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## Trends in Federal Funds Rate Volatility

*Spence Hilton*

*The behavior of the fed funds rate—a key monetary policy target and a benchmark for short-term interest rates—is closely watched by many market participants. After a decade marked by periodic bouts of high volatility in the funds rate, volatility has declined sharply since 2001. An analysis of the major factors influencing the rate’s behavior shows that some of the forces behind the current fall in volatility first emerged in response to the earlier increases.*

The overnight federal funds rate is the operating target of the Federal Reserve’s Federal Open Market Committee (FOMC) when it sets the stance of monetary policy. This rate is also a key benchmark for interest rates in the U.S. short-term money market. Consequently, the rate’s behavior is of considerable interest to more than just participants in the federal funds market.

In recent years, volatility in the federal funds rate has fallen markedly. The drop follows a decade in which volatility surged in extended bouts. In this edition of *Current Issues*, we shed light on the major factors influencing federal funds rate volatility since 1989. Our review places the rate’s recent volatility decline and current levels of volatility in historical perspective. It also underscores how developments both within and outside the direct control of the Trading Desk at the Federal Reserve Bank of New York (the Desk), the group charged with implementing monetary policy, have influenced the behavior of the policy rate.

We begin by explaining the nature of the target federal funds rate and the framework for implementing monetary

policy. The measures of rate volatility used in this article are described, as is the importance of what are known as high-payment-flow days in analyses of the behavior of the funds rate. Next, we examine the rate’s behavior over two periods, 1989-2000 and 2001–midyear 2005.<sup>1</sup> For each period, we identify the main forces contributing to volatility. Significantly, we show that some of the forces behind the recent decline in volatility first emerged in response to rises in the earlier period. Prospects for future volatility in the federal funds rate are also considered.

### Managing the Federal Funds Rate

In the federal funds market, depository institutions (banks) operating in the United States directly borrow from, and lend to, one another on an unsecured basis the balances (reserves) that they hold in accounts at the Federal Reserve.<sup>2</sup> The FOMC directs the Desk to use open market operations to maintain the overnight federal funds rate “at an average of around” a specified rate, commonly referred to as the target rate. Since February 1994, the FOMC has publicly announced changes in the target rate. In the five or so preceding years, the Committee did not

formally target the funds rate. Nonetheless, it established “desired” rate levels internally, which in turn were “signaled” to the market through open market operations. The Desk sought to attain these desired rate levels much as it does now with the announced targets.<sup>3</sup>

The Desk’s basic operating procedures for managing the federal funds rate are well documented.<sup>4</sup> It influences the rate indirectly by adjusting the supply of reserve balances through open market operations. Two components of the framework for implementing monetary policy that are important for our discussion are the structure of banks’ total requirements to hold reserve balances at the Federal Reserve and the Fed’s discount window lending arrangements.<sup>5</sup>

Banks hold reserve balances at the Federal Reserve in order to meet various requirements, which are fixed for two-week intervals called maintenance periods. The structure of total requirements to hold balances at the Fed comprises *reserve requirements*, which are set by the Fed in proportion to a bank’s deposit liabilities, less the bank’s holdings of cash on its premises, and a contractual form of requirements known as *clearing balance requirements*, which are set voluntarily by each bank. Reserve requirements are not remunerated. In contrast, banks earn income credits on balances held to meet their clearing balance requirements at a rate linked to the federal funds rate. However, these credits can be used only to pay for certain Federal Reserve priced services used by banks, a restriction that effectively limits the level of a clearing balance requirement that a bank would ever contract to hold.<sup>6</sup> A bank may hold balances in any daily pattern consistent with holding a cumulative total over a two-week maintenance period that satisfies its requirements, as long as the bank ends no day overdrawn on its Fed account. A bank that meets or exceeds its requirements before a period ends is considered to be “locked into” holding excess balances, and it will attempt to hold a level of balances as close to zero as possible on each day remaining in the period.

The Federal Reserve’s discount window—another component of the monetary policy framework—is available as a source of reserve supply in the event that a shortage would otherwise leave banks overdrawn at the end of a day or short of their requirements at the end of a period. However, the terms under which discount window loans are extended severely limit the use of this facility. Under present arrangements, a bank in generally sound financial condition with sufficient collateral may borrow on a short-term basis directly from the Fed at a discount window facility called the primary credit facility, at a “discount” rate normally set 100 basis points above the target level of the federal funds rate. The primary credit facility has been in operation since

January 2003. Previously, when the adjustment credit facility had been in place, the discount rate typically had been set slightly below the target federal funds rate, and banks’ borrowing behavior was controlled by more administrative measures.

To avoid being overdrawn at the Fed or falling short of its requirements, a bank would be willing to pay a rate as high as the discount rate in the funds market so as not to borrow at the discount window. Conversely, a bank would be willing to lend in the market at rates as low as 0 percent to avoid holding excess reserves. Multiday maintenance periods and high levels of requirements can dampen federal funds rate volatility because they widen the daily range of reserves a bank may hold consistent with its maintenance period requirements.

### Measures of Federal Funds Rate Behavior

Most trades between large banking institutions in the federal funds market are arranged through a handful of brokers. The Federal Reserve Bank of New York collects data on the overnight trades arranged each day by the major brokers in this market and uses the data to calculate a volume-weighted daily average (“effective”) rate and other measures of rate behavior. For this analysis, a complete set of daily federal funds rate observations from January 1989 through June 2005 was compiled from this source.

Federal funds rate behavior is most commonly measured in one of two ways: the deviation of the effective funds rate from the target rate (or its absolute value) is widely used to gauge average performance of the rate over an entire day relative to the operating target; the intraday standard deviation of rates around the daily effective rate is the most comprehensive measure of rate volatility within a day.

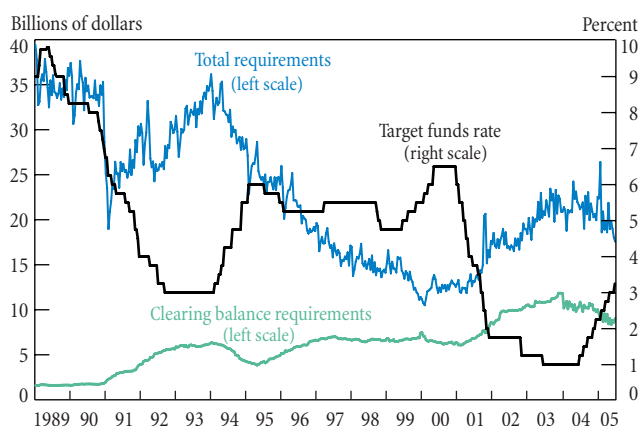
Both measures tend to become elevated on so-called high-payment-flow days—normally the first, middle, and final business day of each month. On these days, the flow of financial transactions that affect the distribution of reserves held at the Fed by banks is much heavier and more uncertain than usual. Accordingly, we examine funds rate behavior on high-payment-flow days and on all other days separately. To obtain summary statistics for this analysis, we calculate median values for these measures over semiannual periods.<sup>7</sup>

### Federal Funds Rate Behavior: 1989-2000

#### *The Decline in Total Requirements*

During the 1990s, the decline in total requirements was the most significant development that affected the behavior of the funds rate (Chart 1). The drop came in several waves and

Chart 1  
Requirements and the Target Federal Funds Rate  
Biweekly Maintenance Period Values



Source: Federal Reserve Bank of New York.

Notes: Total requirements are reserve requirements less applied vault cash plus clearing balance requirements. Figures for 2005 are through June 30.

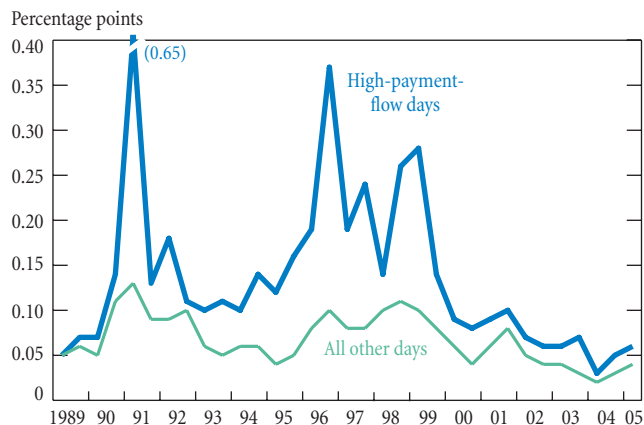
had more than one immediate cause. Reserve requirements fell abruptly around year-end 1990, when the Federal Reserve’s Board of Governors eliminated requirements on all nontransaction deposits, which had been 3 percent of the value of these deposits. Reserve requirements again fell in April 1992, when the Board reduced from 12 percent to 10 percent the maximum marginal requirement ratio on transaction deposits. Within a couple of years, the impact of these cuts was offset by the effects of falling interest rates on the growth of bank deposits subject to reserve requirements, as well as by an increase in contractual clearing balance requirements at large banks seeking to blunt the effects of

lower reserve requirements.<sup>8</sup> Afterward, over a period of roughly three years beginning in 1996, the rapid adoption by commercial banks of retail “sweep” programs—designed to reduce the level of bank deposits subject to reserve requirements, which earn no interest—brought total requirements down to historically low levels. By 1999, banks had largely exhausted their opportunities for reducing reserve requirements further through sweep programs.

The declines in requirements in turn were associated with higher funds rate volatility.<sup>9</sup> When lower requirements are in place, swings in a bank’s reserve position at the Fed of a given amount are more likely to leave the bank either overdrawn or in peril of accumulating unwanted excess reserves. Attempts by banks to avoid these outcomes can place upward or downward pressure on market rates. Intraday standard deviations jumped in 1991 and remained high the following year for high-payment-flow days and all other days before falling back (Chart 2), likely helped by the subsequent rise in requirements brought on by a decline in interest rates. Intraday rate volatility again rose as the use of sweep programs gained momentum starting in 1996, and it remained somewhat elevated on high-payment-flow days and all other days for a few years as total requirements continued to fall.

The impact of falling requirements on absolute deviations of the daily effective funds rate from the target is shown in Chart 3. For high-payment-flow days, the daily absolute deviations of the effective rate from the target became quite elevated in 1991-93, receded a bit, and returned to high levels from 1996 to 1998. Effective rates on high-payment-flow days were typically well above the target.

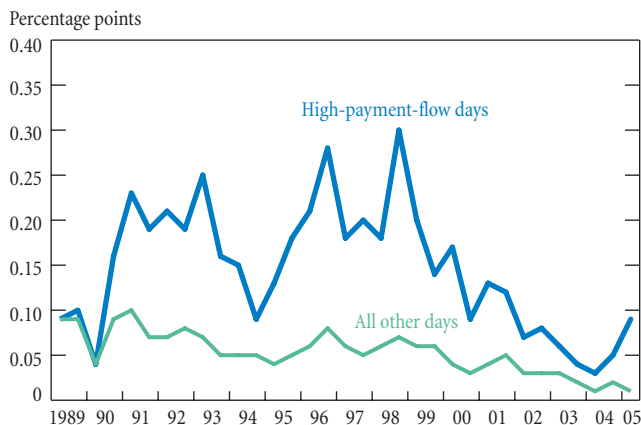
Chart 2  
Semiannual Median of Daily Intraday Standard Deviations



Source: Federal Reserve Bank of New York.

Note: Figures for 2005 are through June 30.

Chart 3  
Semiannual Median of Daily Absolute Deviations of Effective Rate from Target Rate



Source: Federal Reserve Bank of New York.

Note: Figures for 2005 are through June 30.

In contrast, for all other days, the increase in deviations of the effective rate from the target was fairly muted, especially in the 1996-98 period. Moreover, these deviations were more evenly balanced above and below the target. In general, the Desk's ability on these days to keep the rate on average around the target was not seriously impaired by lower requirements, even as intraday rate volatility increased.

**Responses to Rising Rate Volatility**

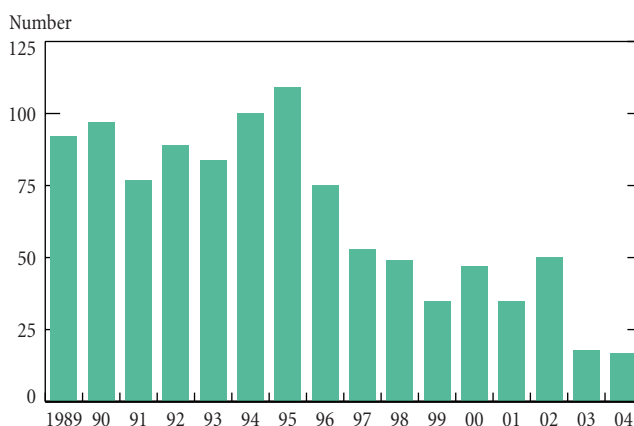
The rise in federal funds rate volatility created by the decline in requirements set in motion a number of responses both within the Federal Reserve and among banks that mitigated the extent of the rise and eventually contributed to a measurable fall in volatility.

In the 1990s, the Fed made several changes to the accounting framework for the reserve maintenance period. In 1992, it liberalized the rules that determine the portion of reserve requirements in one period that a bank may defer until the following period, or the portion of the next period's requirements that a bank may satisfy with excess reserves held in the current period. By increasing the "carryover" limits from 2 percent to 4 percent of the level of reserve requirements, the Fed provided banks with more flexibility to address surprises to their reserve positions on maintenance period settlement days without having to borrow or lend in the funds market.

In 1998, the Fed adopted a *lagged* reserve accounting structure, in which the level of reserve requirements in a two-week maintenance period would be set and become known before the period began. Previously, under the contemporaneous reserve accounting structure, which had been in place since 1984, reserve requirements for a maintenance period were based partly on a bank's deposit liabilities through the first twelve days of the two-week maintenance period itself. This arrangement made it difficult to estimate accurately reserve demand within a maintenance period.

At the same time, the Desk altered some of its daily intervention practices. It became more sensitive to daily patterns of reserve demand, instead of considering just the period-average level of demand determined by the level of requirements. A measurable effect of this greater sensitivity to daily reserve demand was a significant decrease, starting in 1996, in the frequency with which the Desk stayed out of the market and refrained from adjusting the supply of reserves through temporary open market operations (Chart 4). The Desk also started to collect daily reserve position reports from a much larger number of individual banks (see table). The main reason for obtaining this information was to identify banks that had inadvertently held more reserves than

Chart 4  
Number of Business Days When the Trading Desk Did Not Arrange Temporary Open Market Operations



Source: Federal Reserve Bank of New York.

Note: There were about 252 business days each year.

were needed to meet their requirements before the last day of a maintenance period, thereby becoming locked into holding unwanted levels of excess reserves. As the incidence and size of lock-ins grew as a result of the decline in requirements, it became more critical for the Desk to be aware of their size in order to measure accurately the total level of reserves needed over an entire maintenance period.<sup>10</sup> By examining the daily reserve position reports, the Desk also developed a better basis for estimating the daily demand preferences of banks.

Developments in the banking sector also served to limit the rise in funds rate volatility associated with lower requirements, although the evidence here is more fragmentary and anecdotal. Banks active in settling large financial payments on their Fed account took measures to reduce the uncertainty of these payment flows. Enhanced information systems for tracking and anticipating payment flows were adopted by institutions with complex organizational structures.<sup>11</sup> Consolidation in the banking sector may also have improved the overall efficiency with which banks anticipated large

**Daily Reserve Position Reports Collected by the Trading Desk from Large Banks**

	1994	1999	2004
Number of reporting banks	12	31	118
Total value of these banks' requirements (billions of dollars)	6.0	4.5	16.0
Percentage of aggregate total requirements	20	40	65

Source: Federal Reserve Bank of New York.

Note: Shifts in requirements during each year make all figures approximate.

payment flows. In addition, as we observed earlier, large banks took advantage of the Fed's existing, but largely unused, contractual clearing balance program to increase their total requirements.

## Federal Funds Rate Behavior: 2001–Midyear 2005

### The Trend toward Lower Volatility

By 2000, most measures of rate volatility had returned to their pre-1991 levels. Since then, measures of both intraday rate volatility and daily absolute deviations of the effective rate from the target have drifted steadily downward (Charts 2 and 3). This decline in volatility is evident in the measures of rate behavior for both high-payment-flow days and other days. The fall in these measures can be attributed to several factors.

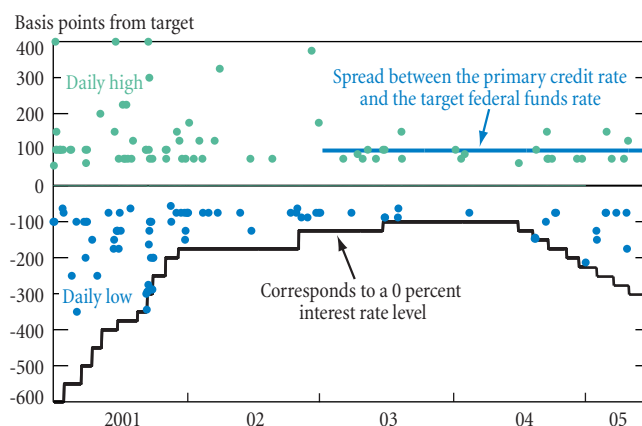
Certain developments that helped bring measured volatility down toward the end of the 1990s have subsequently grown more pronounced, reducing volatility even more. The number of large banking institutions from which the Desk collects daily reserve reports has continued to expand, enabling it to improve further its estimates of period-average and daily demands for reserves (see table). This additional information—along with the further decrease, albeit slight, in the number of days on which the Desk has refrained from adjusting reserve supply through open market operations (Chart 4)—has allowed the Desk to accommodate daily reserve demands better.

The low absolute value of the target federal funds rate has helped reduce rate volatility through indirect and direct channels. Indirectly, it has contributed to lower volatility by stimulating growth in demand for transaction deposits at banks subject to reserve requirements. A lower target funds rate has also decreased the rate of return on reserves held to meet contractual clearing balance requirements, thereby increasing the level of clearing balance requirements that would generate enough income credits for a bank to pay for all the Federal Reserve priced services it uses. As a result, total requirements rose from prevailing levels of around \$13 billion in early 2000 to more than \$20 billion in 2004 (Chart 1). More directly, with the target funds rate at historically low levels through most of 2002–04, the magnitudes of the steepest feasible downward moves in the rate were curtailed by the 0 percent lower bound on interest rates (Chart 5).<sup>12</sup>

Meanwhile, the Federal Reserve's establishment of a primary credit facility in January 2003 appears to have contributed to rate compression from the other direction, by setting an effective upper bound on potential rate movements (Chart 5). On only four days in the period from the facility's introduction to midyear 2005 did the federal funds rate

Chart 5

### Daily High and Low Federal Funds Rates: Deviations of More Than 50 Basis Points from Target



Source: Federal Reserve Bank of New York.

Note: Figures for 2005 are through June 30.

exceed the primary credit rate (and only by a modest amount and for a small volume of trading). On several occasions, upward spikes in the market rate halted exactly at the rate on primary credit. Anecdotally, reserve managers indicate that the primary credit facility has removed some of their inhibitions about borrowing at the discount window. However, in the year or so preceding the introduction of the facility, the market rate rarely had risen as much as 100 basis points above the target funds rate. Given the general absence of market conditions that might lead to discount window borrowing, it is difficult to be certain about the facility's total effect on the behavior of the funds rate.<sup>13</sup>

### Recent Developments

Volatility in the federal funds rate picked up in the second half of 2004. Intraday standard deviations were a bit higher and daily deviations of the effective rate from the target were somewhat greater than before, although both measures of volatility rose only slightly over this period and for the most part are still well below levels prevailing even just a few years earlier (Charts 2 and 3). At least some of the increase in volatility is likely attributable to the higher absolute levels of the target funds rate, which unwound some of the compression in rates that occurred when the target rate was at its lowest levels. Higher rates have also been accompanied by a decline in the level of total requirements.

Also contributing to the observed rise in volatility over the past half year has been the effect on the federal funds rate of episodes of expected monetary policy tightening. In maintenance periods in which a policy change was widely expected, the funds rate tended to move toward the new tar-

get in the days ahead of the actual change, as bank demand for reserves within the maintenance period shifted to take advantage of the anticipated rate change. These effects were confined to the nine maintenance periods (out of twenty-six) since mid-2004 in which a policy change occurred. In all instances, expectations of a policy rate hike were nearly universal just ahead of each FOMC meeting, and the funds rate was pressured up toward the expected higher target rate—and away from the prevailing target—in the days of the maintenance period leading up to each meeting. The Desk has a limited ability to counteract the effects of these expectations because banks can substitute reserve holdings between different days of the same maintenance period.

### Prospects

This article has examined the key factors influencing federal funds rate volatility from 1989 to midyear 2005. Looking ahead, we note that if interest rates were to move above current levels, volatility may also increase further because the potential range for interest rate movements in the federal funds market will expand. In addition, because of the way in which total requirements are currently structured, higher interest rates could heighten volatility by further reducing reserve requirements and clearing balance requirements.

However, even if intraday volatility and deviations of the effective federal funds rate from the target were to rise under these circumstances, volatility would likely retrace only a portion of the decline recorded over the past four years because other developments that have reduced volatility would remain in place. These include the Federal Reserve's move to lagged accounting for reserve requirements, the high frequency of intervention by the Desk, its improved ability to estimate daily reserve demands, and banking sector trends that appear to have reduced bank uncertainty associated with payment and settlement flows. Furthermore, although its potential effect on rates has not been fully tested, the Fed's primary credit facility could mute any tendency for rate volatility to increase.

### Notes

1. We use year-end 2000 as our break point because it marks the onset of a period of decline in most measures of federal funds rate volatility.
2. Although the federal funds market is largely an interbank market, government securities dealers and certain federal government agencies that maintain accounts at the Fed are active lenders in the market.
3. A gradual shift in operating procedures toward implicit adoption of a target level for the federal funds rate occurred during the 1980s and was effectively

completed by 1989. See Meulendyke (1998, chap. 2) for a description of the evolution of the FOMC's operating targets.

4. An overview of the Desk's operating practices is found in Federal Reserve Bank of New York (2005, pp. 1-2); for a more detailed description, see Krieger (2002, pp. 73-4).
5. Descriptions of these requirements and the administration of the discount window are found in Board of Governors of the Federal Reserve System (2005, chap. 3).
6. Further detail on the structure of total requirements, including clearing balance requirements, can be found in Bennett and Peristiani (2002). The authors also describe the reductions in reserve requirement ratios and the effect of retail sweep accounts in lowering the total level of requirements in the 1990s.
7. Individual daily outlier observations from the federal funds market sometimes significantly affect average values, even over semiannual time intervals. Accordingly, our analysis uses median values because they provide a better sense of the typical or prevailing levels for our measures of funds rate behavior. However, median values may not always reflect some short-lived episodes of heightened rate volatility.
8. The sensitivity of total requirements to the level of interest rates can be seen from the inverse relationship between total requirements and the target funds rate depicted in Chart 1.
9. The link between reductions in reserve requirements and federal funds rate volatility is discussed in Bennett and Hilton (1997), Bennett and Peristiani (2002), and Krieger (2002).
10. In the absence of this information and prior to the sizable declines in requirements in the 1990s, the Desk implicitly assumed that lock-ins were not significant. Thus, for a time as lock-ins became larger (as requirements decreased) but still went unrecognized, there was a greater potential for the Desk to underestimate final reserve needs late in a maintenance period.
11. Anecdotal reports from bankers suggest that these types of initiatives were part of the general preparations made ahead of the century-date change.
12. By just limiting the *potential* size of any rate decline that could occur, a low absolute level of rates might help reduce rate volatility on days when market participants are uncertain about their prospects for accumulating excess reserves.
13. Under some circumstances, the impact on rate volatility of the shift to the primary credit facility is ambiguous. The highest potential rate ever likely to develop in the market may be lower under the primary credit facility arrangement. However, market rates would normally have to be 100 basis points above the target before a bank would choose to borrow at the discount window. In contrast, under the old discount window arrangements, some banks were willing to borrow when market rates reached a level that was less than 100 basis points above the target rate, especially if the amount borrowed was large. Other banks, though, would not borrow until market rates had reached much higher levels.

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