in the money supply before October 1979, the response to a

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[14] Formal specification of this model is presented in Table 2. In addition to the factors mentioned in the text, dummy variables were added to the specification to control for relative day of the week effects on Treasury bill yields. While these day of the week dummies are statistically significant as a group, their presence does not significantly change the qualitative results. For a discussion of day of the week effects, see Michael R. Gibbons and Patrick J. Hess, "Day of the Week Effects and Asset Returns," *Journal of Business,* October 1981, pp. 579-96.

[15] The hypothesis that the estimated response to unanticipated changes in industrial production was not significantly different from zero could be rejected at the 10 percent significance level, but not at the 5 percent level. For all other inflation and real economic activity measures, the same hypothesis could not be rejected at the 10 percent significance level.

[16] See, for example, V. Vance Roley, "Weekly Money Supply Announcements and the Volatility of Short-Term Interest Rates," *Economic Review,* Federal Reserve Bank

similar surprise after that was 10.4 basis points, more than a sixfold increase.

The difference in the market's response to changes in the discount rate was equally dramatic." Before the change in operating procedures, the Federal Reserve used an interest-rate instrument to control the money supply. Under this approach, changes in the discount rate would not be expected to have a direct effect on other interest rates. Despite that fact, however, a change in the discount could have had an "announcement effect" if the change was interpreted as signaling future policy moves. Results from the first period tend to support this view. Treasury bill yields moved an average of only about 10 basis points in response to an announced change of 1 percentage point in the discount rate. After the shift to a reserves-based approach to monetary control, the market response rose to more than 50 basis points. The change can be attributed primarily to the greater importance of the discount rate in implementing monetary policy under the new procedures. Unlike announcements regarding the basic discount rate, announced changes in the surcharge rate did not change bill yields significantly.

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of Kansas City, April 1982, pp. 3-15. As earlier studies focused on the immediate effect of money announcements on interest rates, the time interval between pre- and post-announcements was generally much shorter in these studies. One result of earlier studies was the significance of Federal Reserve policy ranges. That is, market participants were found to react differently, depending on the announced money supply compared with the long-run money growth targets and whether the money surprise was positive or negative. With daily changes in the Treasury bill yield, however, the hypothesis that responses to the different categories of money surprises were the same could not be rejected at the 10 percent significance level in the second period. Thus, the effect of Federal Reserve policy ranges was not considered further in this study.

17 Because actual announced changes in the discount rate were used in the empirical investigation, such changes were implicitly assumed to be unanticipated.

The market's response to new information

Although evidence indicates that while the change in Federal Reserve operating procedures prompted a much stronger market reaction to announcements directly related to monetary policy—whether changes in the money supply or discount rate—reactions to other announcements did not change. With only one statistically significant market response to announcements regarding inflation, unemployment, and industrial production, any change in response to these announcements cannot be distinguished. Despite this result, market responses to all categories of announcements taken together differed across the two periods.[18] As a consequence, the greater volatility in interest rates over the past three years may be partly attributed to an increase in market sensitivity to new economic information.

Sources of increased interest rate volatility

Since market responses to various types of announcements were different after October 1979, the volatility of interest rates was decomposed according to the identified sources of volatility in an effort to better identify causes of the change. Specifically, the volatility of interest rates in the second period was decomposed to equal the volatility in the first period,

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18 The hypothesis that the market's response was the same in both periods for inflation, unemployment, and industrial production announcements cannot be rejected individually at the 10 percent level of significance. Similar hypotheses for money and discount rate announcements can be rejected at significance levels well below 1 percent. The joint hypothesis that the market's response to all information announcements was the same across periods can be rejected at the 1 percent significance level. To avoid problems associated wtih heteroscedasticity, each of the estimated equations in the test was weighted by the reciprocal of its estimated standard error.

plus the rise in volatility due to changes in the volatility of surprises in the announcements, plus increases in volatility due to changes in the market's response by the type of surprise, plus the change in random **volatility**.[19] The results of the decomposition are presented in Table 3.

The results indicate that about **9.2** percent of the daily volatility of the 3-month Treasury bill yield after October **1979** can be attributed to increased market responsiveness to unanticipated changes in the money supply. Another 4.6 percent can be attributed to a stronger market reaction to changes in the basic discount rate. Thus, nearly **14** percent of interest-rate volatility since October **1979** can be tied to the new monetary-control procedures adopted by the Federal Reserve.

Less than **1** percent of the interest-rate volatility since October **1979** can be attributed

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[19] The volatility decomposition **can** be represented analytically as

$$(1/N_2) \cdot \sum_{t=N_1+1}^{N_2} \Delta R_t^2 = (1/N_1) \cdot \sum_{t=1}^{N_1} \Delta R_t^2$$

$$+ \left[\sum_{i=1}^{7} \sum_{t=N_1+1}^{N_2} c_i^2 (1/N_2) S_{i,t}^2 - \sum_{i=1}^{7} \sum_{t=1}^{N_1} c_i^2 (1/N_1) S_{i,t}^2 \right]$$

$$+ \left[\sum_{i=1}^{7} ((c_i')^2 - (c_i)^2) \cdot \sum_{t=N_1+1}^{N_2} (1/N_2) S_{i,t}^2 \right]$$

$$+ \left[(1/N_2) \cdot \sum_{t=N_1+1}^{N_2} e_t^2 - (1/N_1) \sum_{t=1}^{N_1} e_t^2 \right]$$

where $c_i (i=1,...,7)$ = estimated coefficients in the first period
$c_i' (i=1,...,7)$ = estimated coefficients in the second period
N_1, N_2 = number of observations in the first and second periods, respectively
$S_i (i=1,...,7)$ = unanticipated component of respective infbrmation announcements.

This representation of the decomposition is exact when the events are mutually exclusive. When only a small subset of events occur simultaneously, as is the case in this study, this representation is a close approximation.

to increased market responsiveness to the release of other economic indicators. Moreover, the increased volatility of the unanticipated component of information announcements has had an insignificant impact on the variability of short-term interest rates. Thus, nearly all the explained volatility in interest rates since the change in Federal Reserve operating procedures is linked to the response to data related directly to monetary policy. Still, almost **75** percent of the interest-rate volatility since October **1979** has been due to an increase in random volatility that cannot be assigned to any specific **cause**.[20]

CONCLUSIONS

The relationship between the rise in the volatility of short-term interest rates since late **1979** and economic data releases shows that the increased response of short-term interest rates to weekly money supply announcements has contributed to the rise in volatility. Just over **9** percent of the rise in daily volatility was estimated as resulting from the increased response to these announcements alone. Another 5 percent was found to result from a greater response to changes in the discount rate. The response to other announcements, including those relating to inflation and economic activity, does not appear to have contributed to the increased volatility. Only announcements closely related to the change in money control procedures were found to contribute significantly to the rise in interest-rate volatility.

Results of this study **also** have implications for the weekly release of information on the money supply. Because of the volatility of in-

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[20] While only a moderate amount of the rise in interest-rate volatility may be attributed directly to the change in operating procedures, this does not necessarily imply that the unexplained volatility is unrelated to the change in **procedures**.

			Change in Market Response to			Change in	Change in Volatility and Type	
	Volatility in Period = II	Volatility in Period + I	M1	+ Discount + Rate	Other Announce- + ments	Change in Day of the Week + Effects	Volatility and Type of An- + nouncement	Change in Random Volatility
Table 3 DECOMPOSITION OF INTEREST RATE VOLATILITY SINCE OCTOBER 1979									
Mean-Square Error	0.1005	0.0097	0.0092	0.0046	0.0003	−0.0013	0.0003	0.0750
Percent of Mean-Square Error	100.0	9.7	9.2	4.6	0.3	−1.3	0.3	74.6

terest rates associated with the weekly money announcements, some observers have suggested that the Federal Reserve change the way these announcements are made. One suggestion has been that M1 information be released monthly instead of weekly.[21] The contention is that since a monthly series would be less volatile and more easily predicted, it would not induce such large

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[21] Another proposal is that the Federal Reserve release weekly money supply data in terms of moving averages. To the extent that these releases contained the same information as before, such announcements should not affect the interest-rate response. See, for example, *Bondweek,* April 12, 1982, p. 4, "Street Expects Fed to Drop Seasonal Money Adjustments," or *Bondweek,* April 26, 1982, p. 4, "Garn May Ask for Monthly M1 Release If New System Doesn't Pan Out."

movements in interest rates. This study indicates, however, that the greater **unpredictability** of money announcements contributes only slightly to the overall volatility of interest rates. To move away from weekly reporting of changes in the money supply may reduce interest-rate volatility only marginally. Also, to the extent that less direct information about Federal Reserve policy was available to investors, other announcements might take on more importance. If market participants use inflation and other economic information to infer the future course of Federal Reserve policy, surprises in the announcement of other series besides the money supply might induce significant swings in interest rates, shifting a portion of volatility away from money toward these announcements.