

Interest rate volatility in 1980

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Interest rates displayed extreme volatility in 1980, reaching record highs in early spring, then plummeting until midsummer, only to rise above their previous peaks by late fall. Interest rates were more variable not only in a cyclical sense, but also in their weekly and daily behavior. It is unlikely that any single factor was responsible for the volatile behavior of interest rates in the past year, as rates are subject to myriad influences. These include changing inflationary expectations, exogenous commodity-specific supply shocks, fiscal and monetary policy actions, and national and international political developments.

Although these or similar factors are present to some degree every year, one of them—monetary policy—underwent a profound change just prior to 1980 that undoubtedly had important effects on rates during the year. On October 6, 1979, the Federal Reserve announced a new operating procedure that placed “greater emphasis in day-to-day operations on the supply of bank reserves and less emphasis on confining short-term fluctuations in the federal funds rate.” As later explained, the reason for the change in operating procedure

was to underscore, in terms of public perception and debate, the central importance of maintaining control over monetary growth and bank reserves to deal with inflation, and to better discipline . . . [Federal Reserve] internal policy-making with respect to monetary and credit growth, thus enhancing . . . [the Federal Reserve’s] ability to achieve . . . [its] objectives.¹

¹Paul A. Volcker, Chairman, Board of Governors of the Federal Reserve System, “Supplementary Statement—The New Operating Procedures,” before the Subcommittee on Domestic Monetary Policy of the Committee on Banking, Finance and Urban Affairs, House of Representatives, November 19, 1980, p. 1; processed.

This article examines some of the implications of the new operating procedure with respect to the variability of interest rates and discusses the economic costs of interest rate variability.

Old vs. new operating procedures

From 1970 through October 6, 1979, the Federal Open Market Committee (FOMC) generally attempted to achieve its economic goals by specifying a federal funds rate trading range for the period between FOMC meetings (usually one month) thought consistent with these goals.² Although, as the decade progressed, more and more attention was focused on achieving specified growth rates in a family of monetary aggregates as intermediate targets of policy, the immediate operating target remained the federal funds rate. Each week within the intermeeting period, a federal funds rate target was chosen by a representative of the FOMC in consultation with staff members of the Board of Governors and the Trading Desk of the Federal Reserve Bank of New York (Desk).

Shifts in the demand for nonborrowed reserves within the statement week would be accommodated by the Desk in order to maintain the targeted federal funds rate. Similarly, changes in nonborrowed reserves caused by unexpected changes in so-called “market factors,” such as Federal Reserve float, tended to be offset by Desk open market operations if they caused the federal funds rate to deviate from its targeted level. This federal

²For a discussion of pre-October 6, 1979, Federal Reserve monetary policy operating procedures, see Peter Keir and Henry Wallich, “The Role of Operating Guides in U.S. Monetary Policy: A Historical Review,” *Federal Reserve Bulletin*, vol. 65 (September 1979), pp. 679-691, and Raymond E. Lombra and Raymond G. Torto, “The Strategy of Monetary Policy,” *Economic Review*, Federal Reserve Bank of Richmond (September/October 1975), pp. 3-14.

funds rate targeting strategy was tantamount to the provision of a perfectly elastic supply of nonborrowed reserves at a given federal funds rate until the afternoon of the last day of the reserve settlement week.³

Each Friday morning the FOMC received new projections of monetary growth rates and could then choose a new weekly federal funds rate target thought appropriate for achieving its goals. Thus, under the old operating procedure in effect prior to October 6, 1979, daily variation in the federal funds rate was minimal. But because it was largely the direct result of a policy decision, weekly variation could have been about whatever the FOMC desired.

Under the new operating procedure adopted October 6, 1979, the FOMC continues to set intermediate-term (two- or three-month) growth targets for the monetary aggregates. Now, however, the specified intermeeting federal funds rate trading range is typically much wider than under the old operating procedure.⁴ The Federal Reserve Board staff determines an average level of nonborrowed reserves over the intermeeting period thought to be consistent with the FOMC's desired growth in the monetary aggregates. The Desk is then directed to attempt to hit a weekly average level of nonborrowed reserves with relatively little regard for the level of the federal funds rate unless the boundaries of the intermeeting trading range are in danger of being violated. In contrast to the old operating procedure, the new procedure does not accommodate shifts in banks' demand for nonborrowed reserves

³After 1 P.M., New York time, it becomes increasingly impractical for the Desk to buy or sell U.S. government securities for same-day delivery and, thus, to affect reserves on that day. Since Wednesday is the last day of the reserve settlement week for depository institutions subject to reserve requirements, the supply of nonborrowed reserves becomes, for all intents and purposes, perfectly inelastic after 1 P.M. on Wednesdays, and the federal funds rate rises or falls to clear the market.

⁴From October 1978 through September 1979, the average specified intermeeting federal funds rate range was 0.62 percentage points in contrast to 5.45 percentage points from October 1979 through September 1980.

within the reserve settlement week. Moreover, because daily federal funds rate control has been deemphasized, the Desk is less likely to take immediate action to offset undesired daily movements in nonborrowed reserves—and, thus, in the federal funds rate—caused by unexpected changes in reserve market factors.

In light of the new projections of monetary growth rates usually available on Friday mornings, a decision is made as to how to distribute nonborrowed reserves on a weekly average basis over the remaining weeks of the policy period so as to achieve the FOMC's intermeeting average level objective. Occasionally, it is decided to change the intermeeting average level objective.⁵ For a given level of the Federal Reserve discount rate and a given relationship between the level of borrowing from the Fed and the nonpecuniary costs associated with that borrowing, the federal funds rate will rise (fall) if the specified level of nonborrowed reserves implies a higher (lower) level of borrowed reserves.⁶ Under the new operating procedure, weekly changes in the federal funds rate tend to be more automatic, whereas they were more discretionary or policy-determined before. For example, if the monetary aggregates were growing faster than the FOMC desired, then,

⁵For a discussion of the mechanics of the nonborrowed reserves targeting procedure, see Steven H. Axilrod and David E. Lindsey, "Federal Reserve System Implementation of Monetary Policy: Analytical Foundations of the New Approach" (paper presented at the Denver meeting of the American Economic Association, September 6, 1980; processed); Board of Governors of the Federal Reserve System, "Appendix B: Description of the New Procedures for Controlling Money" (appended to "Monetary Policy Report to Congress Pursuant to the Full Employment and Balanced Growth Act of 1978," February 19, 1980; processed); Warren L. Coats, Jr., "Recent Monetary Policy Strategies in the United States" (unpublished paper, August 8, 1980; processed); and "Monetary Policy and Open Market Operations in 1979," *Quarterly Review*, Federal Reserve Bank of New York, vol. 5 (Summer 1980), pp. 60-62.

⁶Under lagged reserve accounting, depository institutions' required reserves in the current reserve settlement week depend on the level of their reservable liabilities two weeks prior. Assuming a constant level of excess reserves, the level of nonborrowed reserves in the current week defines the level of borrowed reserves.

presumably, required reserves would be growing faster than targeted nonborrowed reserves. As a result, borrowed reserves would rise and so too would the federal funds rate. Under the old operating procedure, the federal funds rate would rise only within the range specified at the last FOMC meeting unless the FOMC made a conscious decision to let it rise further.

In sum, then, there is a strong presumption that day-to-day variability in the federal funds rate will be greater under the new operating procedure than under the old one. Week-to-week variability in the federal funds rate might also be expected to be greater under the new operating procedure because the level of the federal funds rate, given the level of the Federal Reserve discount rate, depends critically on depository institutions' "reluctance" to borrow from the Fed, which also may be variable.

With regard to longer-run cyclical movements in the federal funds rate, it is not clear why the two procedures should yield markedly different outcomes. Under the old procedure, the level of the federal funds rate was a direct FOMC policy decision.⁷ Under the new operating procedure, the level of the federal funds rate is indirectly determined by policy decisions, in that it depends on the targeted path of nonborrowed reserves, the level of the discount rate, and the nonpecuniary costs associated with borrowing from the Fed.

Federal funds rate variability

As the graph and table make clear, the federal funds rate has indeed shown greater

⁷For discussions of why the federal funds rate was not moved by greater amounts under the pre-October 6 operating procedure, see John P. Judd and John L. Scadding, "Conducting Effective Monetary Policy: The Role of Operating Instruments," *Economic Review*, Federal Reserve Bank of San Francisco (Fall 1979), pp. 29-30; Thomas A. Lawler, "Fed May be Shifting to a True Reserves-Targeting Policy," *The Money Manager*, December 8, 1980, pp. 8, 11; Paul A. Volcker, op. cit., pp. 1-2, 5, 6; and Henry C. Wallich, Member, Board of Governors of the Federal Reserve System, "Federal Reserve Policy and the Economic Outlook" (remarks to the Chesapeake Chapter of Robert Morris Associates, Bethesda, Maryland, December 3, 1980, pp. 2, 8; processed).

day-to-day and week-to-week variability in the year since October 6, 1979, compared with the year before. As already discussed, one of the reasons for this greater variability is that under the new procedure, shifts in banks' demand for nonborrowed reserves within the reserve settlement week are not accommodated by Desk open market operations. Moreover, it could be expected that these intraweek demand shifts would be more volatile in the post-October 6 period.

Under the old procedure when the federal funds rate was being targeted within narrow bands on a weekly basis, banks had little incentive to increase or decrease their federal funds purchases or sales in order to take advantage of a higher or lower federal funds rate on any particular day. If the federal funds rate moved above (below) the perceived upper (lower) limit of the FOMC's targeted range, then bidding (offering) would subside as market participants expected the federal funds rate to fall (rise) either on its own accord or as a result of Desk open market operations.

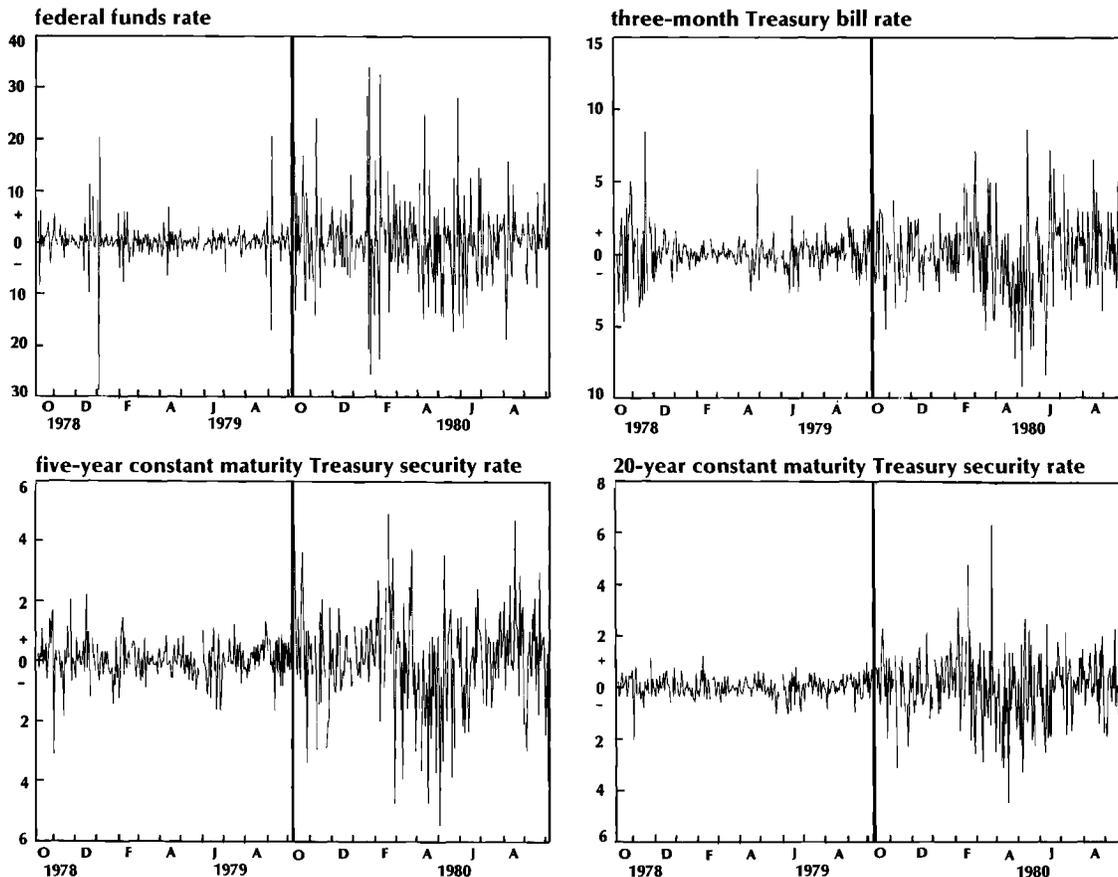
Standard deviations of percentage changes of selected interest rates

	October 1978- October 1979	October 1979- October 1980
	(percent)	(percent)
Federal funds rate		
Daily	3.672	8.118
Weekly averages*	2.061	3.154
Three-month Treasury bill rate		
Daily	1.425	2.612
Weekly averages**	0.731	1.353
Five-year constant maturity Treasury security rate		
Daily	0.630	1.580
Weekly averages**	0.319	0.845
20-year constant maturity Treasury security rate		
Daily	0.398	1.357
Weekly averages**	0.201	0.647

*Seven-day averages of daily effective rates for the week ending Wednesday.

**Five-day averages of daily closing bid rates for the week ending Friday.

Daily percentage changes in selected interest rates



Since October 6, however, the weekly federal funds rate trading range tolerated by the FOMC has widened significantly. As a result, depository institutions may enjoy large gains or suffer large losses depending on the accuracy of their intraweek federal funds rate forecasts.⁸ If the federal funds rate starts to rise, depository institutions no longer have the assurance they once did that the rate will fall later in the settlement week. Given greater

uncertainty as to the level of the federal funds rate later in the day or settlement week, bidding may continue, forcing the rate even higher. Conversely, a falling federal funds rate might not result in the withdrawal of offers to sell federal funds.

Even if there were no change in depository institutions' intraweek demand for nonborrowed reserves under the new operating procedure, greater day-to-day volatility in the federal funds rate could be expected due to changes in nonborrowed reserves resulting from movements in uncontrollable reserve market factors that were unanticipated by the Fed. Under the old procedure, the Desk had good reason to believe that the demand for

⁸Because of lagged reserve accounting, depository institutions know, entering the reserve-settlement week, the weekly average level of reserves they must hold to avoid a deficiency. Their decision is how to distribute their reserve holdings within the week in order to meet their known reserve requirements at minimum cost.

Economic events in 1980—a chronology

Jan 1 Minimum wage rises from \$2.90 to \$3.10. (It goes to \$3.35 on January 1, 1981.)

Jan 1 Social Security wage base rises from \$22,900 to \$25,900. Tax rate stays at 6.13 percent. (On January 1, 1981, base rises to \$29,700, and tax rate to 6.65 percent.)

Jan 1 Regulatory authorities replace four-year floating rate CD (established July 1, 1979) with 2½-year "small saver" CD.

Jan 1 Treasury Department starts issuing double-E bonds yielding 7 percent over 11 years.

Jan 4 President Carter denounces Russian invasion of Afghanistan. He embargoes shipments of agricultural products to Russia.

Jan 23 State of Union message calls for draft registration and 5 percent boost in real defense spending.

Jan 28 Saudi Arabia raises its basic oil price to \$26.

Feb 1 Trade agreement between the U.S. and the Peoples Republic of China goes into effect.

Feb 6 IMF auctions 444,000 ounces of gold at \$712 per ounce, up from record \$563 on January 2.

Feb 7 Federal Reserve Board announces new monetary aggregate definitions: M-1A is old M-1 but excludes demand deposits held by foreign banks and institutions. M-1B adds other checkable deposits, including NOW and ATS accounts. M-2 adds savings and small time accounts at banks and thrifts, overnight RPs and Eurodollars, and money market funds. M-3 adds large CDs and other RPs. L (for "liquidity") adds savings bonds, short-term Treasuries, other Eurodollars, commercial paper, and bankers' acceptances.

Feb 14 Chicago firemen go on strike. (They return to work March 8.)

Feb 15 Algeria boosts oil price \$3.00 per barrel to \$37.21.

Feb 15 Federal Reserve raises discount rate from 12 percent to a record 13 percent.

Feb 18 In Canada Trudeau's Liberals defeat Joe Clark's Conservatives ending nine-month government.

Feb 19 Federal Reserve announces money and credit growth targets for 1980: M-1A, 3½-6 percent; M-1B, 4-6½ percent; M-2, 6-9 percent; M-3, 6½-9½ percent; total bank credit, 6-9 percent.

Feb 27 One-year Treasury bills sell at 15.3 percent bond-equivalent yield, highest ever for any U.S. security.

Feb 28 Nuclear Regulatory Commission lifts moratorium on new nuclear plants imposed after Three Mile Island accident.

Mar 1 Regulatory authorities impose temporary ceilings on "small saver" CDs, 11¼ percent for banks, 12 percent for thrifts.

Mar 12 Chicago bank raises its mortgage rate to 16.25 percent.

Mar 13 President Carter endorses 7.5-9.5 percent wage rise guidelines for 1980, up from 7 percent in 1979.

Mar 14 President Carter announces new anti-inflation program, and activates Credit Control Act of 1969.

Mar 14 Federal Reserve Board announces 15 percent "special deposit" on growth of money market funds and some types of consumer credit, a voluntary "Special Credit Restraint Program" to restrict business credit, an increase in marginal reserves on managed liabilities from 8 to 10 percent, and a 3-point "surcharge" on frequent borrowings from Federal Reserve by large banks. Banks are urged to limit loan growth to 6 to 9 percent.

Mar 21 Administration suspends "trigger price mechanism" intended to curb steel imports. (Mechanism is reinstated October 21.)

Mar 23 Rock Island Railroad ceases operations.

Mar 24 Bond-equivalent yield on three-month Treasury bills jumps sharply to 17.5 percent.

Mar 25 Large Chicago S&L increases mortgage rate to 17 percent.

Mar 27 Spot price of silver drops \$5 to \$10.80 per ounce. (Peak of \$50 was reached in January.)

Mar 29 FmHA's Economic Emergency Loan Program to aid financially distressed farmers is extended and expanded.

Mar 31 Depository Institutions Deregulation and Monetary Control Act (Monetary Control Act) is approved. Among its many provisions: all depository institutions, member and nonmember, will be phased in to the same new reserve requirements over a period of years; Federal Reserve member banks can no longer avoid reserve requirements by withdrawing from the system; all institutions will have full access to the Federal Reserve's discount window and services; Federal Reserve will establish a pricing schedule for its services; all institutions will be able to offer NOW accounts beginning December 31, 1980; interest rate ceilings on savings and time deposits will be phased out in six years; thrift institutions will have expanded asset powers; state usury ceilings for mortgages and certain other loans are overridden; FDIC/FSLIC insurance limits are boosted from \$40,000 to \$100,000.

Apr 2 Major bank boosts prime rate to 20 percent.

Apr 2 Act imposing "windfall profits" (excise) tax on domestic crude oil output is approved. Tax is retroactive to March 1.

Apr 7 U.S. breaks diplomatic relations with Iran, and cuts off all trade.

Apr 16 Major bank cuts its prime rate from 20 to 19.75 percent.

Apr 17 Federal Reserve Board extends seasonal borrowing privilege to small nonmember banks.

Apr 17 China replaces Taiwan as a member of the International Monetary Fund.

Apr 20 International Harvester workers end longest United Automobile Workers strike after 172 days.

Apr 21 Dow Jones industrial average closes at 759, low for the year. (See **Nov 20**.)

Apr 25 President Carter announces failure of airborne attempt to rescue U.S. hostages held in Iran.

Apr 28 Secretary of State Vance is succeeded by Senator Muskie.

May 4 U.S. stops granting visas to Cuban refugees.

May 7 Federal Reserve eliminates 3 percent surcharge on frequent borrowings by large banks.

May 14 Saudi Arabia raises its basic oil price from \$26 to \$28.

May 17 Unemployment compensation claims reach a new high.

May 18 Mt. St. Helens erupts violently causing extensive damage.

May 18 National Guard moves to control rioting in Miami.

May 22 National Association of Purchasing Agents survey shows business "dropped like a rock" in April and May.

May 22 Federal Reserve eases credit restraint program.

May 27 Lyle Gramley joins Federal Reserve Board.

May 29 Federal Reserve reduces discount rate from 13 to 12 percent.

May 30 Aluminum workers win 42 percent boost over three years, assuming 11 percent inflation rate.

- Jun 13** Federal Reserve reduces discount rate from 12 to 11 percent.
- Jun 13** Many banks reduce prime rate to 12 percent.
- Jun 24** Chrysler obtains \$500 million loan after government board approves federal guarantee.
- Jun 30** Syntfuel act creates Synthetic Fuel Corporation.
- Jun 30** Punishing heat wave hits the Southwest.
- Jul 1** Checks to 35.2 million Social Security recipients rise 14.3 percent based on Cost of Living Adjustment (COLA) formula.
- Jul 1** Motor Carrier Reform Act partially deregulates trucking.
- Jul 1** Department of Labor reports white-collar salaries rose 9.1 percent on average in 12 months ending in March.
- Jul 3** Federal Reserve Board announces complete phaseout of credit restraint program.
- Jul 3** Federal Home Loan Bank Board authorizes S&Ls to issue credit cards and offer unsecured loans.
- Jul 7** Indefinite layoffs at Big Four auto makers hit a record 246,000.
- Jul 12** Detroit city workers settle 11-day strike that had halted buses and garbage pickups on eve of GOP convention.
- Jul 15** Secretary of Labor Marshall bars Firestone from government contracts because of job bias charges.
- Jul 16** Republicans nominate Reagan and Bush.
- Jul 21** Major bank cuts prime rate from 11.5 to 11 percent.
- Jul 27** The Shah of Iran dies in Cairo.
- Jul 28** Federal Reserve reduces discount rate from 11 to 10 percent.
- Jul 28** Chrysler begins assembly of new K-cars.
- Jul 29** Chairman Volcker's letter to Congress states that money growth targets for 1981 are ½ percentage points under 1980 targets for M-1A, M-1B, and M-2, but warns that precise numerical targets may confuse rather than clarify.
- Aug 11** AT&T three-year labor contract gives 34.5 percent pay boost over three years, assuming 9.5 percent rise in CPI.
- Aug 13** Democrats renominate Carter and Mondale.
- Aug 17** Polish factory workers strike demanding pay hike, shorter week, more food, free speech, and free church.
- Aug 18** Ford begins assembly of its new small "Erika" cars.
- Aug 21** Import duty on small trucks rises from 4 to 25 percent.
- Aug 22** Major banks boost prime rate to 11.25 percent, first of a series of increases.
- Aug 28** Federal Reserve publishes proposed pricing schedule and pricing principles for its services.
- Sep 1** Revised Regulation A, as required by Monetary Control Act, gives all depository institutions access to the discount window.
- Sep 12** Military coup seizes power in Turkey.
- Sep 17** Saudi Arabia boosts its oil price \$2 to \$30 per bbl.
- Sep 22** Iran-Iraq war begins over disputed border waterway.
- Sep 26** Federal Reserve raises discount rate from 10 to 11 percent. Major banks boost prime rate to 13 percent.
- Sep 29** Bond-equivalent yield on three-month Treasury bills jumps a full point to 12 percent.
- Oct 1** Federal employees receive a 9.1 percent general pay boost, in addition to annual step increases.
- Oct 2** Major bank leads boost in prime rate to 14 percent.
- Oct 9** Regulatory authorities set 5¼ percent ceiling on NOW accounts, effective December 31.
- Oct 14** Staggers Rail Act provides for gradual deregulation.
- Oct 14** Lawrence Klein wins Nobel prize in economics.
- Oct 20** Agriculture Department announces that drought cut major crops—peanuts, 37 percent; soybeans, 23 percent; corn, 17 percent.
- Oct 22** Agriculture Department announces four-year agreement committing China to substantial purchases of wheat and corn.
- Nov 4** Spot oil prices on world market increase to \$37-40 range, \$6-9 over official prices.
- Nov 4** Reagan wins the Presidency. GOP wins control of the Senate, and makes gains in the House.
- Nov 6** Major banks raise prime rate from 14.5 to 15.5 percent.
- Nov 9** Major steel company reopens strip mill closed last May.
- Nov 10** International Trade Commission turns down request by Ford and UAW for quotas on imports of cars and light trucks.
- Nov 13** First phase of reserve requirement provisions of Monetary Control Act becomes effective.
- Nov 13** Copper producers settle record 19-week strike. Pact calls for 39 percent boost over three years, assuming 11 percent COLA.
- Nov 17** Federal Reserve raises discount rate from 11 to 12 percent, with 2 points added for \$500 million institutions that borrow frequently.
- Nov 20** Governor Thompson of Illinois orders 60-day hiring freeze.
- Nov 20** The Dow Jones index closes at 1000, high for the year. (See **Apr 21**.)
- Nov 24** New York legislature eliminates usury ceilings on most loans.
- Dec 5** Federal Reserve raises discount rate to 13 percent, equaling high of last spring, and raises surcharge to 3 percent.
- Dec 10** Auto makers extend holiday closings to cut inventories.
- Dec 10** Major banks raise prime rate from 19 to 20 percent.
- Dec 15** Bond-equivalent yield on three-month Treasury bills hits 17.64 percent, passing 17.5 percent high on March 24, 1980.
- Dec 15** Saudi Arabia raises its basic oil price from \$30 to \$32. Maximum OPEC price will be \$41.
- Dec 16** Council on Wage and Price Stability decides not to issue new price and wage standards, effectively ending its career.
- Dec 16** American Motors Corporation stockholders vote to allow Renault to acquire control.
- Dec 19** Most major banks raise prime rate to record 21.5 percent.
- Dec 21** Iran demands \$24 billion ransom to release hostages.
- Dec 22** Major banks reduce prime rate from 21 to 20.5 percent.
- Dec 22** Yields on Treasury bills drop sharply.
- Dec 23** Labor Department announces that November Consumer Price Index was 12.7 percent above the level of a year earlier.
- Dec 26** Retailers report strong pre-Christmas sales.
- Dec 29** Libya raises its oil price from \$37 to \$41, OPEC maximum.
- Dec 30** Agriculture Department calls Commodity Credit Corporation loans on all corn in reserve program.
- Dec 31** Major S&L says high interest rates have virtually shut down Chicago area residential real estate markets.

nonborrowed reserves on a day-to-day basis within the settlement week was relatively stable. Consequently, a movement of the federal funds rate outside its targeted range was a warning that the supply of nonborrowed reserves might be something other than what the Fed had forecast.⁹ The Desk often undertook “defensive” open market operations based on the deviation of the actual level of the federal funds rate from its expected level. Since October 6, however, the daily federal funds rate has provided the Desk with less information about the actual level of nonborrowed reserves because changes in the rate may reflect not only changes in the supply of nonborrowed reserves, but also shifts in the demand for them.

Variability in longer-term rates

Although increased day-to-day volatility in the federal funds rate was expected to accompany the new operating procedure, there was more uncertainty about the response of longer-term rates to the increased volatility of one-day rates. The relationship between interest rates and the maturity of securities is known as the term structure of interest rates. Although there are variants on the theme, most theories of the term structure posit that expectations about the future level of short-term rates play a major role in the determination of longer-term rates.¹⁰ For example, according to the pure expectations theory, the current 90-day Treasury bill rate is a geometric average of 90 expected future one-day Treasury bill rates. The degree to which greater variability in the federal funds rate, a one-day rate, will lead to greater variability in longer-term rates depends on the degree to which daily changes in the federal

⁹In the pre-October 6 period, the Fed also made daily reserve projections and had some intuition as to the rate level at which federal funds would trade, given required reserves and the level of the discount rate.

¹⁰For a discussion of different theories of the term structure of interest rates, see Burton G. Malkiel, *The Term Structure of Interest Rates* (Princeton University Press, 1966).

funds rate affect expectations of future daily federal funds rates.

It has been argued that under the old operating procedure, short-term movements in the federal funds rate contained more information about future movements in this rate because the FOMC was targeting its level within narrow bands. Thus, it was believed that short-term movements in the federal funds rate had significant effects on expectations and were quickly translated into movements of longer-term rates. Because short-term movements in the federal funds rate under the new operating procedure contain less information about policy intentions, such movements are likely to have less of an effect on expected future federal funds rates. Thus, the response of longer-term rates to short-term movements in the federal funds rate might be diminished under the new operating procedure.¹¹

The first part of this argument may have some empirical validity. That is, movements in the federal funds rate since October 6, 1979, appear to have conveyed less information about its future movements than before in as much as the correlation coefficient between daily percentage changes in the federal funds rate on the current and preceding day decreased from -0.51 in the year preceding October 6, 1979, to -0.34 in the year after.¹² Despite this, as shown in the graphs and table, the variability of longer-term rates, as represented by the three-month Treasury bill rate and the five-year and 20-year constant maturity Treasury securities rates, increased in the year following October 1979, compared with the year before. Moreover, the correlation between daily percentage

¹¹See Judd and Scadding, *op. cit.*, pp. 30-31; and Raymond Lombra and Frederick Struble, “Monetary Aggregate Targets and the Volatility of Interest Rates: A Taxonomic Discussion,” *Journal of Money, Credit, and Banking*, vol. 2 (August 1979), pp. 290-291.

¹²Correlations using weekly average percentage changes in the federal funds rate tell a different story. The correlation coefficients between the current week and the previous week for the year prior to and the year after October 6, 1979, were -0.11 and 0.21, respectively.

changes in the federal funds rate and in the three-month Treasury bill rate and the five-year and 20-year constant maturity Treasury securities rates increased from 0.06, 0.004, and -0.04 to 0.13, 0.12, and 0.12, respectively, between the two periods.

Increased correlation coefficients, however, do not necessarily mean that longer-term rates have become more sensitive to daily movements in the federal funds rate since the new operating procedure was adopted. Given the enormous increase in the variability of the federal funds rate under the new procedure, even a diminished sensitivity could be expected to produce greater variation in longer-term rates and to increase the proportion of that variation which is explained by variation in the federal funds rate; that is precisely what a correlation coefficient measures.¹³

A more meaningful measure of the sensitivity would be the regression coefficients calculated from regressions of daily percentage changes in longer-term rates on daily percentage changes in the federal funds rate before and after the adoption of the new operating procedure. As seen in the table, the regression coefficients (b_1) have increased in size and statistical significance in the year fol-

¹³To illustrate this point a little more clearly, suppose that the relationship between some variable Y and some explanatory variable X were as follows:

$$Y = a + bX + e$$

where a and b are constants and e is a random disturbance term. So long as X and e are independent, the greater the variability of X, the more variable Y will be and the greater the proportion of the variability of Y that will be attributable to variation in X. But if X is held constant or nearly so (as was the case with the federal funds rate from Thursday through Tuesday under the old operating procedure) then (a + bX) will be a constant, and movements in X will account for virtually none of the total variation in Y—even though the basic relationship between Y and X, as measured by coefficient b, is unchanged. An alternative way of showing this is to look at the formula for the correlation coefficient, $r = \hat{\beta} \frac{S_X}{S_Y}$

where r is the correlation coefficient, $\hat{\beta}$ is the estimate of the coefficient b in the equation, S_X is the sample standard deviation of X, and S_Y is the sample standard deviation of Y. If S_X is very low (the variability of X is very low), r will be small regardless of the size of $\hat{\beta}$.

Regression coefficients for the equations

$$\text{Daily \% } \Delta \text{ Interest Rate} = b_0 + b_1 \text{ Daily \% } \Delta \text{ Federal Funds Rate} + e$$

Dependent Variable	October 1978- October 1979		October 1979- October 1980	
	b_0	b_1	b_0	b_1
Three-month Treasury bill rate	0.1135 (1.25)	0.0254 (1.03)	0.0063 (0.04)	0.0409* (2.01)
Five-year constant maturity Treasury security rate	0.0602 (1.50)	0.0008 (0.07)	0.0502 (0.50)	0.0228** (1.85)
20-year constant maturity Treasury security rate	0.0381 (1.50)	-0.0044 (-0.64)	0.0660 (0.77)	0.0202** (1.91)

T-statistics in parentheses.

*Statistically significant at the 0.05 level.

**Statistically significant at the 0.10 level.

lowing the adoption of the new operating procedure compared with the year before. Thus, contrary to expectations, the regression coefficients confirm the result suggested by the correlations—that longer-term rates have become more sensitive to short-term movements in the federal funds rate under the new operating procedure.

Together with the marked increase in the volatility of all maturities of interest rates immediately after October 6, 1979, and its continuation throughout 1980, these results constitute suggestive but not conclusive evidence that the new operating procedure has been primarily responsible for the increased variability in longer-term rates. As mentioned at the outset, since the adoption of the new operating procedure, the financial markets have been subjected to a number of extraordinary events including dangerous turmoil in the Middle East, sharp increases in energy prices, uncertainties with respect to the federal budget, the temporary imposition of credit controls, and the bursting of speculative bubbles in the commodity markets. Moreover, given the relatively short period of time that the new operating procedure has been in effect, it is reasonable to assume that market participants are still discovering its nuances and may occasionally be misinterpreting the meaning of short-run movements

in the federal funds rate. As they learn more about the new procedure, some of the increased volatility may disappear.

Economic costs of interest rate variability

Most investors are risk averters. That is, the higher the risk associated with a particular investment, the higher the expected return must be to induce the investor to purchase the investment. For example, consider two investment alternatives. The first guarantees a return of \$100 at the end of some specified time period. The second alternative offers possible returns of \$150 and \$50, each with a 50 percent probability. The expected return of the second investment is \$100, the same as the first.¹⁴ But because of the higher risk—that is, variability or uncertainty of return—associated with the second alternative, most people would prefer the no-risk or certain first investment choice. If the equally probable outcomes of the second alternative were raised to \$200 and \$100, so that the expected return was \$150, then some investors would be induced to opt for it despite its higher risk.¹⁵

Because the market price or capital value of a fixed-income security varies inversely with its market yield, interest rate variability is an inherent risk of holding such a security. Assuming that the demand for a given class of fixed-income securities is dominated by risk-averse investors, an increase in the interest rate variability of these securities would lead investors to hold fewer securities at any given level of expected return. In order to induce investors to hold the same quantity as in the period of lower rate variability, the expected

return must rise to reflect the higher risk.¹⁶

Because of their highly leveraged positions—i.e., the relatively low ratio of their capital to the value of their securities inventory—government securities dealers are particularly sensitive to interest rate variability. An unexpected sharp rise in interest rates, even of short duration, can have a profound negative impact on dealer solvency. As a result, an increase in interest rate volatility may reduce dealers' willingness to make markets in government securities, resulting in lower dealer inventories and a widening of the spread between the prices at which dealers stand ready to buy and sell securities (the bid-ask spread).¹⁷ This hypothesized decline in the "efficiency" of the government securities market implies higher costs of marketing government debt.

A comparison of dealer bid-ask spreads on Treasury bills for the years before and after October 6, 1979, confirms that they have widened. The average spread on the current three-month Treasury bill has increased from 3.6 basis points to 6.2 basis points.¹⁸ Similar

¹⁶In a world in which there is one riskless asset and more than one risky asset and the variances of return on all of the risky assets have increased, the expected returns on all the risky assets need not increase unless all of them are gross substitutes for each other. Assets are gross substitutes for each other if, in response to an increase (decrease) in the price of one of them, the individual demands for all other assets increase (decrease).

¹⁷For theoretical analysis and empirical evidence concerning dealer behavior, see Louise Ahearn and Janice Peskin, "Market Performance as Reflected in Aggregative Indicators," *Joint Treasury-Federal Reserve Study of the Government Securities Market—Staff Studies*, part 2, pp. 93-153; Micha Astrachan, "The Costs of Interest Rate Variability," Federal Reserve Bank of New York Research Paper No. 7821, December 1977; and Burton Zwick, "Interest Rate Variability, Government Securities Dealers, and Stability in the Financial Markets," Federal Reserve Bank of New York Research Paper No. 7734, September 1977.

¹⁸The data used in these calculations were the first available when-issued quotes (usually Tuesday) on the most recently auctioned three-month Treasury bill. The data source was the Federal Reserve Bank of New York's closing composite quotations of U.S. government securities. It should be noted that empirical studies indicate that other factors, in addition to interest rate variability, affect bid-ask spreads. Thus, it would be imprudent to attribute the widening of bid-ask spreads in the post-October 6, 1979, period solely to increased interest rate volatility.

¹⁴Expected return is defined as the sum of the products of the probability of an investment outcome occurring and the value of that outcome. Thus, in the hypothetical second alternative, the expected return is equal to $.5 \times \$50$ plus $.5 \times \$150$ or \$100.

¹⁵For a formal discussion of the effects of risk on asset demands, see James Tobin, "Liquidity Preference as Behavior Towards Risk," *Review of Economic Studies*, vol. 25 (February 1958), pp. 65-86.

results obtained for the current six-month Treasury bill. However, an examination of monthly data since October 6, 1979, fails to reveal any decrease in dealer net positions in U.S. government securities as a proportion of all marketable U.S. government securities held by the public. If anything, the data show a slight increase in net deflated positions.

Increased uncertainty concerning future interest rate levels resulting from the observed increase in rate variability could also produce wider dispersions of accepted bids in Treasury securities auctions. In the weekly auctions of six-month Treasury bills, the average percentage point spread between the highest accepted bid (in terms of rates) and the lowest increased from 0.045 in the year prior to October 6, 1979, to 0.125 in the year following the adoption of the new operating procedure. Insofar as this increased bidding dispersion reflects greater investor uncertainty, and investors are risk averse, it might imply that the Treasury paid higher interest rates than it otherwise would have had to in order to compensate investors for the higher perceived risk.

Finally, the increased day-to-day variability of the federal funds rate imposes an obvious cost on depository institutions subject to reserve requirements. Because of the greater uncertainty about the rate level at which federal funds will trade during the week and the associated higher penalties for "poor" timing of federal funds transactions, depository institutions could be expected to devote more resources to forecasting daily federal funds rate levels and/or end up holding higher levels of excess reserves.¹⁹ In either

case, the depository institutions would attempt to pass on their higher costs to their customers.

Summary

Since the Fed adopted its new operating procedure on October 6, 1979, the short-run variability of interest rates has increased dramatically across the maturity spectrum. Although greater variability of the federal funds rate was expected as a direct implication of the new operating procedure, arguments based on the expectations theory of the term structure of interest rates suggested that the variability of longer-term rates might not increase commensurately. However, the results reported in this paper indicate that longer-term rates have become both more variable and more sensitive to movements in the federal funds rate.

Regardless of its source, increased variation in interest rates implies a decreased demand for fixed-income securities as a result of increased risk or uncertainty of return. The general level of interest rates must rise in order to induce investors to hold the quantity of fixed-income securities outstanding. Thus, increased interest rate variability implies higher marketing costs of Treasury debt. Most of the empirical evidence presented is consistent with this hypothesis. Of course, in assessing experience under the new operating procedure, these costs of increased interest rate variability must be weighed against any benefits of the new procedure in terms of more stable growth of the monetary aggregates and of nominal income.

¹⁹Average weekly excess reserves increased from 0.486 percent of total reserves in the year prior to October 6, 1979, to 0.622 percent in the year after. This

increase marginally misses being statistically significant at the 5 percent level for a single-tailed test.