

**Implementing Monetary Policy in the United States:  
the Policy Framework and Operating Procedures**

**Federal Reserve System Staff**

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## **Implementing Monetary Policy in the United States: the Policy Framework and Operating Procedures<sup>1</sup>**

### **I. Introduction and Summary**

This paper describes the Federal Reserve's current approach to implementing monetary policy, along with the framework of reserve requirements and contractual clearing balances in which the Open Market Desk at the Federal Reserve Bank of New York operates. The paper treats the major factors that determine the demand for balances held in accounts at the Federal Reserve Banks, the procedures and operations the Desk uses to manage the supply of balances, and the resulting equilibrium in the federal funds market. It then discusses the strengths and shortcomings of the U.S. approach to implementing monetary policy. The paper includes a brief treatment of monetary policy implementation during the period of market turmoil that began in August of 2007.

In short, the Federal Open Market Committee sets the stance of U.S. monetary policy by adopting a target for the federal funds rate that it judges will best achieve its dual objectives of maximum employment and price stability. The Open Market Desk implements U.S. monetary policy by conducting open market operations during the morning of almost every business day in an effort to make each day's total supply of balances in accounts at the Federal Reserve Banks equal to the total quantity that depository institutions would demand that day if the federal funds rate were equal to the target rate set by the FOMC.<sup>2</sup>

The demand for balances equals the sum of pre-determined levels of non-remunerated required reserve balances and implicitly remunerated contractual clearing balances, plus a time-varying level of desired excess reserves. The demand for excess reserves, in turn, normally reflects depository institutions' desire to hold precautionary balances to reduce the risk of having to pay the penalties the Federal Reserve imposes on institutions that incur reserve deficiencies or run overnight overdrafts in the accounts they maintain at their Reserve Banks, and thus reflects institutions' uncertainty about daily debits and credits to their accounts. The desired level of excess reserves varies widely from day to day even in normal times, partly in response to the overall volume of payments flowing through the banking system,

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<sup>1</sup> This paper is background for the FOMC's initial discussion, scheduled for April 30, 2008, of options for implementing new legal authority to reduce required reserve ratios to as low as zero and to pay interest on balances depository institutions hold at the Reserve Banks. The paper was prepared by Steve Meyer (Research Department, Federal Reserve Bank of Philadelphia), Seth Carpenter, Sherry Edwards and Beth Klee (Division of Monetary Affairs, Board of Governors), and Chris Burke and Spence Hilton (Markets Group, Federal Reserve Bank of New York).

<sup>2</sup> The federal funds rate is the interest rate at which depository institutions borrow and lend among themselves, overnight, on an unsecured basis; the "federal funds" they borrow and lend are balances in the accounts they maintain at Federal Reserve Banks.

making it difficult for Federal Reserve staff to predict each day's total demand for balances. In abnormal times, the demand for excess reserves can be elevated by banks' desire for extra liquidity. The supply of balances reflects not only the Desk's operations but also autonomous factors that the Desk does not control; these factors can make the supply of balances deviate from the level the Desk sought to provide. Even so, the supply generally is close to the quantity demanded at the target rate and the daily effective federal funds rate (the average rate at which federal funds are lent during the course of a day) usually is within a few basis points of the target set by the FOMC. Moreover, both intra-day volatility and day-to-day fluctuations of the funds rate normally are quite small.

While federal funds generally trade at rates quite close to the target rate, unintended mismatches between the demand for and supply of balances sometimes are large enough to cause the funds rate to spike up or down toward the end of the business day. The Federal Reserve's primary credit facility helps contain upward spikes, but depository institutions' evident reluctance to borrow from the primary credit facility, particularly during periods of financial stress, means that the federal funds rate sometimes goes well above the primary credit rate. The Federal Reserve currently has no mechanism for absorbing an excess supply of balances that becomes apparent during the afternoon, so the federal funds rate occasionally drops well below the target in late trading.

The environment in which the Federal Reserve implements U.S. monetary policy includes a complex and costly system of largely-avoidable reserve requirements that dates from the Monetary Control Act of 1980 and is in part a legacy of the 1979-1982 period during which the FOMC targeted money growth and the Desk employed a reserves-based operating procedure. The Federal Reserve Act does not currently authorize the payment of interest on balances held at the Federal Reserve Banks, so balances held to meet reserve requirements earn no interest. Accordingly, depository institutions use a variety of costly reserve avoidance mechanisms that distort the menu of liabilities they offer and substantially reduce the level of reservable deposits on their balance sheets. Even so, depository institutions devote significant resources to complying with reserve requirements and the Federal Reserve expends considerable resources on monitoring and ensuring compliance. The complex structure of reserve requirements and the inability to pay interest on reserve balances have not prevented improvements over time in the techniques used to implement U.S. monetary policy, but they have ruled out some approaches used effectively by other central banks.

Recently enacted legislation gives the Federal Reserve new authority, effective October 1, 2011, to reduce reserve requirements to as low as zero and to pay interest on balances that depository institutions hold at the Reserve Banks. This new authority gives the Federal Reserve an opportunity to simplify the environment in which it implements monetary policy and the procedures the Desk uses to keep the

federal funds rate close to target. One objective might be to reduce the regulatory burdens, distortions in resource allocation, and deadweight losses that result from the current system of reserve requirements and the associated reporting, monitoring, and enforcement regime. Other objectives might be to eliminate infrequent large deviations of the effective federal funds rate from target, or to damp occasional large end-of-day movements in the funds rate.

We turn next to a detailed discussion of factors that affect the demand for balances in accounts at the Reserve Banks, of tools the Federal Reserve uses to manage the supply of those balances, and of relevant aspects of the environment in which depository institutions and the Federal Reserve operate. An appendix uses an illustrative analytic framework to help draw out the implications of these details—and of some potential changes—for equilibrium in the federal funds market.

## II. Factors Affecting the Demand for Federal Reserve Balances

Depository institutions hold balances at the Federal Reserve Banks to satisfy reserve requirements and to settle interbank and bank-to-government payments that arise from a wide variety of transactions they and their customers undertake. To avoid incurring penalties for reserve deficiencies or inadvertent overnight overdrafts, many institutions routinely hold balances larger than their minimum required levels.

During 2007, about 7,100 depository institutions had accounts at a Federal Reserve Bank and held total end-of-day balances averaging \$15.1 billion per day. Balances held to meet reserve requirements averaged about \$6.9 billion while balances held under contractual clearing balance arrangements (explained later) averaged approximately \$6.7 billion. In addition, depository institutions held excess reserves averaging about \$1.5 billion per day. The demand for balances is far from constant; it rises by several billion dollars or more at quarter-end and on other high-payment-flow days, and subsequently declines.

**A. Reserve Requirements.** The current structure of reserve requirements is rooted in the Monetary Control Act of 1980 (MCA). The MCA extended reserve requirements to all U.S. depository institutions. Previously, the Federal Reserve was not able to impose reserve requirements on U.S. depository institutions that were not members of the Federal Reserve System.<sup>3</sup> The rationale for universal reserve requirements was to facilitate closer control of the M1 money aggregate at a time when the Federal Reserve was targeting M1 growth and using a reserves-based operating procedure to implement monetary policy. Though M1 and the other monetary aggregates have long been deemphasized as a guide for monetary policy,

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<sup>3</sup> The *International Banking Act* of 1978 had given the Fed authority to impose reserve requirements on U.S. branches and agencies of foreign banks and certain domestic banking entities that engage in international transactions.

reserve requirements and the reserves-based operating regime, along with the infrastructure for collecting deposit data and ensuring compliance with reserve requirements that was established in 1980, remain largely intact today. The next four paragraphs summarize the current U.S. reserve requirement regime. Full detail is available in the 135-page *Reserve Maintenance Manual*.

The MCA allows the Federal Reserve Board to impose reserve requirements solely for the purpose of implementing monetary policy. The Act specifies the liabilities on which the Board may impose reserve requirements and sets ranges within which reserve requirement ratios must lie. It sets a range of 8 to 14 percent for the ratio on transaction deposits (this range will become 0 to 14 percent on October 1, 2011) and a range of 0 to 9 percent for the reserve requirement on nonpersonal time deposits (including nonpersonal savings accounts). The Act does not allow a reserve requirement on personal time deposits. The MCA gives the Board authority to impose reserve requirements on the net liabilities that depository institutions in the United States owe to foreign affiliates or other foreign banks. It also permits the Board, under extraordinary circumstances and after consulting with Congress, to establish supplemental and emergency reserve requirements; these powers have not been used.

Reserve requirements are structured to bear less heavily on smaller institutions. The MCA placed a lower required reserve ratio on the first \$25 million of transaction accounts (the low reserve tranche) and mandated that the amount be indexed each year to the growth in these accounts. The Garn-St Germain Depository Institutions Act of 1982 exempted the first \$2 million of reservable liabilities from reserve requirements (the exemption amount); this amount also is indexed. The following table shows 2008 required reserve ratios.

## Reserve Requirements in 2008

Type of liability	Requirement	
	Percentage of liabilities	Effective date
Net transaction accounts		
\$0 to \$9.3 million	0	12-20-07
More than \$9.3 million to \$43.9 million	3	12-20-07
More than \$43.9 million	10	12-20-07
Nonpersonal time deposits	0	12-27-90
Eurocurrency liabilities	0	12-27-90

Each institution's reserve requirement is based on deposit data reported by that institution. Roughly 3,300 larger depository institutions must submit daily data on their deposit and vault cash levels to their Reserve Bank each week. (The Federal Reserve collects daily data to limit depository institutions' ability to avoid reserve requirements by shifting liabilities from reservable to nonreservable accounts on reporting dates, and to reduce the volatility in reported deposits that could result from using a single day's value.) The reserve requirement for each of the larger institutions is based on the average of its reported deposit levels over the fourteen-day reserve computation period ending every second Monday; that computation period spans two one-week reporting periods. Regulation D provides that each of these institutions must satisfy its reserve requirement over a fourteen-day reserve maintenance period that begins seventeen days after the computation period ends.

By law, the Federal Reserve's mandatory reports must impose a smaller burden on depository institutions with reservable liabilities below the exemption amount than on those with reservable liabilities above the exemption amount. About 5,200 smaller depository institutions are required to submit daily data for one week each quarter. These data are used to calculate reserve requirements that the institutions will have to meet during a sequence of consecutive seven-day maintenance periods. The first of these periods begins on the fourth Thursday following the end of a quarter's computation period; the last ends on the fourth Wednesday after the close of the next quarter's computation period. Another 8,900 very small depository institutions have zero required reserves and must report their deposits once per year or not at all.

Approximately three-fourths of the 3,300 larger institutions and nearly 90 percent of the 5,200 smaller institutions meet their reserve requirements by holding vault cash equal to or greater than their required reserves.<sup>4</sup> About 1,500 institutions hold vault cash in amounts smaller than their reserve requirements; each must meet the remainder of its requirement by holding a positive end-of-day balance, called a required reserve balance, in its account at a Federal Reserve Bank or a correspondent bank (which holds an equal amount in its account at a Reserve Bank on behalf of the respondent). Each institution satisfies its reserve requirement if the average of its end-of-day balance on each day of the reserve maintenance period is sufficiently close to its required reserve balance.<sup>5</sup> An excess or deficiency up to 4 percent of the requirement can be carried over to the next maintenance period.<sup>6</sup> Any excess or

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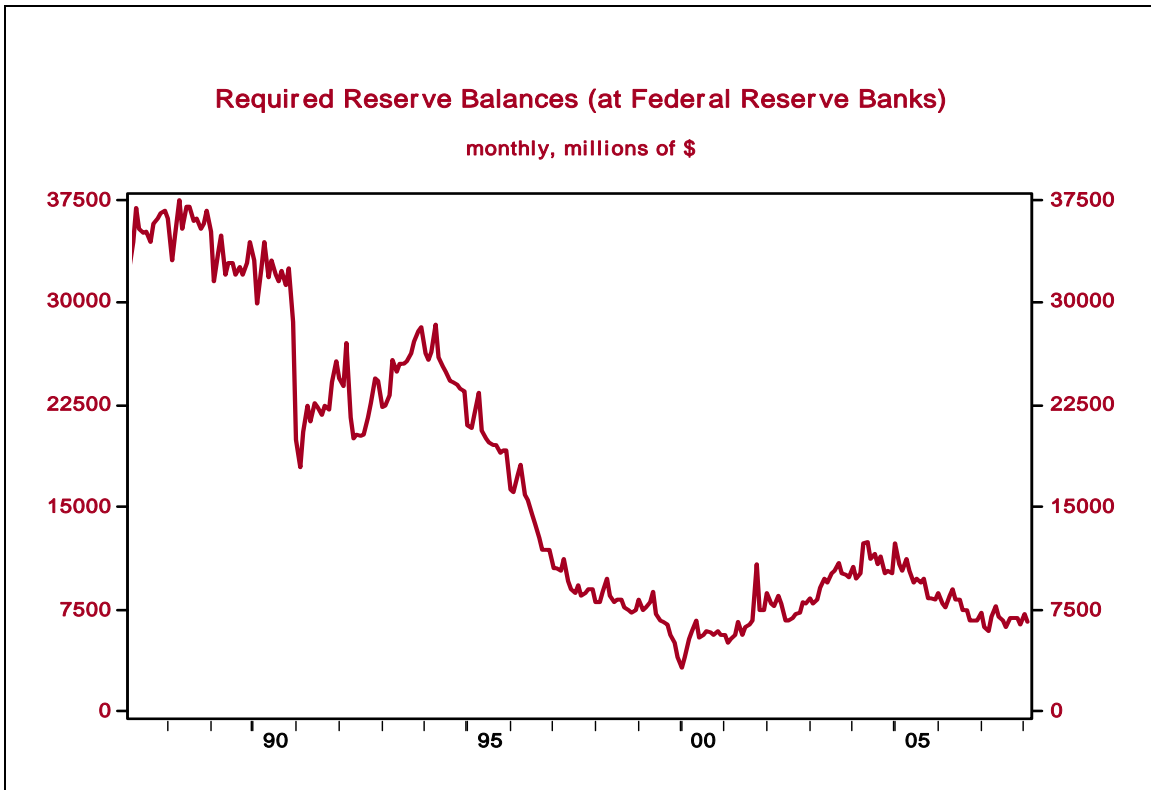
<sup>4</sup> The Federal Reserve and the Swiss National Bank appear to be the only central banks that allow depository institutions to use vault cash to meet reserve requirements. Swiss banks hold roughly equal amounts of vault cash and balances at the SNB. U.S. banks hold nearly six times as much vault cash as reserve balances

<sup>5</sup> Friday's end-of-day balance counts for Saturday and Sunday, too. Hence Friday's balance receives three times the weight, in calculating the maintenance period average, of another day's balance.

<sup>6</sup> Vault cash in excess of an institution's reserve requirement is not considered excess reserves and cannot be applied against the next maintenance period's reserve requirement.

deficiency must be used or covered in that next period. Any deficiency that cannot be carried forward, and any deficiency that is carried over but not covered in the next period, is charged a penalty equal to the deficiency multiplied by the primary credit rate plus 1 percentage point.

**B. Retail Sweep Programs.** Although reserve requirement ratios have not changed since the early 1990s, the level of required reserve balances has fallen considerably because of depository institutions' widespread implementation of retail sweep programs. Under such a program, a depository institution shifts amounts above a predetermined level out of depositors' checking accounts into special-purpose money market deposit accounts (or, in some cases, money market mutual fund accounts) that the institution creates and links to depositors' checking accounts. In this way, the depository institution shifts funds from an account that is subject to reserve requirements to one that is not and therefore reduces its reserve requirement. The depository institution can thereby lower its required reserve balance, on which it earns no interest, and buy interest-earning assets with funds that it otherwise would have to hold in a non-interest-bearing account at the Federal Reserve. Largely because of the spread of retail sweep programs, required reserve balances have declined by nearly 75 percent since 1993, from about \$26 billion to their current level of somewhat less than \$7 billion.



**C. Contractual Clearing Balances.** During the business day, depository institutions use their Federal Reserve accounts to settle large numbers of financial

transactions including real-time funds transfers via Fedwire, payments that result from securities purchases and sales, and credits and debits for checks processed by the Federal Reserve Banks. Depository institutions have limited ability to predict the volume and timing of the transactions that clear through their accounts every day, and know that some non-Fedwire debits or credits can be posted to their accounts after the end of the business day, so they seek to hold an end-of-day balance that is high enough to protect against unexpected debits that could leave their accounts overdrawn at the end of the day and trigger overnight overdraft fees. (Overnight overdraft fees are assessed at a rate 4 percentage points above that day's effective federal funds rate on the amount of the overnight overdraft.) If a depository institution finds that targeting an end-of-day balance just large enough to meet its reserve requirement provides insufficient protection against overdrafts, it may hold excess reserves or establish a contractual clearing balance.

A contractual clearing balance, also called a required clearing balance, is an amount exceeding its required reserve balance that a depository institution commits to hold at its Reserve Bank. The institution accrues earnings credits (at a rate equal to 80 percent of the yield on three-month Treasury bills) on the balance it holds to meet the contractual commitment. Institutions use earnings credits to defray the fees they are charged for the Federal Reserve services they use, including check clearing and wire transfers of funds and securities. Earnings credits larger than the fees an institution incurs by using the Federal Reserve's priced services are of no value to the institution because they cannot be paid in cash. Clearing balances, like other funds in the institution's account, are used during the business day to make payments.

An institution satisfies its clearing balance requirement so long as the maintenance-period average of its actual clearing balance (the actual balance in its account minus its required reserves balance) falls within a narrow band. The top and bottom of the band lie \$25,000 or 2 percent (whichever is greater) above and below the institution's contractual clearing balance. The institution earns no credits on amounts in excess of the band. If an institution's clearing balance falls below the bottom of the range, it is assessed a fee equal to 2 percent of the shortfall for a deficiency up to 20 percent of the contractual balance and 4 percent for the amount over 20 percent. There is no carryover privilege for contractual clearing balances.

As noted earlier, the spread of retail sweep programs after the mid-1990s reduced required reserve balances and left many banks with insufficient protection against overnight overdrafts; banks responded by establishing or expanding contractual clearing balances. As indicated in the figure on the next page, the growth in contractual balances did not match the decline in required reserve balances; banks apparently did not need as large a balance to protect against overnight overdrafts as they once needed to meet reserve requirements. The result is that total required balances (required reserve balances plus contractual clearing balances) have declined by more than half since the early 1990s (to a bit less than \$14 billion in 2007) despite



the very substantial increase in bank deposits and in the volume of transactions flowing through banks' reserve accounts since then.

**Required Reserve Balances and Contractual Clearing Balances**



**D. Access to intra-day credit.** Rather than relying solely on balances to settle financial transactions, financially healthy institutions that have regular access to the discount window may incur intra-day overdrafts (negative intra-day balances) in their Federal Reserve accounts to facilitate interbank payments. The Federal Reserve provides intra-day credit, also known as daylight credit, to promote a smoothly functioning payments system and avoid payment delays that might result if institutions were unable to make outgoing payments until they had received enough incoming payments to ensure that their account balance never fell below zero.

Depository institutions make substantial use of daylight credit. One measure of usage is the daily sum of depository institutions' average end-of-minute overdrafts. During the first quarter of 2007, this measure averaged \$57 billion per day, nearly four times the level of overnight balances held at the Federal Reserve. It is important to note, however, that there is significant variation in overdrafts during the course of any given day; peak overdrafts are appreciably larger than the average of end-of-minute overdrafts. Peak usage can be measured as the greatest value reached by the sum across all institutions of the end-of-minute overdrafts for a given day. During the first quarter of 2007, this system-wide peak level of daylight overdrafts averaged \$153 billion per day, more than two-and-a-half times the average level of daylight

overdrafts. The peak in daylight overdrafts typically occurs during the late morning. There is sizable usage of daylight credit throughout the business day, though it drops off rapidly in the hour before Fedwire closes at 6:30 p.m.

To give depository institutions an incentive to economize on the use of intra-day credit without forcing them to delay outgoing payments until they have received incoming payments, the Federal Reserve charges for more-than-minimal intra-day overdrafts at a rate of 36 basis points per year.<sup>7</sup> In addition, the Federal Reserve has implemented policies and procedures to limit the credit risk Reserve Banks bear when institutions use intraday credit. Healthy depository institutions routinely are allowed to incur daylight overdrafts as large as 40 percent of their capital. Healthy institutions that need greater amounts of daylight credit to meet their business needs may be allowed net debit caps up to 225 percent of their capital.<sup>8</sup> Net debit caps are not hard limits, but an institution that repeatedly incurs overdrafts larger than its net debit cap faces administrative penalties that could include revoking the institution's access to daylight credit and rejecting instructions to make payments from the institution's account when the account contains insufficient funds. While standard net debit caps provide sufficient intra-day liquidity to most institutions, a small number experience such large intra-day mismatches between the timing of outgoing and incoming payments that even the highest of the standard caps does not allow them enough intra-day liquidity. These few institutions may pledge collateral to secure daylight overdrafts in excess of their net debit caps, subject to Reserve Bank approval. The Reserve Banks accept the same wide range of assets as collateral for daylight credit as for discount window loans. Though most daylight overdrafts are not explicitly collateralized, many are implicitly collateralized because the Reserve Banks have the ability to claim any collateral that an overdrafting institution has pledged to secure potential discount window borrowing, should it fail before repaying the overdraft.<sup>9</sup>

Providing daylight credit by allowing financially sound depository institutions to run overdrafts in their Federal Reserve accounts reduces institutions' demand for balances. If the Federal Reserve were to provide no daylight credit, the many banks whose required reserve balances are smaller than their need for working balances to clear payments during the business day either would have to hold excess reserves at an opportunity cost equal to the federal funds rate minus the interest rate banks earn

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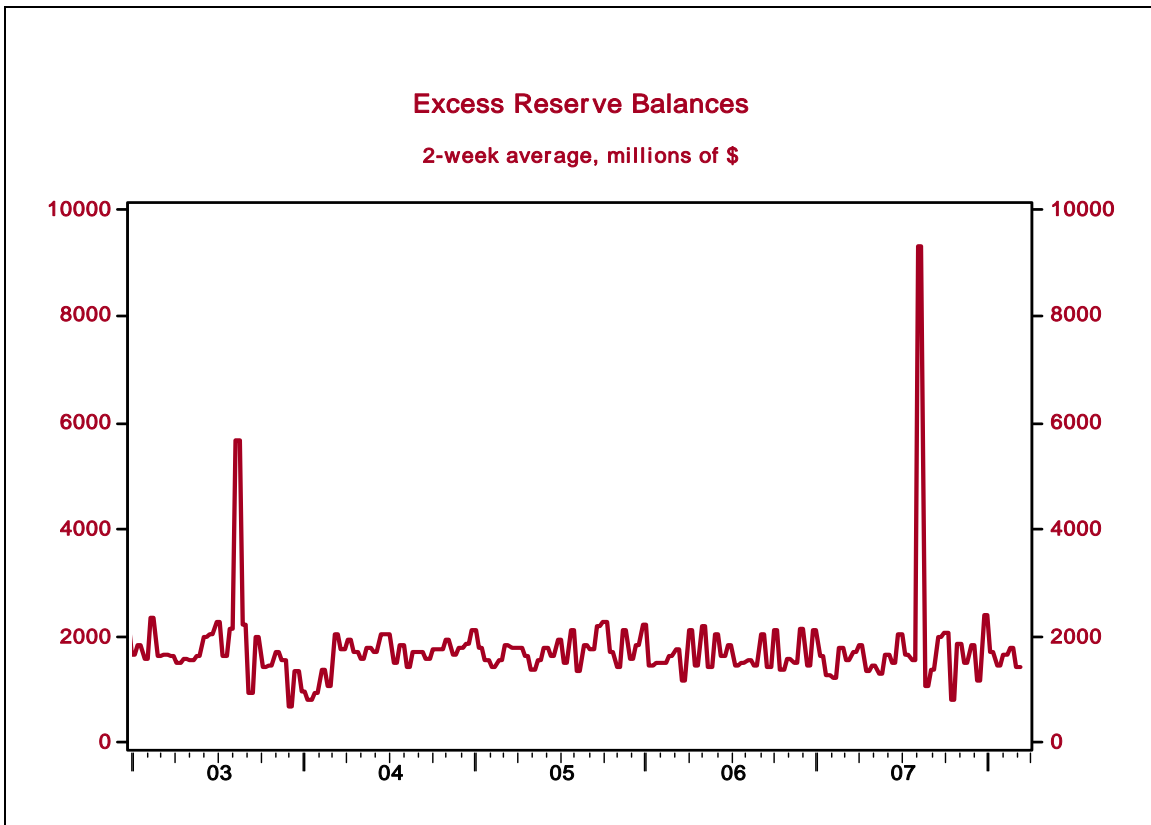
<sup>7</sup> An institution's daily overdraft charge is calculated by taking its average end-of-minute overdraft and multiplying it by the daily effective rate, which is the 36 basis point annual rate adjusted to reflect the 21½ hour Fedwire day and a 360 day year; the resulting number is reduced by a deductible which depends on an institution's risk-based capital position. Fees for using daylight credit totaled about \$65 million in 2007.

<sup>8</sup> For information on net debit caps and the relevant measures of capital, see *Federal Reserve Policy on Payment System Risk* or the more detailed *Guide to the Federal Reserve's Payment System Risk Policy*.

<sup>9</sup> The Federal Reserve has requested public comment on potential changes in its Payment System Risk (PSR) policy; those changes would reduce the fee for explicitly collateralized daylight credit to zero but raise the fee for uncollateralized daylight credit to 50 basis points. For details, see <http://www.federalreserve.gov/newsevents/press/other/other20080228a1.pdf>

on excess reserves (currently zero) or would have to delay making payments during the day until sufficient funds were available in their accounts to settle those payments.

**E. Desired Excess Reserves.** Depository institutions' heavy reliance on daylight overdrafts to make payments during the business day increases the odds that some will end the day with an overdraft. An overdraft that is not covered by the end of the day becomes an overnight overdraft and incurs a penalty at a rate 4 percentage points above the effective federal funds rate on the day of the overdraft. To reduce the risk of incurring penalties, depository institutions hold an average of \$1.5 billion of excess reserves. In general, institutions seek to hold minimal excess reserves because they earn no interest. However, the risk of an overnight overdraft increases on days during which banks process an unusually large volume of transactions, so banks seek to hold larger-than-usual -balances on high-payment-volume days. Small depository institutions tend to hold positive excess reserves every day (perhaps many such institutions do not make extensive use the Federal Reserve Banks' priced services and therefore are not able to benefit from contractual clearing balance arrangements). Large banks typically hold zero excess reserves on average over each maintenance period; they tend to hold very sizable excess reserves (relative to the balances they need to hold to meet their reserve requirements) on high-payment-volume days and negative excess reserves on other days. The magnitude of this daily variation in demand for balances is difficult to predict accurately.



**F. The Monetary Policy Role of Required Reserve Balances and Contractual Clearing Balances.** Required and contractual balances facilitate the implementation of U.S. monetary policy in two ways. First, the levels of required reserve balances and contractual clearing balances are determined before each reserve maintenance period, creating a predictable lower bound on depository institutions' maintenance-period-average demand for balances (though allowing institutions to run retail sweep programs and meet reserve requirements with vault cash makes the lower bound small). Second, reserve requirements and contractual clearing balances can be met on average over the reserve maintenance period, not each day, giving institutions considerable flexibility in managing their end-of-day balances and making the demand for balances highly interest-elastic (except on the last day or two of the reserve maintenance period). On days when federal funds trade below the FOMC's target, institutions often seek to hold more than their required balances and typically do so by increasing their net purchases of federal funds. On days when the funds rate is high relative to target, institutions can choose to hold a lower level of balances, and they can lend in the federal funds market even if doing so leaves that day's balance below their requirements. (Institutions know that the Desk will try to return the funds rate to target, so they can plan to hold a larger balance when the funds rate comes back down). This flexibility in managing account balances makes the demand for balances highly elastic and thus cushions the effect of temporary shortages or surpluses in the supply of balances that would otherwise put pressure on the funds rate. However, the flexibility to hold a low balance is limited, particularly on high-payments-flow days, because holding a low balance raises the probability that the depository institution will incur an overnight overdraft if its account is hit by an unexpected debit late in the day. Indeed, institutions hold much larger balances on high-payments-flow days than on other days; daily demand for balances varied from less than \$10 billion to more than \$30 billion during the past year.

### **III. The Supply of Federal Reserve Balances**

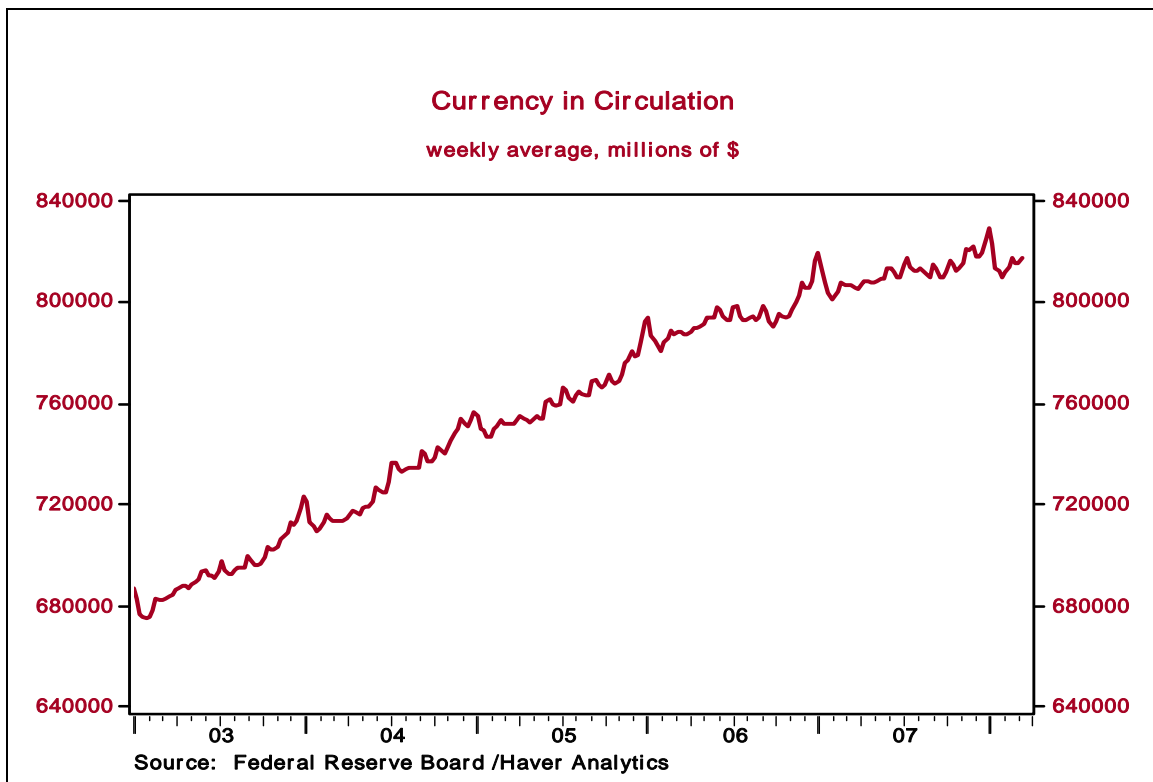
The FOMC has, for many decades, designated the Federal Reserve Bank of New York as its agent to implement monetary policy. The Open Market Desk at the New York Fed buys and sells securities, typically using repurchase agreements but occasionally conducting outright purchases or sales, in an effort to supply a level of balances equal to the quantity banks would demand each day if the funds rate were equal to the target rate set by the FOMC. When the actual supply of balances is close to the quantity demanded at the target rate, the funds rate is close to target.

In discussing the supply of balances, it is convenient to consider first technical factors that affect the supply of balances, then open market operations, and the discount window third. Technical or autonomous factors are items on the Federal Reserve's balance sheet (shown in Appendix A) that the Desk does not control directly but that cause changes in the aggregate level of balances held by depository institutions. Open market operations are intentional adjustments of the System

portfolio to accommodate changes in the demand for balances, to offset changes in autonomous factors, or to implement changes in monetary policy. The discount window encompasses several programs through which depository institutions (and primary dealers, in the current unusual and exigent circumstances) can borrow directly from the Reserve Banks.

**A. Autonomous Factors.** The autonomous factors that have large effects on the supply of balances are currency in circulation, statement float, the Treasury's balance at the Federal Reserve, and the foreign repurchase agreement pool. Because autonomous factors affect the supply of balances but are not directly controlled by the Desk, forecasts of each must be made in order to plan open market operations.

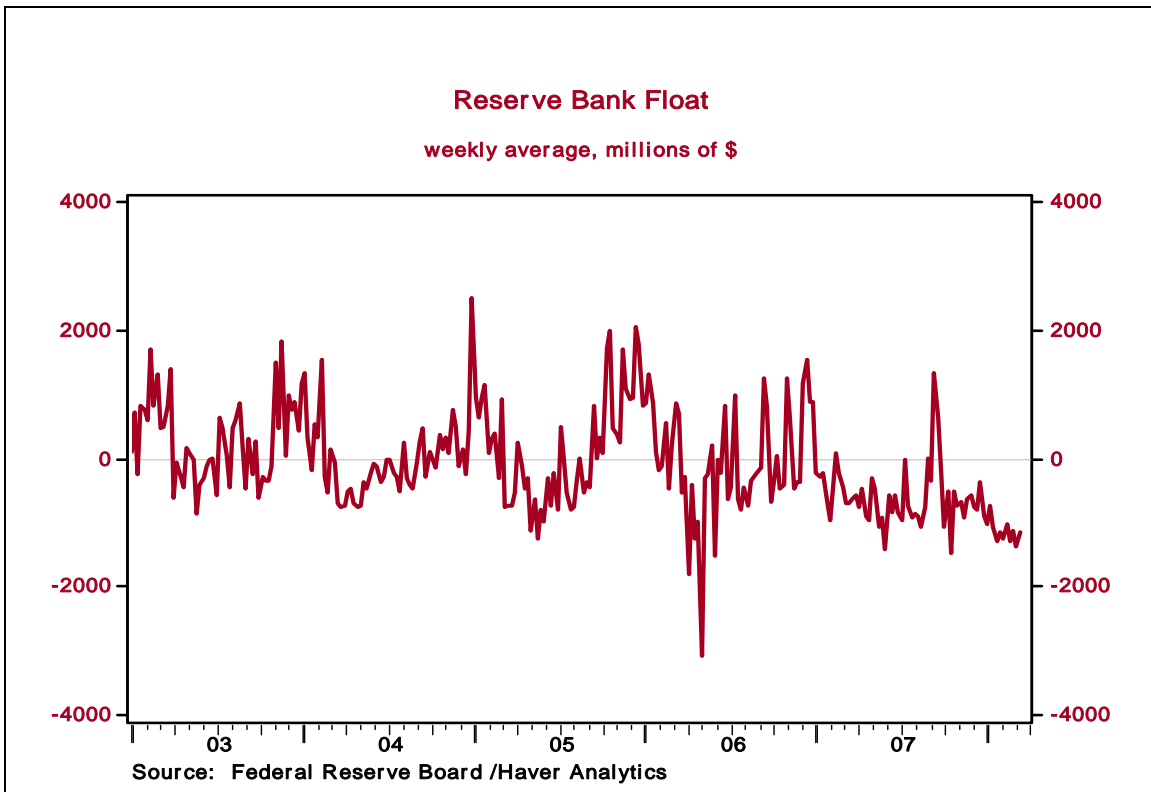
*Currency in Circulation.* When a depository institution orders currency from a Reserve Bank, the Bank ships Federal Reserve notes to the institution and debits the institution's Federal Reserve account. Consequently, an increase in currency in circulation reduces the level of balances held in depository institutions' accounts at the Reserve Banks. Similarly, when an institution finds that it is holding more currency in its vaults than it needs, it ships the excess currency to a Federal Reserve Bank; the Reserve Bank credits the institution's account, raising the level of balances.



Currency is by far the largest autonomous factor, with a current level of about \$750 billion. It has a rising trend and grew at an average 4.5 percent annual rate (about \$31 billion per year) during the past four years. Holidays generate pronounced

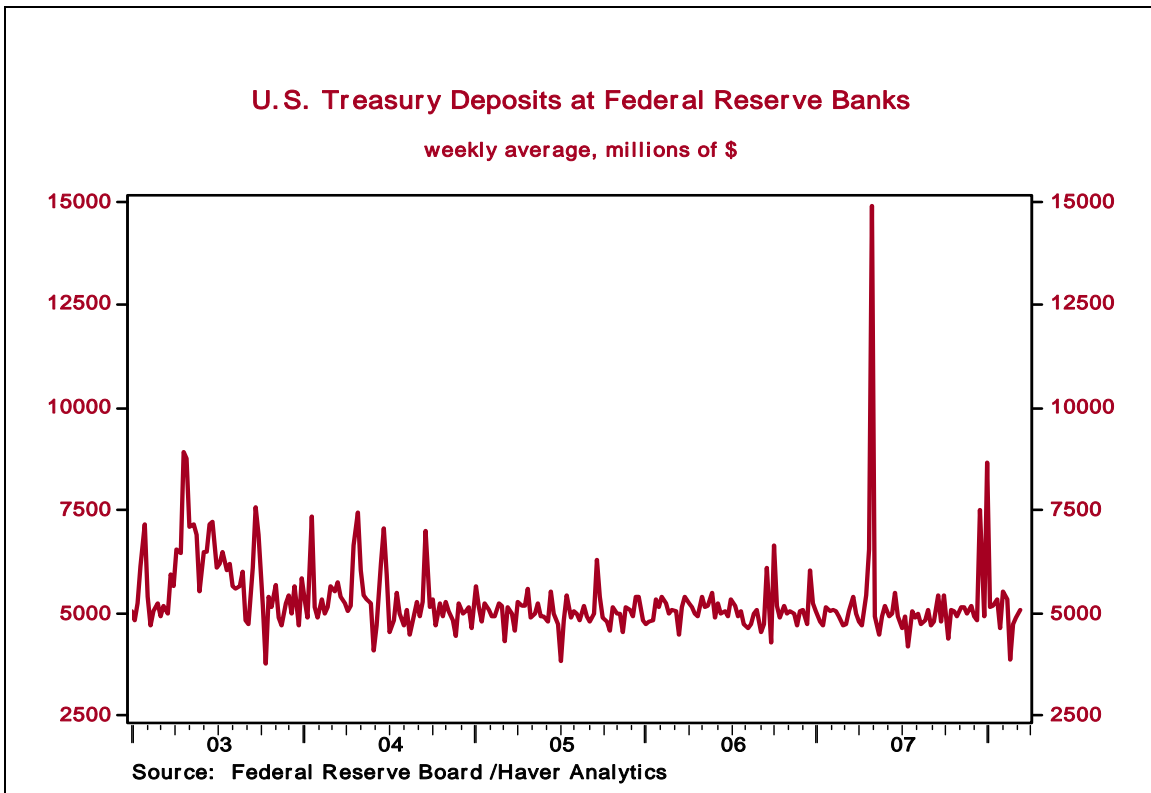
but temporary changes in currency in circulation, with an increase preceding holidays and a reflow of currency to the Federal Reserve Banks afterwards. The biggest seasonal swing occurs during the holiday shopping season in the last two months of the year. Currency in circulation also displays considerable daily variation; the absolute value of the daily change in currency in circulation has averaged about \$900 million in recent years. The pronounced seasonal patterns make changes in currency in circulation predictable to a large extent; the absolute value of the Board staff's same-day errors in forecasting daily changes in currency in circulation averaged about \$170 million from mid-2006 to mid-2007.

*Float.* "Statement float" primarily reflects a mismatch in the timing of the credits and debits to Federal Reserve accounts that result from the Reserve Banks' check clearing function. Reserve Banks make payment for checks they clear a fixed number of days after the checks are delivered to the Reserve Bank. If operational problems or bad weather delay the presentment of checks to the paying institution, the credit to the receiving institution's account may be posted one or more days before the matching debit is posted to the paying institution's account. When that happens, the total level of balances is higher than it would be if the credits and debits were posted on the same day. At other times, checks are presented to the paying institution, and its account is debited, a day before credit is posted to the receiving institution's account; the result is negative float and a lower level of balances. Float averaged about -\$265 million per day from mid-2006 to mid-2007.



The level of float generally is quite small, but occasional spikes can raise float by several billion dollars for a day or two. Changes in statement float are not readily predictable; the absolute value of the staff's same-day errors in forecasting daily float averaged nearly \$500 million from mid-2006 to mid-2007.

*Treasury Balance.* The Treasury General Account (TGA) is the account the U.S. Treasury maintains at the Federal Reserve. The vast majority of the Treasury's revenues eventually are collected into the TGA and its payments are made from the TGA. Taxes and other receipts that flow from the private sector to the Treasury first are collected in accounts (Treasury Tax and Loan, or TT&L, accounts) the Treasury maintains at a variety of depository institutions and then are transferred from those institutions' accounts at the Reserve Banks into the TGA; that transfer reduces the level of balances in depositories' accounts. Conversely, funds flow out of the TGA and into the accounts of depository institutions when the Treasury makes payments. Typically, the Treasury aims to transfer enough cash from TT&L accounts into the TGA each day to match the day's payments and leave its end-of-day balance equal to \$5 billion.<sup>10</sup> When it succeeds, the Treasury avoids causing a change in the aggregate level of balances in depository institutions' Federal Reserve accounts.



<sup>10</sup> The Treasury targets a \$5 billion balance so that it will not incur an overdraft in the TGA when payments from the TGA inadvertently are larger than the inflow of funds into the TGA.

As shown in the preceding figure, the Treasury generally comes close to maintaining a \$5 billion balance; the mean of the absolute value of daily deviations from that target was somewhat less than \$400 million from mid-2006 to mid-2007. But deviations can be an order of magnitude larger (and are much more difficult to forecast accurately) on days when large tax payments flow into the Treasury. The balance in the TGA can rise by several billion dollars on such days, sharply reducing the aggregate supply of balances in depository institutions' accounts.

*Foreign Repo Pool.* As a courtesy to foreign monetary authorities and some international organizations, the Federal Reserve Bank of New York provides a repurchase agreement (“repo”) facility for these entities to invest, on an overnight basis, U.S. dollars that otherwise would remain in the non-interest-bearing accounts they maintain at the New York Fed. These foreign entities enter into an overnight repurchase agreement with the System Open Market Account, temporarily acquiring interest-bearing securities in exchange for cash. An increase in the amount of funds invested in this “foreign repo pool” reflects an increase in funds in the accounts foreign official institutions maintain at the New York Fed; those funds, in turn, were transferred from depository institutions' accounts at the Reserve Banks into the foreign institutions' accounts, so an increase in the size of the foreign repo pool is associated with a drain of balances from the banking system. Conversely, a decrease in the pool is associated with an increase in balances held by depository institutions. Recently, the level of the foreign repo pool has been about \$35 billion. Daily changes average somewhat more than \$800 million in absolute value but often are known early in the day; the mean of same-day errors in projecting the supply of balances due to daily changes in the foreign repo pool is about \$200 million.

**B. Open Market Operations.** The Desk conducts open market operations (purchases or sales of securities) almost every morning. These operations are efforts to adjust the supply of balances in a manner that will keep the federal funds rate at or close to the target set by the FOMC.

Open market operations can be classified as permanent or temporary. Historically, permanent or “outright” operations were used mainly to address a recurring need to accommodate the upward trend in demand for U.S. currency; this year, the Desk has sold \$58 billion of Treasury bills and coupons to offset part of the persistent increase in supply of balances that has resulted from the introduction and expansion of the Term Auction Facility, creation of the Primary Dealer Credit Facility, and substantial expansion of 28-day repurchase agreements. The Desk almost always sizes its outright operations so as to leave the supply of balances below the quantity demanded. The Desk then employs repurchase agreements to supply the remainder of the need, to offset temporary fluctuations in autonomous factors, and to accommodate temporary changes in the demand for balances.



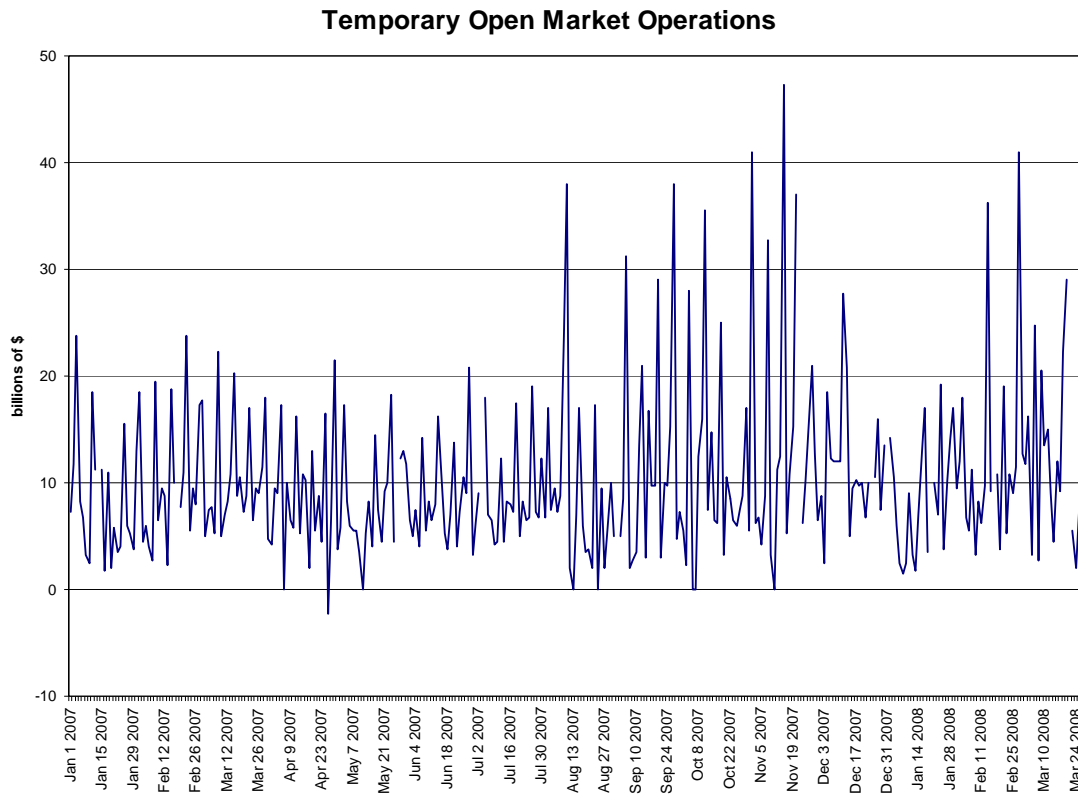
Currently, the Desk conducts outright operations only in U.S. Treasury debt, usually for next-day settlement. To avoid distorting prices in the secondary market for U.S. Treasury debt, the Desk holds no more than 35 percent of any particular issue. Normally, the Desk exchanges its holdings of maturing Treasury securities for new issues as the Treasury auctions new debt to replace maturing debt; doing so leaves the supply of reserve balances unchanged. From time to time, however, the Desk redeems maturing securities (i.e., it does not replace maturing securities with new ones) if projections indicate a prolonged need to drain balances or if rolling over the entire maturing amount would violate the 35 percent guideline. During the first few months of 2008, in addition to conducting outright sales, the Desk redeemed \$104 billion of Treasury bills and coupon securities to offset the increase in balances that has resulted from the System's efforts to improve liquidity in term markets.

**C. Operating Procedures.** Each morning, staff at the Desk and the Board of Governors forecast the day's supply of balances by projecting each of the major factors that affect the supply of balances. Simultaneously, staff estimate the quantity of balances that depository institutions will want to hold if the federal funds rate is equal to the target set by the FOMC. When estimating the day's demand for balances, staff consider the likely volume of payments, the level of required reserve and clearing balances, the degree to which requirements have already been met during the maintenance period, and money market trading conditions. The size of the day's planned open market operation is the difference between the estimated quantity demanded at the target rate and the projected supply of balances.

As shown in the figure on the next page, the Desk conducts temporary open market operations almost every morning, typically a repurchase agreement for same-day settlement in an amount between \$2 billion and \$20 billion. Most are for overnight maturity, but the Desk often enters into term repurchase agreements with maturities of two days to two weeks. The daily operation typically is executed around 9:30 a.m., following a consultation between Desk staff and staff in the Board of Governors' Division of Monetary Affairs. In addition, each Thursday, the Desk arranges a two-week repurchase agreement, again for same-day settlement, to address more persistent needs to add balances. These term repos typically total \$5 billion to \$15 billion and are executed around 8:30 a.m. The Desk conducts open market operations in the morning because that is when the repo market among private-sector parties is active. (On normal days, almost all collateral the Desk could accept for repurchase agreements has been pledged by mid-morning.) The Desk conducts its occasional outright purchases or sales after any temporary operations. The Desk conducts its open market operations with the primary dealers as counterparties, almost always using a sealed-bid, discriminatory price auction.<sup>11</sup>

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<sup>11</sup> Primary dealers are dealers in U.S. Treasury securities that elect to make markets for the Federal Reserve and to provide market intelligence as needed. Currently, there are 20 primary dealers. Details about the role of primary dealers and the process to become one are posted on the Federal Reserve Bank of New York's website at <http://www.newyorkfed.org/markets/primarydealers.html>.



The Desk normally executes repurchase agreements against three types of collateral: Treasury securities, debt issued by agencies of the U.S. government, and mortgage-backed securities fully guaranteed by U.S. government agencies. Bids for repurchase agreements against each class of collateral are evaluated against indicative quotes reflecting current market trades; the Desk accepts the highest bids in each class versus that class’ benchmark. The Desk’s infrequent reverse repurchase agreements, which drain balances temporarily, use only Treasury bills as collateral. In 2008, the Desk undertook several \$15 billion, 28-day, “single-tranche” repurchase agreements in which only mortgage-backed securities were pledged as collateral. These were executed around 10:00 a.m. for next-day settlement; the resulting increase in reserve balances was largely or entirely offset by a redemption of maturing Treasury bills or an outright sale of Treasury securities from the SOMA portfolio

**D. Standing Facilities.** The discount window is a final source of balances. Any depository institution that is in generally sound financial condition and has pledged collateral to its Reserve Bank may borrow from the discount window’s *primary credit facility* on a no-questions-asked basis, usually overnight but sometimes for

longer terms, at a rate above the target federal funds rate.<sup>12</sup> In principle, this facility should place an upper limit on the funds rate, but in practice trading in the funds market sometimes occurs at rates above the primary credit rate because many institutions are reluctant to borrow from the Federal Reserve's "lender-of-last-resort" facility. On these occasions, some depository institutions engage in arbitrage, borrowing from the discount window and lending into the federal funds market at a profit. Depository institutions that are not judged to be financially sound may be granted *secondary credit* at a rate 50 basis points above the primary credit rate.<sup>13</sup> A third discount window facility provides *seasonal credit* to small depository institutions that face a sizable and recurring seasonal need for funds; typically these are small banks in agricultural communities. Total borrowing from the discount window averaged about \$200 million per day from mid-2006 to mid-2007 and was concentrated in seasonal credit; extensions of primary credit averaged about \$50 million per day.<sup>14</sup>

In response to increasing illiquidity in term interbank markets and other short-term funding markets, the Board of Governors, on December 12, 2007, announced the establishment of a temporary Term Auction Facility (TAF). Under the TAF, the Federal Reserve auctions term funds (normally 28-day funds) to depository institutions that are eligible to borrow under the primary credit program. At the end of March 2008, \$100 billion of advances were outstanding under the TAF program. On March 16, 2008, the Board of Governors authorized the FRB New York to create a temporary discount window facility (the Primary Dealer Credit Facility, or PDCF) from which primary dealers may borrow at the primary credit rate. Nearly \$33 billion of PDCF loans were on the New York Fed's balance sheet on March 26.

The Federal Reserve Act requires that all discount window lending be "secured to the satisfaction of the Federal Reserve Bank" that makes the loan. Acceptable collateral for discount window loans to depository institutions, including funds advanced under the TAF program, encompasses nearly all assets the law allows those institutions to hold, provided the assets meet regulatory standards for sound asset quality and the Reserve Bank can establish a security interest in the collateral. Thus, eligible collateral for discount window loans is much broader than eligible

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<sup>12</sup> The primary credit rate was 100 basis points above the target federal funds rate from the inception of the primary credit program in January of 2003 through August 16, 2007. The spread dropped to 50 basis points on August 17 and the Federal Reserve extended term loans as part of an effort to improve market liquidity and promote the restoration of orderly conditions in financial markets. The Board approved a request to reduce the spread to 25 basis points on March 16, 2008 and extended the maximum term of primary credit loans to 90 days.

<sup>13</sup> The Federal Deposit Insurance Corporation Improvement Act (FDICIA) of 1991 contains provisions that restrain how long the Federal Reserve may lend to critically undercapitalized institutions. The Federal Reserve has extended very little credit via the secondary credit facility.

<sup>14</sup> Primary credit occasionally is an important source of liquidity for the banking system and the markets. For example, with federal funds trading severely disrupted in the aftermath of the September 11, 2001 terrorist attack on the World Trade Center, depository institutions borrowed about \$44 billion from the primary credit facility on September 12.

collateral for the Desk's repurchase agreements.<sup>15</sup> Credit extended to primary dealers via the PDCF also must be collateralized; a broad range of investment-grade securities for which market prices are available qualifies as acceptable collateral.

From the Desk's perspective in implementing monetary policy, an extension of credit via any of the discount window facilities (primary and secondary credit, seasonal credit, TAF, and PDCF) results in an increase in balances that may need to be offset by conducting an open market operation to drain balances so as to keep the supply of balances from exceeding demand and driving the funds rate below the target set by the FOMC. Indeed, the Desk conducted a number of draining operations during the first quarter of 2008. Amounts to be extended via the TAF are known several days before the advances are made, so TAF credit is always reflected in the daily staff projections of the supply of balances and pose no surprises for the Desk. Ongoing extensions of discount window credit via the other programs also are reflected in the daily projections of the supply of balances; new extensions of credit, if unanticipated, may result in an unintended increase in the supply of balances and softness in the funds rate. On the other hand, when there is an inadvertent shortfall in the supply of balances relative to demand, and thus upward pressure on the federal funds rate, new borrowing from the discount window serves to restrain the increase in the funds rate. In practice, the new discount window facilities have not resulted in an increase in day-to-day volatility of the federal funds rate.

#### **IV. Current Operating Procedures and the Federal Funds Market**

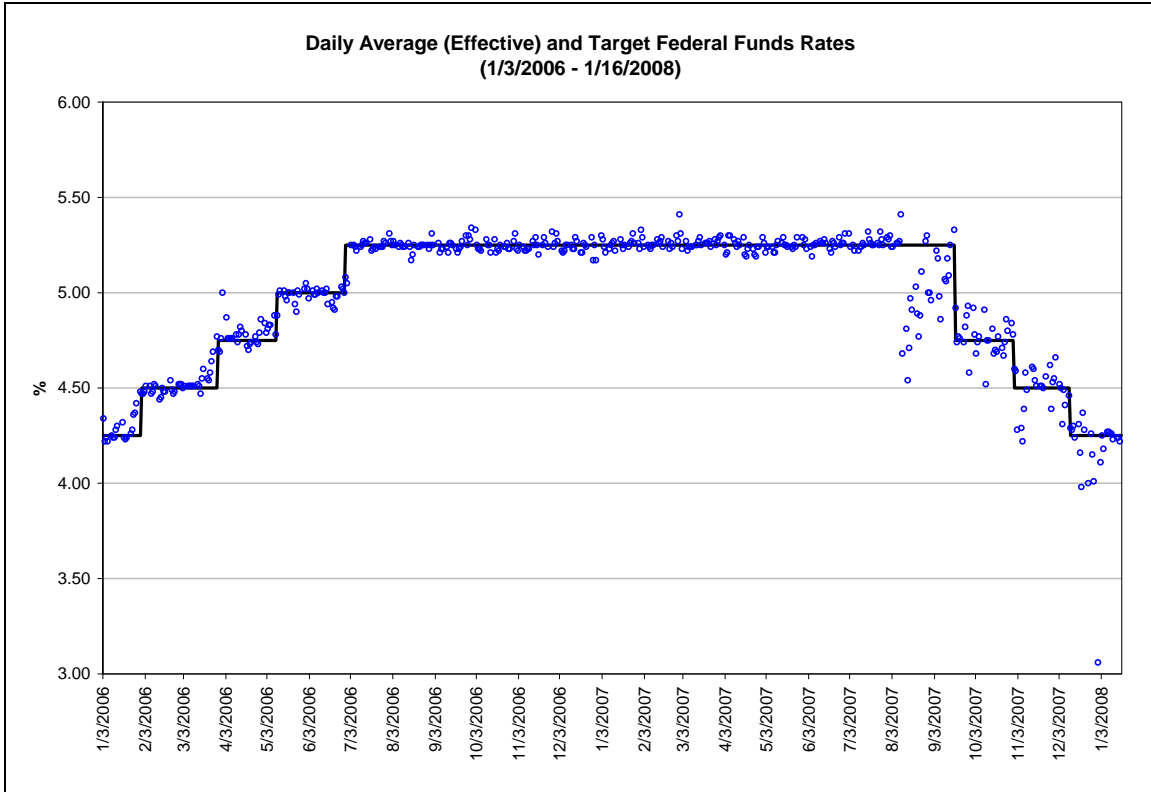
At the end of each FOMC meeting, policymakers issue a directive to the Desk that states “. . . the Committee in the immediate future seeks conditions in reserve markets consistent with maintaining the federal funds rate at an average of around” a stated target (or, if the FOMC changes its target, with increasing or reducing the federal funds rate “to an average of around” the new target). The directive is not explicit with regard to the type of averaging. In practice, the Desk monitors a quantity-weighted average of the overnight federal funds trades conducted through the large federal funds brokers each day (the “effective fed funds rate”) to evaluate the behavior of the funds rate relative to target.

As illustrated in the figure on the next page, the effective rate is almost always quite close to the target rate. From mid-2006 to mid-2007, the mean absolute deviation of the daily effective rate from the target was just above 2 basis points, roughly the same as in earlier years; the same was true on a per maintenance period basis. But during the period of market turmoil from August through December of

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<sup>15</sup> As of the end of 2007, depository institutions had pledged collateral against potential discount window borrowing, including advances under the TAF program, with a market value of \$1.2 trillion and a lendable value (net of haircuts) of \$1 trillion. About 40 percent of that collateral was in the form of marketable securities; about 60 percent was loans the depository institutions had made to their customers.

2007, when many banks sought to be more liquid and became unwilling to lend federal funds until late in the day when they had a good estimate of their likely end-of-day balances, both the intra-day variability in the funds rate and the daily deviations from target were larger than usual. That experience will be discussed later in the paper



**A. The Federal Funds Market.** Federal funds trades are, primarily, loans of balances held at the Federal Reserve Banks by depository institutions doing business in the United States.<sup>16</sup> The vast majority of transactions are for overnight loans with same-day availability; some longer-maturity loans (“term fed funds”) and forward trades also occur. Transactions are uncollateralized and settle over Fedwire (the electronic, real-time, gross settlement payments system operated by the Federal Reserve). Trading in federal funds occurs primarily between 7 and 10 a.m., and between 4 p.m. and the 6:30 p.m. close of Fedwire.<sup>17</sup> About half of federal funds trades settle before 5 p.m.; the remainder settle between 5 p.m. and the close of Fedwire. Standard practice is for overnight fed funds to be returned 22 to 24 hours

<sup>16</sup> In addition, a small number of non-depository financial institutions, including government sponsored enterprises, have Federal Reserve accounts and access to Fedwire and hence are able to participate in the federal funds market.

<sup>17</sup> Fedwire normally closes at 6:30 p.m. Monday through Friday, though the closing time may be extended when depository institutions have a large number of outgoing payments they have not yet processed as 6:30 p.m. approaches. Fedwire reopens for the next day’s transactions at 9:00 p.m. Sunday through Thursday.

after the funds were initially sent; the bulk of fed funds are returned between 4 and 5 p.m. Federal funds can be traded for “early return,” requiring that the funds be returned by a specific time the following day. The interest rate on such transactions typically is several basis points below that on regular return fed funds. Early return transactions represent roughly 10 percent of brokered overnight fed funds trades.

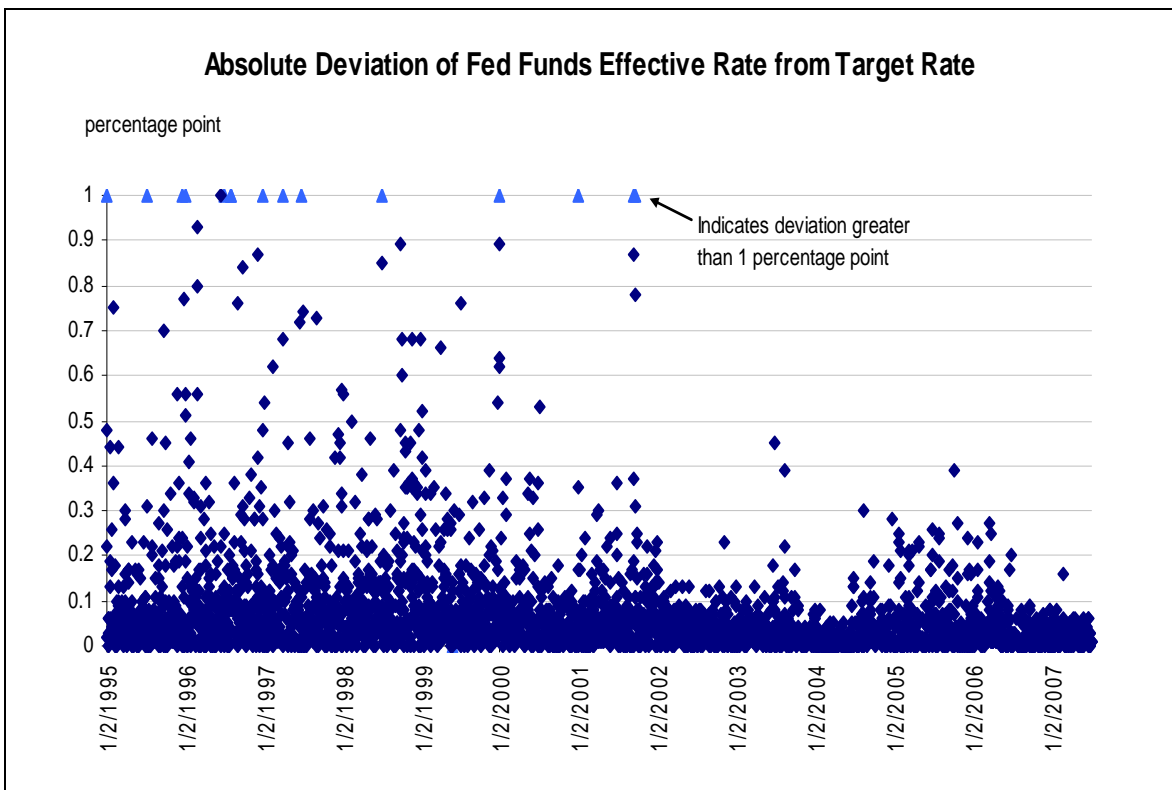
Federal funds can be traded either directly between institutions or through a broker. There are only a handful of fed funds brokers. Participants in the brokered market generally are larger depository institutions that are active in other financial markets or that settle large volumes of payments on behalf of their customers. In direct transactions, one of the counterparties (the lender, or “seller”) is typically a smaller, retail-oriented institution, while the other tends to be a larger institution, also active in the brokered market. Of the roughly 7,100 depository institutions that maintain an account at a Federal Reserve Bank and thus could trade in the fed funds market on their own behalf, two or three hundred actively trade through brokers.

Total overnight fed funds volume varies widely from day to day, but appears to have averaged between \$200 billion and \$250 billion during the past year, roughly fifteen times the average level of balances. The average brokered volume was around \$100 billion, ranging from \$80 billion to \$135 billion over the past year.

The federal funds market is closely linked to the overnight Eurodollar market, which is a substitute source of funds for many larger U.S. banking institutions and for U.S. branches of foreign banks; the *libor* rate and the federal funds rate—both of which are rates on uncollateralized interbank loans—normally are quite close and move together. The collateralized overnight repurchase market can also be a substitute source of short-term funding for U.S. depository institutions, but activity in this market is dominated by non-banking institutions, trading mechanics are quite different, and rates can be heavily influenced by the availability of collateral. Thus the GC (general Treasury collateral) repo rate and the federal funds rate sometimes diverge substantially.

**B. The Behavior of the Federal Funds Rate.** As noted earlier, federal funds generally trade at rates quite close to the target rate; indeed, both intra-day and day-to-day volatility of the funds rate normally are quite small. But mismatches between the demand for and supply of balances sometimes are large enough to cause the funds rate to spike up or down toward the end of the business day. Such mismatches are most likely on high-payment-flow days, when depository institutions need larger working balances during the day than they wish to hold overnight. In addition, the funds rate sometimes spikes up late in the day if a larger than normal fraction of balances is held by small banks that typically do not trade federal funds late in the day.

As indicated by the following figure, fed funds rate volatility relative to target was substantially lower from 2002 through mid-2007 than during the previous ten years. Volatility rose in the early 1990s following a cut in required reserve ratios and the widespread implementation of retail sweep programs. Later, adjustments in the Desk's operating procedures and other developments reduced volatility: The Federal Reserve shifted from contemporaneous to lagged reserve accounting in 1998; the Desk began to monitor more institutions' daily reserve positions to improve forecasts of reserve demand; the Desk now conducts open market operations more frequently; starting in 2003, the primary credit facility has provided balances on days when the federal funds rate is unusually firm; and depository institutions have improved their internal funds management systems. Empirical evidence suggests that remaining day-to-day volatility in the federal funds rate does not affect longer-term interest rates.



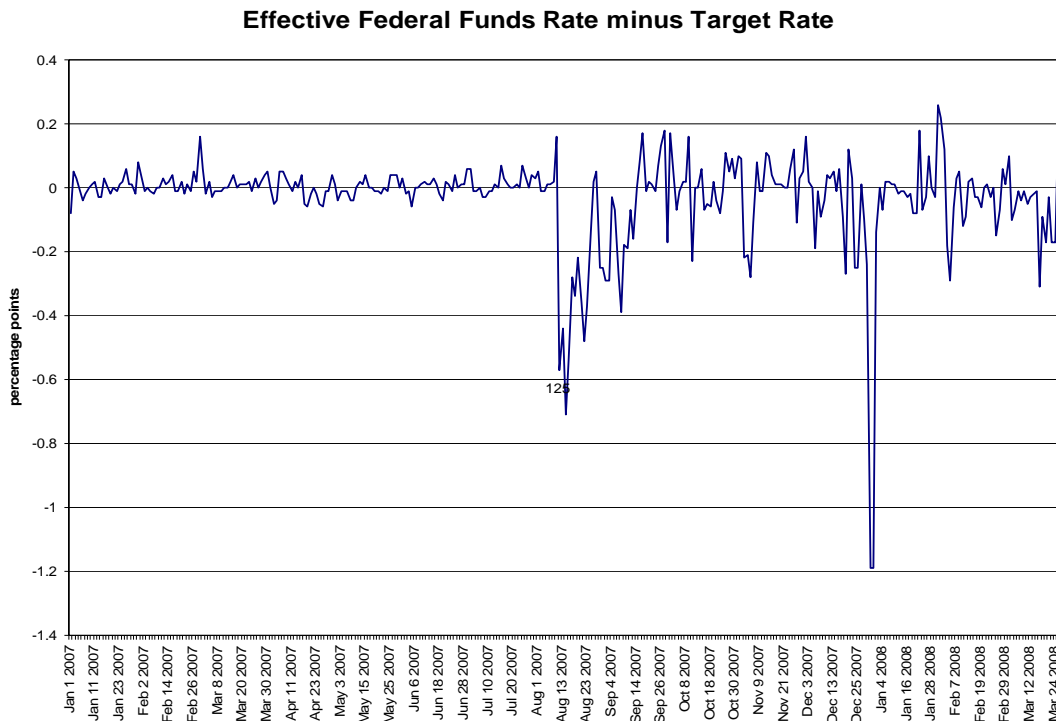
While day-to-day volatility in the federal funds rate is low, there are some recurring patterns in the deviation of the effective rate from the target rate. The demand for balances and the federal funds rate often are soft on Fridays.<sup>18</sup> On high-payment-flow days, such as quarter-end or the day after a holiday weekend, increased demand for balances typically puts upward pressure on the federal funds rate over

<sup>18</sup> Inventory-theoretic models of reserve demand suggest that this pattern reflects an institutional detail: holding excess reserves at the end of the day on Friday means giving up three days of interest, while having an overdraft on Friday night incurs a one-night penalty; thus excess reserves are more expensive relative to overdrafts on Friday than on Monday through Thursday.

much of the day even though the Desk provides additional balances on such days; the rate also tends to fall late in the day on high-payment-flow days. On the final day of the two-week reserve maintenance period, settlement Wednesday, deviations from the target rate tend to be larger, though with little overall bias in recent years.

Given the averaging of balances for satisfying reserve requirements and clearing balance requirements, well-anticipated changes in the target rate that are expected to occur before the end of a reserve maintenance period can become evident in rates before the expected change. For example, from June 2004 through June 2006, the target rate was increased seventeen times. Each time, the market fully anticipated the 25 basis point increase, and fed funds regularly traded at or near the expected new target rate a day or two before the actual announcement.

**C. Monetary Policy Implementation since August 2007.** The turmoil in interbank markets that began in August of 2007 challenged the Federal Reserve’s standard approach to implementing monetary policy and generated larger than normal intraday and day-to-day fluctuations in the federal funds rate. As shown in the following figure, the Desk’s response to the onset of liquidity pressures left the average funds rate well below target during August and early September. Thereafter, the funds rate was more volatile than usual but the Desk succeeded in keeping the maintenance-period-average of the effective federal funds rate quite close to target.





The onset of market turmoil in August was accompanied by a surge in the demand for balances. The Desk supplied additional balances; excess reserves in the two-week reserve maintenance period ending on August 15 rose to \$9.3 billion from \$1.5 billion in the prior two-week period. Even so, federal funds generally traded firm to the target in the morning; anecdotal evidence indicated that European banks bid aggressively for federal funds early in the day in New York to obtain dollar funding before the end of the business day in Europe. But late in the afternoon in New York, when federal funds trading is largely dominated by domestic banks that, at the time, had substantial excess reserves positions, the federal funds rate often would fall well below target as banks that held larger-than-normal balances during the day sought to “sell” (lend) federal funds rather than hold large non-interest-bearing excess reserve balances overnight.

The high level of excess reserves in the maintenance period ending August 15 generated substantial “carry-in” for the subsequent two-week period, meaning that the banking system as a whole had to hold smaller balances to meet reserve requirements than otherwise.<sup>19</sup> The Desk supplied fewer balances, and excess reserves dropped to just over \$1 billion in the maintenance period ending August 29. Again, the federal funds rate often traded firm to the target in the morning, indicating a shortage of balances, but dropped well below target late in the afternoon on many days, indicating that depository institutions were trying to pare excess balances; the unusual intra-day pattern in the federal funds rate made it difficult to assess the true demand for balances. Moreover, on some days the overnight federal funds rate moved higher late in the afternoon, sometimes rising well above the target rate and even above the primary credit rate. Evident reluctance on the part of some depository institutions to borrow at the discount window meant that the primary credit facility did not effectively cap the federal funds rate.

As a consequence, intraday and day-to-day volatility in the federal funds rate was unusually large during the latter part of 2007; the mean absolute deviation of the daily effective rate from target rose from about 2 basis points during the 12 months from August 2006 through July 2007 to more than 13 basis points during the remainder of 2007. Even so, the overnight federal funds rate averaged quite close to the target set by the FOMC from September through December.

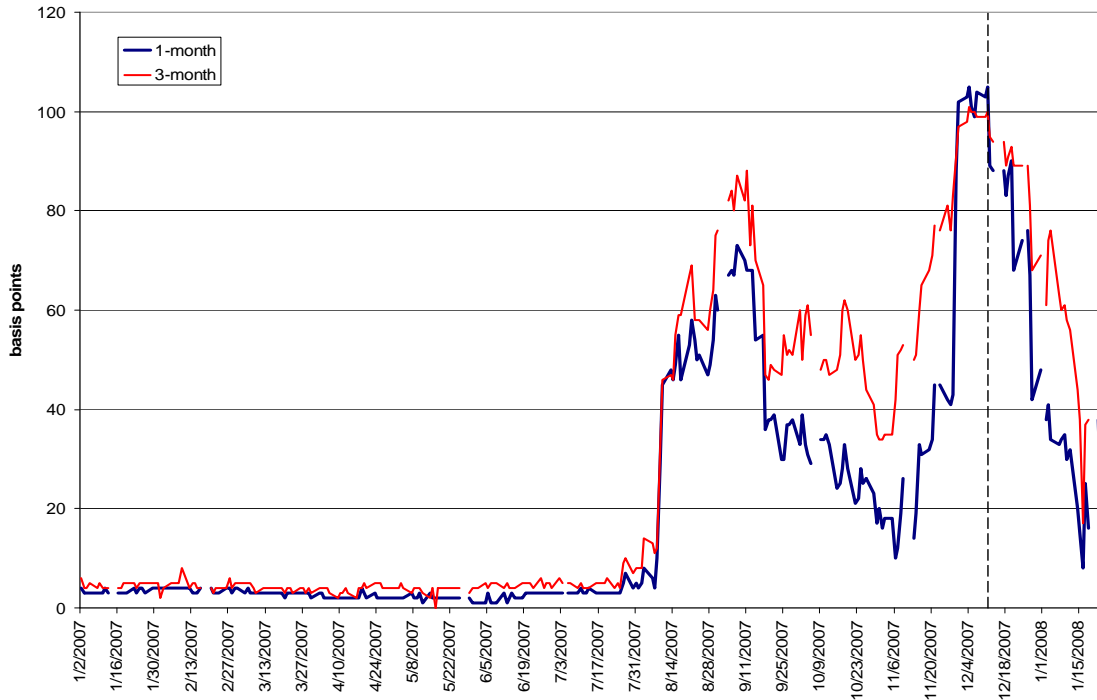
The overnight federal funds market generally remained liquid during the period of market turmoil, though there was some tiering in rates. In contrast, trading in term interbank markets was seriously impaired and term interbank rates rose sharply. As shown on the next page, spreads between term federal funds rates and overnight index swap rates (OIS) for the same maturities widened dramatically; the

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<sup>19</sup> Recall that depository institutions can carry excess reserves (or a reserve deficiency) equal to 4 percent of their required reserves into the next maintenance period. With reserve requirements totaling nearly \$37.5 billion in the maintenance period ending August 15, institutions could carry a maximum of \$1.5 billion of excess reserves into the maintenance period ending August 29.

same was true of spreads between term libor and OIS.<sup>20</sup> These spreads had been a few basis points from January through July, but jumped in August. Anecdotal evidence indicated there was extremely little trading even at the elevated rates.

1 and 3 month fed funds rate minus corresponding OIS rate



In mid-August, the Federal Reserve responded to volatility in overnight rates, illiquidity in term interbank markets, and heightened funding pressures by reducing the primary credit rate, thus narrowing the spread between the primary credit rate and the target federal funds rate from 100 to 50 basis points. In addition to narrowing the spread, the Federal Reserve also allowed all sound depository institutions to borrow from the primary credit facility for terms of one month or more, to renew the loans, and to repay loans early. A few banks availed themselves of the opportunity to obtain term funds and borrowed sizable amounts from mid-August through mid-September, but the opportunity was not widely used. Nonetheless, spreads between term and expected overnight federal funds rates narrowed somewhat in September and October. But spreads spiked again in December, reaching more than 100 basis points as year-end funding pressures, which had been absent from interbank markets for several years, re-emerged.

<sup>20</sup> The rate on a one-month overnight index swap is a measure of market expectations for the average overnight rate during the coming month.

The two TAF auctions conducted in December each provided \$20 billion of term funds at a rate somewhat below the primary credit rate. Spreads between term federal funds rates and the expected overnight federal funds rate narrowed by roughly 50 basis points over the two weeks following the two initial TAF auctions, but remained elevated through the end of the year. Term interbank funding markets saw a significant improvement in liquidity after the year-end. Spreads between term fed funds rates and overnight index swap rates continued to narrow, and the two TAF auctions conducted in January (each for \$30 billion of 28-day funds) had stop-out rates well below the primary credit rate.<sup>21</sup> The improvement in liquidity proved temporary, however; spreads rose again after mid-January, reversing much of the earlier improvement, even as TAF auctions continued. Moreover, liquidity problems spread to other markets, including the repo markets. Nonetheless, the effective federal funds rate generally has been quite close to target each day, though it did fall below the target rate by more than 25 basis points on two separate days.

Finally, the reduction in the spread between the primary credit rate and the target fed funds rate, to 25 basis points, and the introduction of the Primary Dealer Credit Facility, may be contributing to volatility in the funds rate. The smaller spread and the introduction of the PDCF have increased the likelihood of unanticipated borrowing from the discount window and made it more difficult to forecast the level of balances that will become available after the Desk conducts any morning open market operations. Unanticipated borrowing may lead to softness in the funds rate, particularly late in the day. Conversely, if borrowing is less than anticipated on any given day, the supply of balances could fall short of the projected quantity, contributing to firmness in the funds rate late in the day.

## **V. Strengths and Shortcomings of the Current U.S. Approach to Implementing Monetary Policy.**

The current U.S. approach to implementing monetary policy generally keeps the federal funds rate quite close to the target set by the FOMC, promotes an active interbank market, and supports a huge volume of interbank payments. But the current approach also leads depository institutions to employ costly stratagems to avoid reserve requirements, devotes substantial resources to monitoring and ensuring compliance with reserve requirements, and does not prevent occasional large, though transitory, deviations of the effective federal funds rate from target.

### **A. Strengths.**

*There is an Active Interbank Market.* As noted earlier, the volume of federal funds trading now averages about \$225 billion per day. In normal times, the federal funds market is an effective mechanism for redistributing liquidity from depository

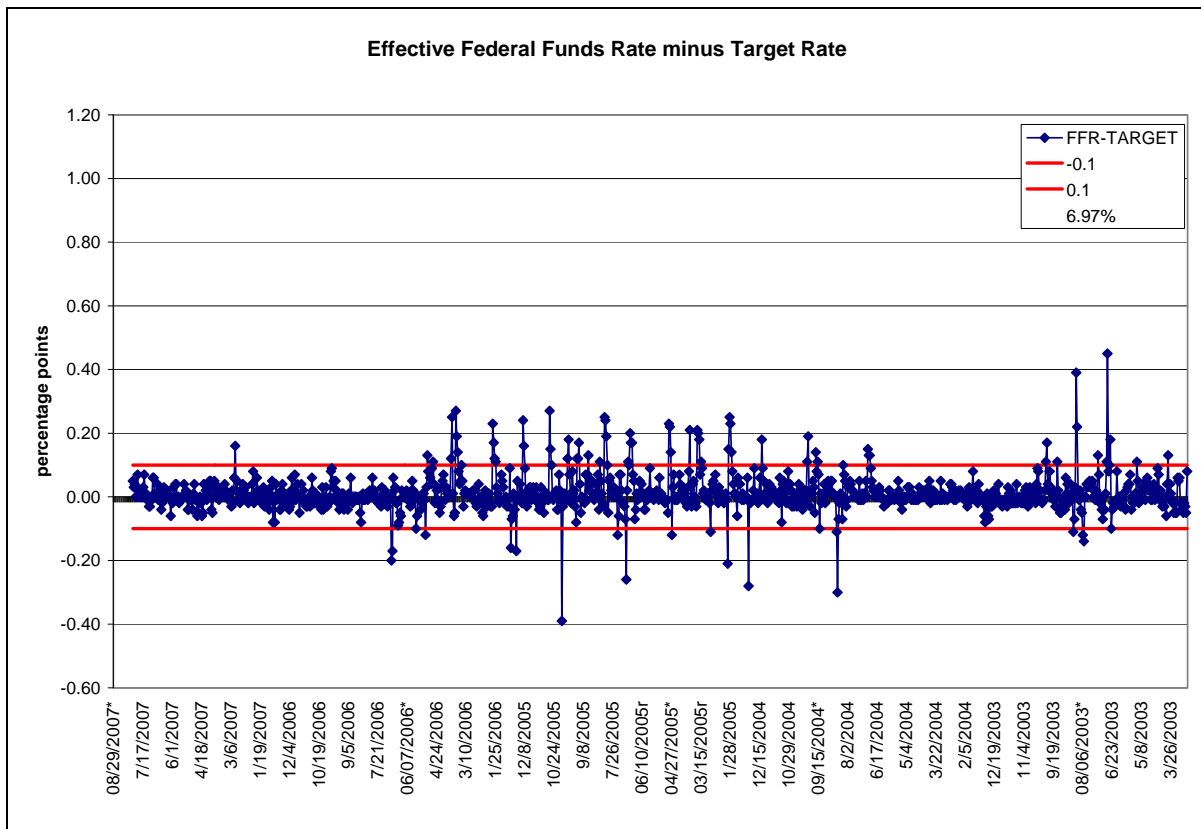
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<sup>21</sup> Appendix B summarizes the results of the eight TAF auctions conducted through March 24, 2008.

institutions that temporarily have more balances than they need to those that have a temporary shortfall. A number of large institutions buy and sell actively as they seek to profit from the generally small intra-day movements in the federal funds rate.

*The System Supports a Large Volume of Interbank Payments.* Fedwire currently processes more than one-half million interbank payments per day with a total daily value of roughly \$2.5 trillion. These payments settle immediately through depository institutions' accounts at the Federal Reserve Banks.

*The Federal Funds Rate is Almost Always Close to Target.* Large deviations from the target have been both rare and short-lived. As shown in the figure on the following page, the effective federal funds rate was within 10 basis points of the target rate on 93 percent of trading days and within 25 basis points of the target on more than 99 percent of days from March of 2003 (when the current institutional environment was put in place with the introduction of the primary credit facility) through July of 2007.



Moreover, the bulk of each day's federal funds trades normally occur at rates very close to the target rate. The intra-day standard deviation of the rates at which brokered trades take place exceeded 10 basis points on fewer than 12 percent of trading days and exceeded 25 basis points on slightly more than 2 percent of days. The averaging provisions in the current system of reserve requirements and

contractual clearing balances are important in helping keep the federal funds rate close to target. Large deviations from target are concentrated on the final day of reserve maintenance periods, when the demand for balances becomes inelastic.

## **B. Shortcomings.**

*The Complex System of Reserve Requirements and the Lack of Remuneration of Reserve Balances Impose Sizable Burdens on Depository Institutions.* Requiring depository institutions to hold reserves as cash in their vaults or as non-interest-bearing balances at the Federal Reserve imposes a tax on the private sector; this “reserves tax” equals interest forgone on balances that depository institutions hold only because of legal requirements and not to meet their customers’ needs. Under the assumption that the level of vault cash is based solely on customers’ needs, Federal Reserve staff estimates that the reserve tax on depository institutions was \$380 million in 2006.

Reserve requirements impose burdens on depository institutions that go beyond the reserve tax. Depository institutions’ employees must learn and comply with the complex rules regarding reserve maintenance. They must ensure that the balances in their institutions’ Federal Reserve accounts are sufficient to satisfy all requirements. They must determine whether various liabilities of the institution or a subsidiary meet the complicated regulatory definition of a deposit. Depository institutions must occasionally obtain legal counsel to deal with reserve requirement issues. Institutions must submit daily data for nine balance sheet items to the Reserve Banks, either each week or for one week per quarter. They must maintain procedures to ensure accurate reporting, and their staff must respond to Reserve Bank questions about their reported data. The applicable rules and the information that must be reported are even more complex when the institution recently has been involved in a merger. Federal Reserve staff estimates that the aggregate burden of filing deposit reports is just under \$12 million per year, not including costs associated with responding to Reserve Bank questions about reported data or other compliance costs.

*The Resource Cost of Administering Reserve Requirements Is Substantial.* The Federal Reserve expends significant resources to administer reserve requirements equitably and ensure compliance. Reserve Bank and Board staff review data on reservable liabilities submitted by each reporting institution to ensure the accuracy of the data. Board staff field numerous questions from depository institutions and their lawyers on the applicability of the Board’s reserve requirement regulation to various complex financial arrangements by the institution or its subsidiaries. The Reserve Banks monitor each depository institution’s compliance with reserve requirements and counsel institutions with poor reserve management histories. Reserve Banks educate depository institutions in their districts about the complex rules and procedures of reserve computation and maintenance through seminars or one-on-one training. Reserve Banks also ensure that changes in reserve requirements and reporting requirements triggered by mergers and other changes in banking structures are

applied correctly and coordinated across districts and within the various operational areas of the Reserve Banks to ensure that the surviving institution's reserve requirement is computed properly. With widespread consolidation in the depository sector, tracking and administering these adjustments has created a significant administrative workload. The Reserve Banks' total expenses for reserve administration averaged \$21 million per year in the past two years.

*The Federal Funds Rate Occasionally Strays Far from Target, Especially Late in the Day.* While the effective (quantity-weighted-average) rate at which federal funds are traded rarely deviates from target by a large amount, it is not uncommon for some trades to occur each day at rates well away from the target rate. There may be a large volume of such trades on days when there is an unintended mismatch between the demand for and supply of balances; a mismatch generally becomes apparent only late in the day. Upward spikes in the funds rate are largely contained by the Federal Reserve's primary credit facility, from which sound depository institutions can borrow at a rate above the FOMC's target for the federal funds rate. The primary credit facility did not, however, effectively cap the federal funds rate during the period of market turmoil in the second half of 2007. The Federal Reserve currently has no mechanism for absorbing an excess supply of balances that becomes apparent during the afternoon. It is not currently feasible to conduct open market operations to drain balances late in the day. U.S. law does not yet authorize the Federal Reserve to pay interest on balances held at the Reserve Banks, so the Federal Reserve cannot remunerate excess reserves or offer an interest-bearing deposit facility like those maintained by some central banks. Hence, the federal funds rate occasionally drops well below the target in late trading.

## **VI. Conclusion**

The environment in which the Federal Reserve implements U.S. monetary policy includes a complex and costly system of largely-avoidable reserve requirements that dates from the Monetary Control Act of 1980 and is in part a legacy of the 1979-1982 period during which the FOMC targeted money growth and the Desk employed a reserves-based operating procedure. U.S. law does not currently authorize the payment of interest on balances held at the Federal Reserve Banks, so balances held to meet reserve requirements earn no interest. Accordingly, depository institutions use a variety of costly reserve avoidance mechanisms that distort the menu of liabilities they offer and substantially reduce the level of reservable deposits on their balance sheets. Even so, depository institutions devote significant resources to complying with reserve requirements and the Federal Reserve expends considerable resources on monitoring and ensuring compliance. Moreover, the inability to pay interest on excess reserve balances means that an inadvertent surplus of balances relative to the quantity demanded sometimes causes the federal funds rate to fall well below the target set by the FOMC.

Recently enacted legislation gives the Federal Reserve new authority, effective October 1, 2011, to reduce reserve requirements to as low as zero and to pay interest on balances depository institutions hold at the Reserve Banks. This new authority gives the Federal Reserve an opportunity to simplify the environment in which it implements monetary policy and the procedures the Desk uses to keep the federal funds rate close to target.

## Appendix A: The Federal Reserve System's Balance Sheet

Factors Affecting Reserve Balances of Depository Institutions  
(Averages of daily figures, week ended March 26,2008)

Reserve Bank Credit	869,437	Currency in circulation(5)	86,955
Securities held outright	628,977	Reverse repurchase agreements (6)	40,706
U.S. Treasury (1)	628,977	Foreign official and int'l accounts	40,706
Bills (2)	124,375	Dealers	0
Notes and bonds, nominal (2)	461,457	Treasury cash holdings	297
inflation-indexed (2)	38,437	Deposits with F.R.Banks	12,854
Inflation compensation (3)	4,708	(other than reserve balances)	
Federal agency (2)	0	U.S. Treasury, general account	5,729
Repurchase agreements(4)	84,821	Foreign official	118
Term Auction Credit	80,000	Service-related	6,754
Other Loans	33,481	Required clearing balances	6,754
Primary credit	550	Adjustments to compensate for float	0
Secondary credit	2	Other	254
Seasonal credit	6	Other liabilities and capital	44,535
Primary dealer credit facility	32,933		
Other credit extensions	0	Total factors, other than reserve	915,347
Float	-1,349	balances, absorbing reserve funds	
Other Federal Reserve assets	43,506		
Gold stock	11,041	Reserve balances	6,109
Special drawing rights certificates	2,200	(with Federal Reserve Banks)	
Treasury currency outstanding (5)	38,778		

Total factors supplying reserve funds 924,456

Note: Components may not sum to totals because of rounding.

- 1 Includes securities lent to dealers, which are fully collateralized by other U.S. Treasury securities.
- 2 Face value of the securities.
- 3 Adjustments in the original face value of inflation-indexed securities for post-issuance inflation.
- 4 Cash value of agreements, which are collateralized by U.S. Treasury and federal agency securities.
- 5 Estimated.
- 6 Cash value of agreements, which are collateralized by U.S. Treasury securities.
- 7 Includes U.S. Treasury STRIPS and other zero coupon bonds at face value.

Sources: Federal Reserve Banks and the U.S. Department of the Treasury.



Appendix B: Term Auction Facility (December 2007 to March 2008)

<b>Term Auction Facility</b>										
<b>Auction Date</b>	<b>Amount Offered (billion \$)</b>	<b>Minimum Rate (OIS, %)</b>	<b>Total Propositions (billion \$)</b>	<b>Stop-out Rate (%)</b>	<b># of Bidders</b>	<b># of FR Districts w/ TAF credit</b>	<b>Fed Funds Target (%)</b>	<b>Actual Fed Funds Rate (%)</b>	<b>Overnight Libor (%)</b>	<b>1-month Libor (%)</b>
17-Dec-07	\$20 B	4.17%	\$61.55	4.65%	93	6	4.25%	4.31%	4.4175%	4.9650%
20-Dec-07	\$20 B	4.15%	\$57.66	4.67%	73	8	4.25%	4.37%	4.3025%	4.8963%
14-Jan-08	\$30 B	3.88%	\$55.53	3.95%	56	11	4.25%	4.25%	4.2875%	4.0813%
28-Jan-08	\$30 B	3.10%	\$37.45	3.123%	52	11	3.50%	3.50%	3.5950%	3.2813%
11-Feb-08	\$30 B	2.86%	\$58.40	3.01%	66	11	3.00%	2.88%	3.0650%	3.1388%
25-Feb-08	\$30 B	2.81%	\$67.96	3.08%	72	11	3.00%	3.00%	3.0738%	3.1237%
10-Mar-08	\$50 B	2.39%	\$92.60	2.80%	82	9	3.00%	2.99%	3.0963%	2.9350%
24-Mar-08	\$50 B	2.19%	\$88.87	2.615%	88	10	2.25%	2.08%	2.8738%	2.6538%

N.B. Actual fed funds rate and libor are as of the date of the TAF auction, except that 24 March 2008 was a holiday in Europe so overnight and 1-month libor are shown for 25 March.

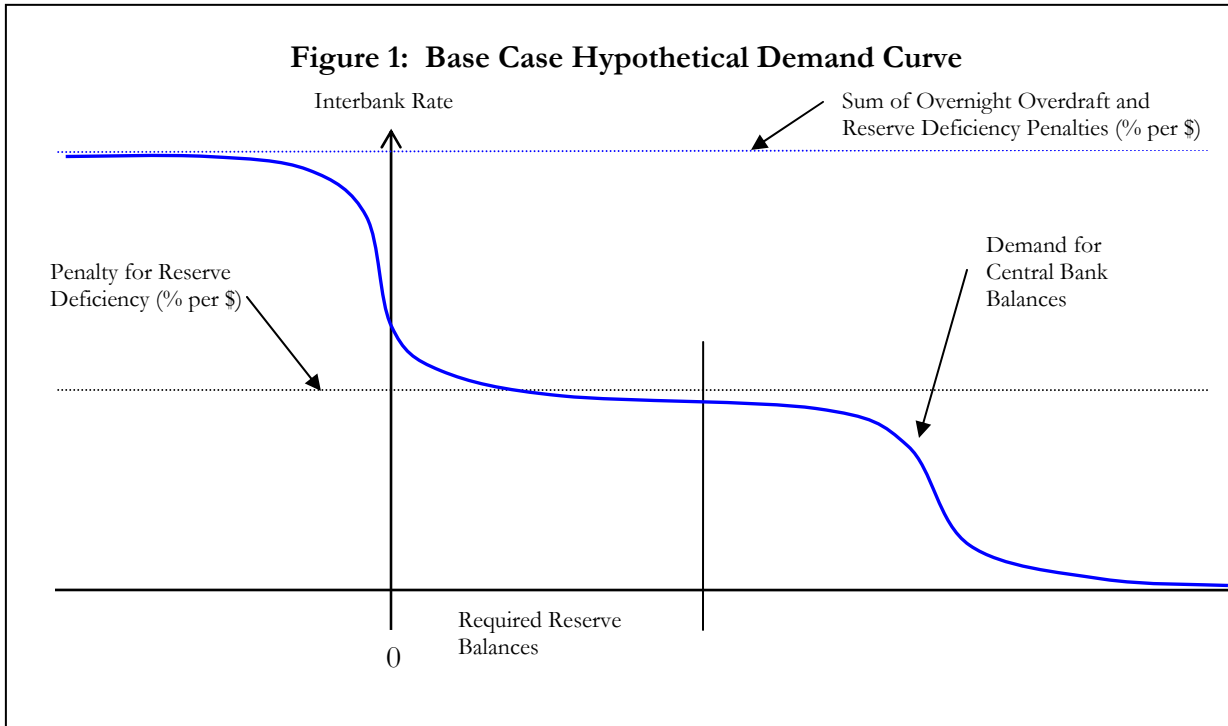
### Appendix C: An Illustrative Analytic Framework

A simple, illustrative analytic framework may prove useful in summarizing how the U.S. policy and regulatory environment conditions depository institutions' reserve management, and how depositories' reserve management and the Federal Reserve's operating procedures interact to determine the federal funds rate. The framework may also prove useful in thinking about implications of alternative approaches to implementing monetary policy that U.S. policymakers may wish to consider.

The framework adopts the inventory theoretic approach advanced in the seminal paper by Poole (1968) and draws upon other papers in the literature on optimal reserve management (Whitesell (2006), for example). In this approach, banks hold reserves largely to reduce the risk of incurring penalties by running a reserve deficiency or overnight overdraft. In determining the optimal quantity of reserves, depository institutions must balance the opportunity cost of holding reserves against this potential insurance value. The framework implicitly adopts a static view of market equilibrium; it does not incorporate elements such as gradual arrival of information about the need for reserves, or price discovery through trading, that could generate intra-day variability in the interbank rate. For simplicity, assume that the interbank market convenes, and clears, at mid-day and that banks do not learn their end of day balances until the end of the day, at which time they cannot trade in the interbank market.

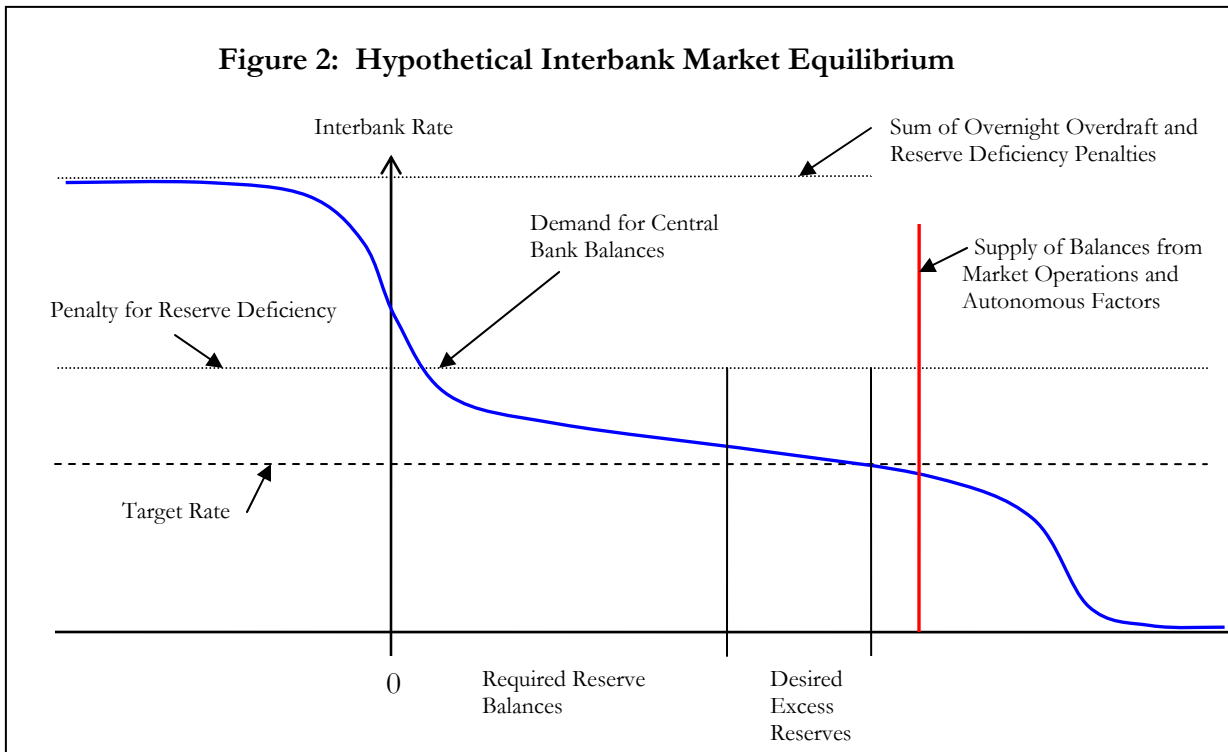
Figure 1 on the next page depicts a stylized demand for central bank balances by a bank that holds balances to meet reserve requirements and to reduce the likelihood of overnight overdrafts in its reserve account. If reserves are not remunerated and the bank has no recourse to a standing facility from which it can borrow to cover a reserves deficiency or overdraft, the demand schedule might look like the blue curve in Figure 1. Beginning at the far left, if the bank were to find itself with a negative balance in its reserve account at mid-day, additional reserves balances would have a high marginal value because the probability of ending the day with both an overdraft and a reserve requirement deficiency would be large, and an additional dollar of balances would reduce the bank's expected overnight overdraft and reserve deficiency nearly one for one. Accordingly, the bank would be willing to borrow in the interbank market at a rate close to the sum of the penalties for overnight overdrafts (the federal funds rate plus 4 percentage points, in the United States) and reserve requirement deficiencies (the target funds rate plus 2 percentage points). As the bank's mid-day reserve balance moves toward and into positive territory, the probability of ending the day with an overdraft declines faster than the probability of ending the day with a reserve deficiency, and the marginal value of additional reserves in reducing expected overnight overdraft fees declines toward zero. However, each extra dollar of balances still has value in reducing potential penalties for reserve requirement deficiencies. As drawn, in the range between a zero balance and its reserve requirement, the bank is willing to pay a rate on market sources of funds close

to the penalty rate imposed for reserve requirement deficiencies. Finally, as the level of mid-day balances increases well beyond the bank's reserve requirement, the marginal value of reserves falls toward zero because an additional dollar of reserves affords little incremental reduction in expected overnight overdrafts or reserve requirement deficiencies. Summing across all depository institutions yields a market demand curve for balances that has the same basic shape.



Banks and other depository institutions that have to hold balances to meet U.S. reserve requirements are allowed to do so by holding the required balances *on average* over a multi-day reserve maintenance period. This averaging provision has important implications for the slope of the demand curve in the vicinity of the target federal funds rate. For most of the maintenance period, the averaging provision makes the demand curve very elastic in the vicinity of the target rate because it allows banks to hold less reserves on days when the federal funds rate rises above the target rate and more reserves on days when the federal funds rate lies below the target; the Desk encourages that behavior by adjusting the next days' supply of reserves to return the funds rate to target. But on the last day of the maintenance period, the demand curve becomes much less elastic because banks no longer have the same opportunity to make up a deficiency in the future or to offset excess balances by holding a lower balance in the future.<sup>22</sup>

<sup>22</sup> The carryover provisions provide some flexibility to make up a period-average reserve deficiency or make use of period-average excess reserves in the subsequent reserve maintenance period, and thus make the demand for balances less than perfectly inelastic on the last day of the maintenance period. Carpenter and Demiralp (2006) estimate that the slope of the demand curve in the vicinity of



In this framework, the supply of central bank balances that results from open market operations plus any changes in autonomous factors such as the Treasury’s balance can be represented by a vertical supply schedule, as shown by the red line in Figure 2. (This representation assumes no standing facilities.) For illustrative purposes, assume that changes in autonomous factors become known before the interbank market clears, but after the central bank conducts its market operations.

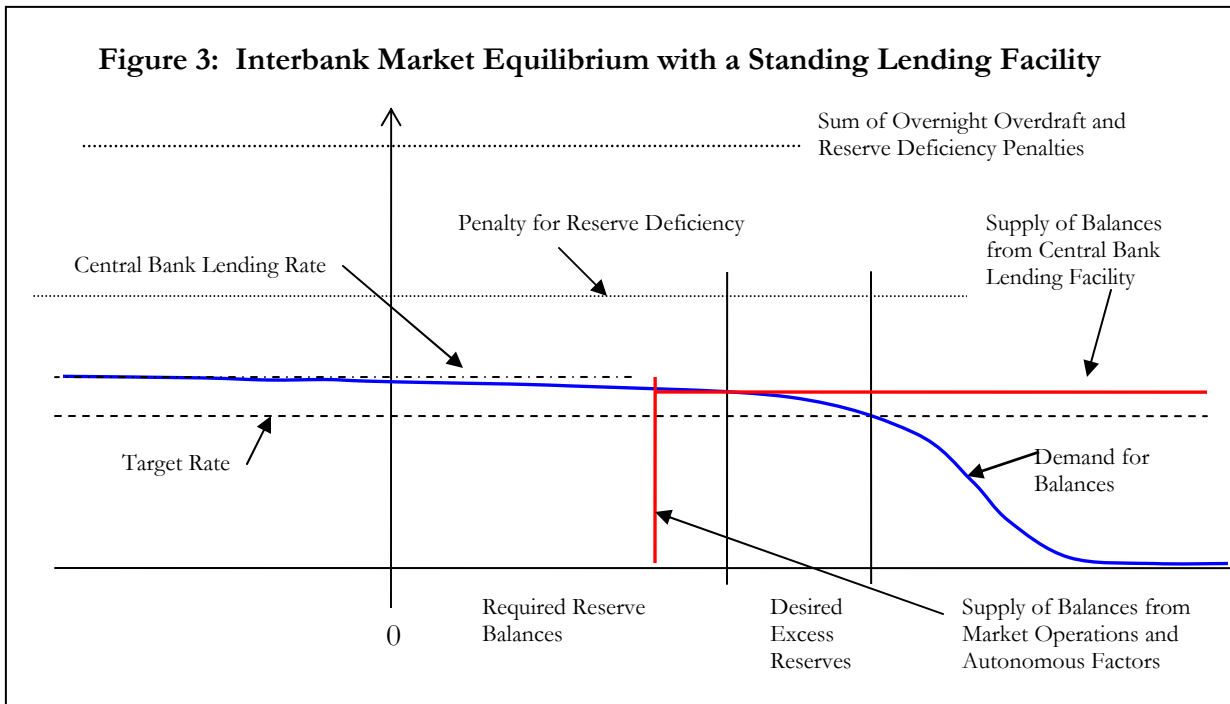
The equilibrium interbank rate is then determined by the intersection of the market demand curve with the vertical supply of balances. If the supply of reserves is close to the quantity demanded at the target rate (the sum of required reserves plus desired excess reserves), as drawn in Figure 2, the federal funds market will clear at a rate close to the target rate. If the supply of reserves were to fall well short of the quantity demanded at the target rate, the federal funds rate would rise above the target rate – potentially well above the target rate, given the assumed absence of a standing lending facility. And if the supply of nonborrowed reserves were to be substantially larger than the quantity demanded at the target rate, the federal funds rates would drop below the target – potentially to zero, given the assumed absence of a mechanism for setting a floor on the interbank rate.

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the target federal funds rate is 5 basis points per \$1 billion of reserves on the last day of the maintenance period, and about 1 basis point per \$1 billion on other days with the magnitude increasing toward the end of the period.

As noted earlier, the Federal Reserve maintains a standing lending facility but does not offer a deposit facility or remunerate excess reserves. Introducing a standing lending facility changes the supply schedule; the supply schedule becomes kinked, as shown by the red line in Figure 3. The vertical portion of the supply schedule represents the quantity of nonborrowed balances that results from the combination of open market operations and any changes in autonomous factors. The horizontal portion of the supply schedule represents the elastic availability of borrowed reserves at the central bank's lending rate—the primary credit rate in the United States, which has been 50 basis points above the target rate since 17 August 2007.)

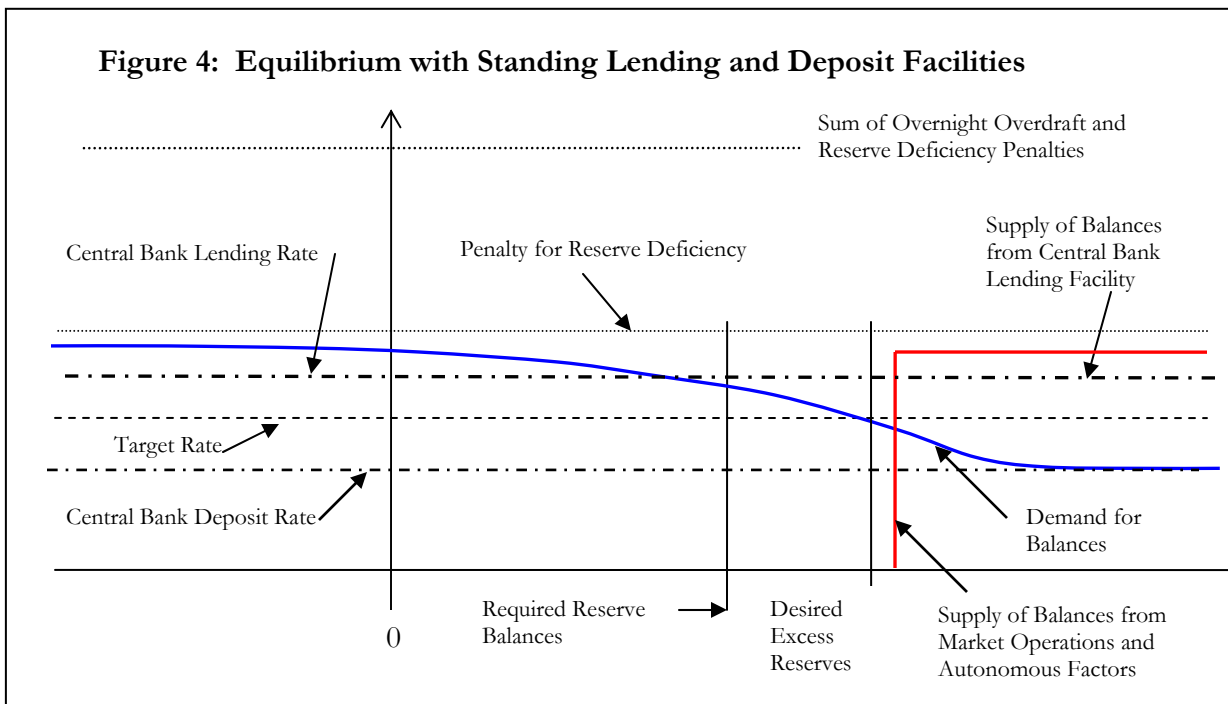
Introducing a standing lending facility also changes banks' optimization problem and thus the demand schedule. If banks may borrow freely at the central bank's lending facility, any bank that faces a too-high probability of incurring an end-of-day overdraft and the associated penalties could reduce that probability and the expected penalties by borrowing at a cost equal to the central bank's lending rate. (The same is true for reserve deficiencies if, as in the United States, borrowed reserves satisfy reserve requirements.) Thus, a bank that has access to a lending facility, and that sees no cost to borrowing from the central bank aside from the interest expense, would not be willing to borrow reserves in the interbank market at a rate above the central bank's lending rate. In this environment, the demand for reserve deposits might be similar to that drawn in Figure 3: introducing a standing lending facility lowers and flattens the leftmost portion of the demand curve but seems unlikely to have much effect on the middle or rightmost portion of the curve.



If the day's supply of nonborrowed reserves were to fall well short of the total quantity demanded at the target rate, the equilibrium interbank rate would rise toward (but not above) the central bank's lending rate, as shown in Figure 3. If the day's supply of nonborrowed reserves were to rise well above the quantity demanded at the target rate, the interbank rate could fall well below the target rate.

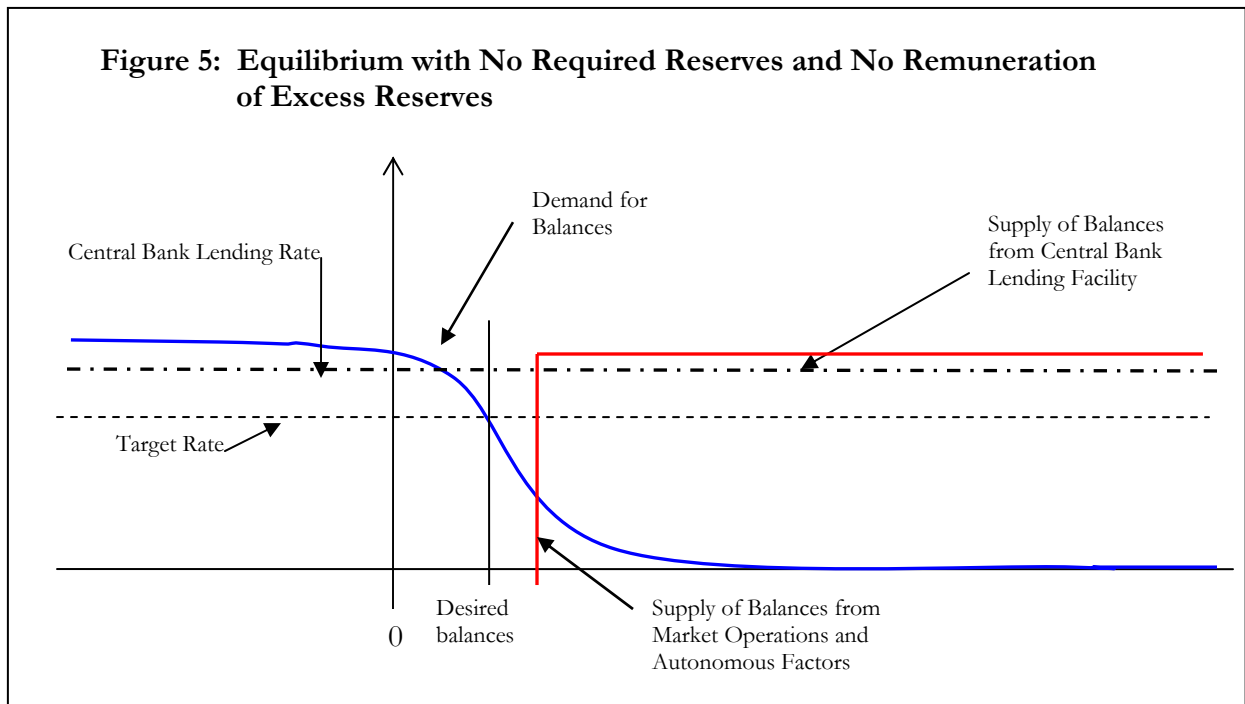
In practice, the primary credit rate is not an absolute upper bound on the federal funds rate; evidently the left side of the demand schedule rises above the primary credit rate, as in Figure 4. That suggests there is some non-pecuniary cost associated with borrowing from the Federal Reserve, or perhaps some fixed cost, in addition to the pecuniary variable cost represented by the primary credit rate.

While many central banks pay interest on excess balances at a rate below their target for the interbank rate, either by maintaining a standing deposit facility or by remunerating excess reserves directly, the Federal Reserve does not have legal authority to do so. As noted earlier, the Federal Reserve will gain authority to pay interest on balances beginning October 1, 2011. In the context of the illustrative analytic framework, paying interest on excess reserves at a rate somewhat below the target rate would raise and flatten the rightmost portion of the demand schedule. Moreover, it would set a floor on the interbank rate (at least it seems likely to do so if depository institutions do not have to take any action to earn the interest available on excess reserves) and create a tunnel or channel system, as in Figure 4.<sup>23</sup>



<sup>23</sup> The demand and supply schedules in Figure 4 reflect the assumption that banks that borrow from the standing lending facility incur not only interest expense but also some non-pecuniary cost.

In the context of this illustrative analytic framework, simply eliminating reserve requirements (without introducing a program of remunerated clearing balances or paying interest on excess reserves) to reduce the costs and burdens associated with the current structure of requirements would shift the demand schedule to the left and make it steeper in the vicinity of the target rate (because the interest elasticity imparted by the ability to average reserve holdings over a multi-day reserve maintenance period would vanish), as shown in Figure 5. Even small imbalances between the quantity of balances demanded at the target rate and the net supply of balances from open market operations and autonomous factors could cause the actual federal funds rate to deviate from target significantly.

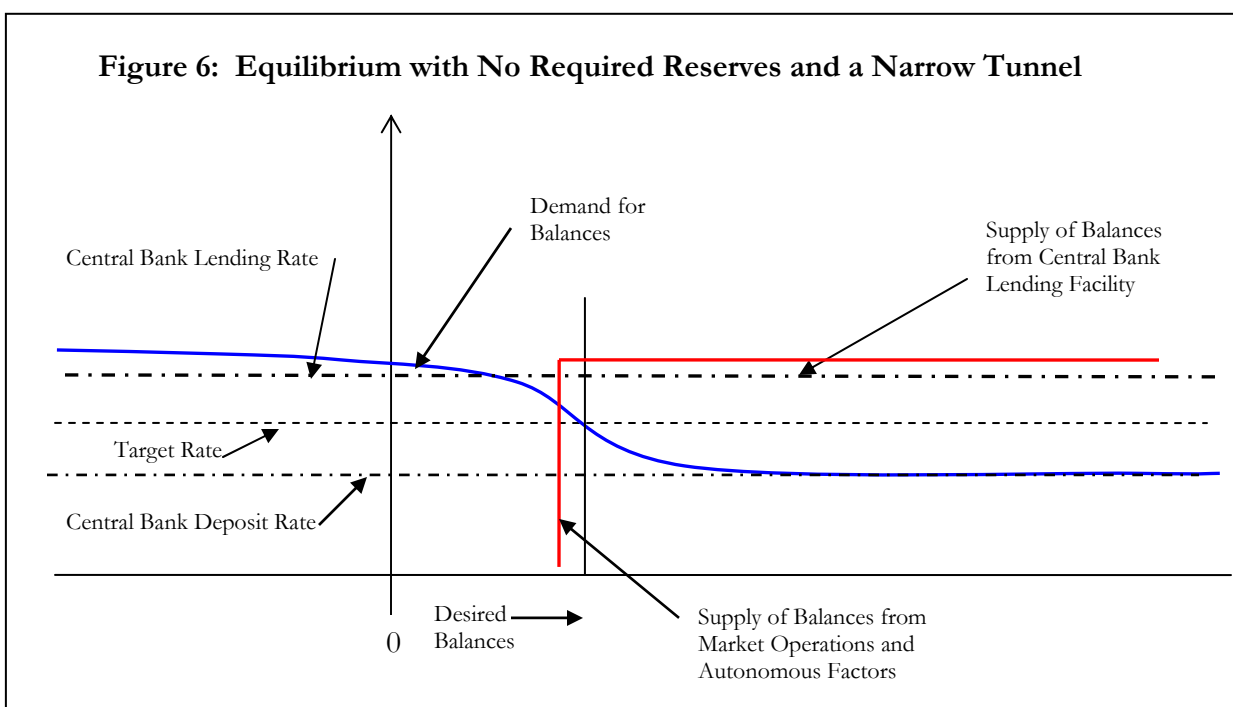


The remaining demand for balances likely would display substantial day-to-day variability, reflecting the time-varying volume of transactions flowing through banks' Federal Reserve accounts and the sizable opportunity cost of holding non-interest-bearing balances on days when they are not needed to avoid end of day overdrafts. To keep the federal funds rate close to target, the Desk would need either accurate information about each day's demand for balances or a mechanism for adjusting the supply of balances in line with unanticipated changes in the quantity demanded.

Eliminating reserve requirements while paying interest on excess reserves at a rate modestly below the target rate would substantially reduce the opportunity cost of holding balances and thus likely would shift the demand schedule to the right relative to that drawn in Figure 5. This approach might also yield a more stable and thus more predictable demand for balances, because the small opportunity cost of holding

balances would give depository institutions little incentive to hold much smaller balances on days without a large flow of payments through their accounts (that is, on days when large balances are not needed to control the risk of end-of-day overdrafts) than on days with large payment flows.

Thus the framework suggests that either a narrow tunnel (with a lending facility that effectively caps the interbank rate and remuneration of excess reserves at a rate modestly the target rate) as shown in Figure 6, or a mechanism for adjusting the supply of balances to offset any imbalance between the supply of and demand for balances that becomes apparent after the Desk does its morning open market operations, or both, would be needed to keep the federal funds rate close to target if there were no reserve requirements and no contractual clearing balances.



If the Federal Reserve were to eliminate reserve requirements but substitute a program of voluntary contractual clearing balances, and pay interest on clearing balances at a rate equal or close to the target rate, the result might well be a more predictable demand for balances because the small opportunity cost of holding balances would give depository institutions little incentive to minimize balances on days without a large flow of payments. If, in addition, depository institutions had to choose their target level of clearing balances in advance and were allowed to hold the target level on average over some multi-day interval rather than having to hold it each day, the demand for balances might be both stable and fairly elastic within the maintenance period.



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