Monetary Policy under a Corridor Operating Framework

By George A. Kahn

The Federal Reserve aggressively eased monetary policy during the 2008-09 global financial crisis. The Federal Open Market Committee (FOMC) cut the federal funds rate target to near zero, and the Board of Governors introduced a number of novel liquidity facilities. In addition, the FOMC purchased long-term Treasuries and agency mortgage-backed securities on a large scale. These actions caused the Fed's balance sheet to balloon.

As the balance sheet grew to unprecedented size, the Open Market Desk at the New York Fed found it increasingly difficult to achieve the FOMC's target funds rate. In response, in October 2008, as authorized under the Financial Services Regulatory Act of 2006 and the Emergency Economic Stabilization Act of 2008, the Federal Reserve began paying interest on excess reserves. This interest rate was expected to establish a floor under the federal funds rate. The discount rate—which since January 2003 has been set as a penalty rate above the funds rate target—was expected to limit upward pressure on the funds rate.

With these moves, the Federal Reserve's operating framework now incorporates the essential elements of a "channel" or "corridor" system.

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In such a system, the target for the federal funds rate would typically be set within the corridor established by the discount rate at the ceiling and the interest rate on excess reserves at the floor. Although the Federal Reserve has not formally adopted a channel system, establishing a floor under the federal funds rate target will be especially important as the Federal Reserve begins to exit its highly accommodative policy stance.

While a corridor framework may offer a number of advantages as an operating system, it may also create new challenges. The key advantages are that it could help the Federal Reserve achieve its target for the federal funds rate while allowing the balance sheet to act as an independent tool of policy. A key question is whether the discount rate will be an effective ceiling and the interest rate on excess reserves an effective floor. In addition, how changes in the funds rate target, the discount rate, and the rate on excess reserves will be sequenced is unclear. In particular, the roles of the FOMC, Board of Governors, and Reserve Bank Boards of Directors in such a system may need to be clarified.

This article examines how a corridor system works in theory and practice. The first section of the article explores how the Federal Reserve has traditionally sought to achieve its target for the federal funds rate and why that no longer works. The second section describes the advantages of a corridor operating system, shows how other central banks have operated such a system, and discusses potential problems in implementing the corridor system in the United States.

I. HOW HAS THE FEDERAL RESERVE TRADITIONALLY OPERATED?

Understanding the merits and potential pitfalls of a corridor operating system first requires understanding the operating procedure traditionally used by the Federal Reserve to achieve the FOMC's target federal funds rate. Potential operational problems and actual policy concerns with this traditional operating framework have prompted policymakers and economists to consider alternatives.

The traditional framework

The FOMC sets a target for the federal funds rate consistent with its objectives of maximum employment, stable prices, and moderate long-term interest rates.[1] The Federal Reserve's traditional approach to

achieving the target federal funds rate differs from the approach required under a corridor system. Traditionally, the FOMC has instructed the Open Market Trading Desk at the New York Federal Reserve to conduct open market operations to achieve the Committee's target funds rate. The Desk carries out its role by estimating the quantity of reserves that will be demanded given the FOMC's target federal funds rate and supplying the reserves required to meet that demand at the target federal funds rate.[2]

The demand for reserves comes in part from reserve requirements set by the Board of Governors under limits set by Congress. This demand depends on the amount of transactions deposits the public chooses to hold at depository institutions. In addition, financial institutions typically hold some reserves in excess of requirements as a precaution against reserve account deficiencies, and they maintain settlement balances at the Fed to clear and settle transactions with each other and with the government.

The demand for reserve and settlement balances at the Fed is inversely related to the federal funds rate—the rate banks charge each other for overnight loans of reserves. This inverse relationship stems from two effects. First, higher interest rates cause the public to reduce their holdings of transactions deposits that are subject to reserve requirements and increase holdings of higher yielding non-transactions accounts that are not subject to reserve requirements. Second, higher interest rates cause financial institutions to limit their holdings of excess reserves and settlement balances. Before 2008, such balances generally paid no interest. As a result, the opportunity cost of holding these balances rose with increases in the federal funds rate, causing financial institutions to economize on their holdings.

While depository institutions determine the demand for reserves, the Federal Reserve has significant influence over the supply of reserves. In particular, the supply depends on the size of the Federal Reserve's portfolio of securities and repurchase agreements, the amount of loans made to depository institutions through the discount window, and on a number of autonomous factors outside the Federal Reserve's day-to-day control. Autonomous factors include changes in the public's demand for currency and the Treasury's balance at the Federal Reserve.

The Federal Reserve can change the supply of reserves through open market purchases or sales of securities, or through repurchase agreements (RPs) and reverse RPs. For example, to increase the supply of reserves, the Federal Reserve can purchase Treasury securities from the public, crediting the reserve account of the seller's bank.

To achieve the FOMC's target for the federal funds rate, the Open Market Desk estimates the demand for reserves and, through open market operations, supplies the quantity of reserves necessary to equate supply and demand at the target funds rate. The Federal Reserve can lower the federal funds rate by increasing the supply of reserves or raise the funds rate by reducing the supply. Given the autonomous factors affecting supply that are outside the Fed's direct control and volatility in the demand for reserves, the funds rate may deviate from target on a daily basis. Volatility is limited, however, by the availability of the discount window to supply reserves when, despite the actions of the Desk, the federal funds rate rises above the target rate.

Why the traditional framework no longer works

The traditional framework's ability to achieve the target federal funds rate without excessive interest rate volatility began to be questioned in the 1990s when required reserves appeared to be on the decline. More recently, the traditional framework has been undermined by the explosion in reserves caused by the expansion of the Federal Reserve's balance sheet in the aftermath of the 2008 financial crisis.

A scarcity of reserves. The traditional framework for achieving the target federal funds rate began to be reconsidered in the mid-1990s as the Federal Reserve reduced reserve requirements and commercial banks found innovative ways to reduce their demand for required reserves. The Federal Reserve cut reserve requirements to reduce the implicit "tax" depository institutions paid on those reserves. With no interest paid on reserves before 2008, the tax imposed by reserve requirements essentially equaled the interest reserves could have earned had they been invested in interest-bearing assets. Reserve requirements, therefore, created a financial market distortion that put depository institutions at a competitive disadvantage relative to other financial institutions. To limit this distortion, the Federal Reserve reduced reserve requirements twice in the 1990s—eliminating the 3 percent requirement on non-

transactions accounts in December 1990 and cutting the requirement on transactions accounts from 12 percent to 10 percent in April 1992. Other central banks also lowered reserve requirements, with some eliminating them altogether.

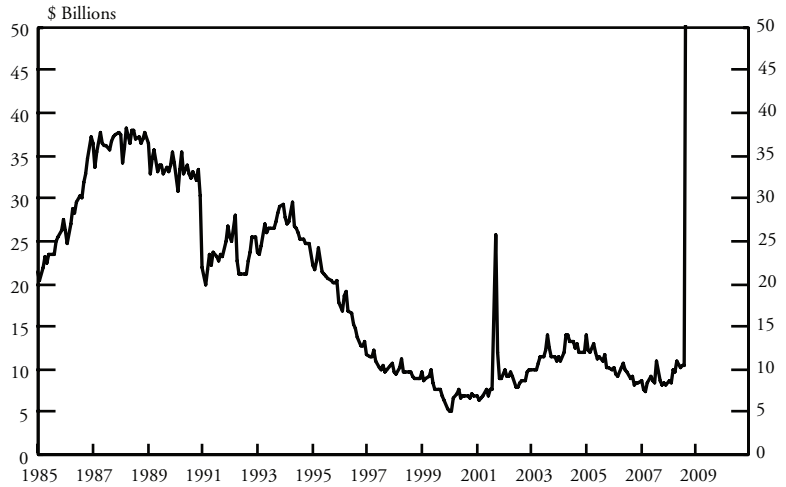
At the same time, depository institutions sought ways to reduce their need to hold non-interest bearing reserves through various financial innovations. For example, in the United States, depository institutions created new types of accounts—such as certificates of deposit, Eurodollar borrowing, repurchase agreements, and sweep accounts—with features similar to deposit accounts but not subject to reserve requirements.[3]

Together, the effect of lower reserve requirements and financial innovation reduced required reserve balances. Chart 1 shows the downward trend in required reserves that occurred as a result of these developments from the early 1990s to 2000. From 2000 to 2006, these effects were mitigated by a low interest rate environment that reduced the opportunity cost of holding reserves. Nevertheless, until the financial crisis of 2008-09, the level of reserves remained well below its peak in the 1980s and 1990s.

The reduction in required reserves beginning in the early 1990s caused concern that the Federal Reserve could lose control over the federal funds rate target. In particular, if reserve requirements fell below the level depository institutions maintained in clearing and settlement balances at the Federal Reserve, the funds rate would no longer depend on the demand for reserves. Rather, the funds rate would depend on the demand for, and supply of, settlement balances. The demand for these balances would in turn depend on payments flows and institutional features of the payments system, such as penalties imposed by the central bank on settlement balance overdrafts. If the demand for settlement balances were more volatile and difficult to predict than the traditional demand for reserve balances, the central bank could find it hard to determine the open market operations necessary to hit the funds rate target. As a result, the funds rate could become more volatile and difficult to control.[4]

An abundance of reserves. More recently, the traditional framework has been complicated, not by a decline in reserve balances, but by a huge run-up in excess reserves. Beginning in 2008, the Federal Reserve greatly expanded its balance sheet in response to the global financial

Chart 1
RESERVE BALANCES



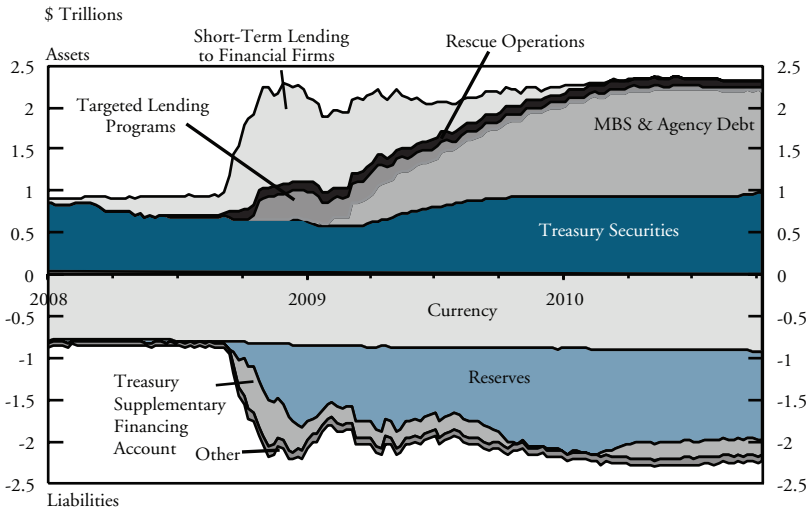
Source: Federal Reserve

crisis (Chart 2). At first, the expansion occurred through the provision of liquidity to key credit markets and lending to financial institutions. Later, the Federal Reserve began a large-scale asset purchase program under which it bought $1.25 trillion of agency mortgage-backed securities and $300 billion in longer-term Treasury securities. These purchases were financed through the creation of bank reserves well in excess of reserve requirements, swelling the Federal Reserve's balance sheet from roughly $800 billion in 2007 to $2.3 trillion at the end of 2009.[5] The purpose of the program was to provide support for mortgage lending, improve conditions in private credit markets, and ultimately help reduce long-term interest rates. Lower rates, in turn, were expected to stimulate economic activity.

As the supply of reserves increased dramatically, the federal funds rate came under considerable downward pressure. Although the FOMC lowered its target for the federal funds rate to 1 percent at the end of October 2008 and to a range of 0 to ¼ percent in December 2008, the ample supply of excess reserves kept the funds rate trading persistently below its target (Chart 3). In essence, the Federal Reserve's Open Market Desk was supplying more reserves to the banking system than de-

Chart 2

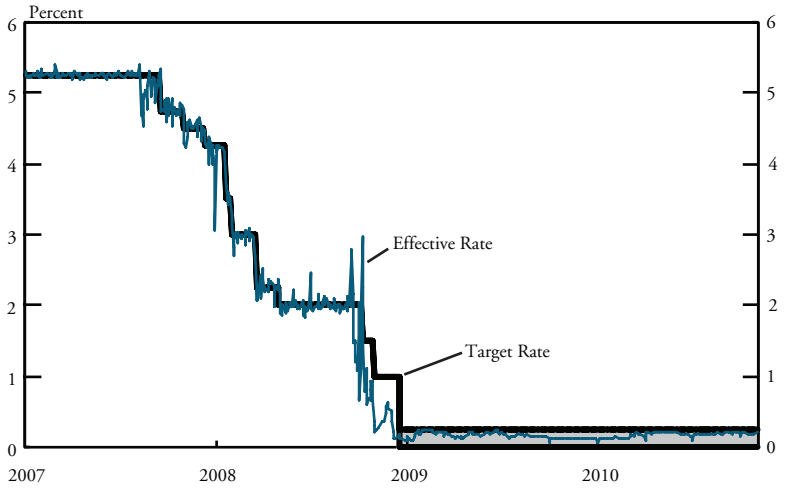
FEDERAL RESERVE BALANCE SHEET



Source: Federal Reserve

Chart 3

FEDERAL FUNDS RATE TARGET AND EFFECTIVE RATE



Source: Federal Reserve

manded at the target federal funds rate. As a result, the effective federal funds rate fell below the target rate.

Beginning in October 2008, the Federal Reserve began paying interest on reserves as authorized under the Financial Services Regulatory Act of 2006 and the Emergency Economic Stabilization Act of 2008. In addition to essentially eliminating the opportunity cost of holding required reserves and promoting efficiency in the banking sector, the purpose was to help establish a lower bound on the federal funds rate. Such a lower bound would in turn "permit the Federal Reserve to expand its balance sheet as necessary to provide the liquidity necessary to support financial stability while implementing the monetary policy that is appropriate in light of the System's macroeconomic objectives of maximum employment and price stability" (FOMC Press Release, October 6, 2008).

Initially, the interest rate paid on required reserve balances was the targeted federal funds rate less ten basis points, and the rate paid on excess balances was the targeted federal funds rate less 75 basis points.[6] Over the next couple of months, however, as it became apparent that these rates on reserve balances were not sufficient to establish a floor under the target funds rate, the FOMC gradually narrowed the difference between the target funds rate and the rate paid on reserves. By mid-December 2008, when the FOMC lowered the funds rate target to a range of 0 to 25 basis points, the Board of Governors set the interest rate on both required and excess reserves at 25 basis points. Since that time, the funds rate has traded within its target range but still persistently below the interest rate on excess and required reserves.

II. WHAT IS A CORRIDOR FRAMEWORK?

A corridor operating framework can, in theory, help a central bank achieve a target policy rate in an environment in which reserve requirements are not binding—due either to low or nonexistent reserve requirements or the use of the central bank's balance sheet as a policy instrument independent of the policy interest rate. In practice, the corridor system has effectively stabilized the policy rate near its target in a number of countries. In the United States, however, the potential effectiveness of the corridor system is yet to be established since it has not been fully implemented.

Theory

In theory, a corridor system could limit volatility in the policy rate and isolate interest rate policy from the size of the balance sheet.[7] In a corridor system, as in the traditional framework, the central bank chooses a target for the overnight policy rate consistent with its goals for inflation and economic growth. And, as in the traditional framework, the central bank supplies a certain level of reserves to the banking system, which it can influence through open market operations.[8] In addition, the central bank establishes a lending facility similar to the Fed's discount window, but through which it stands ready to supply whatever amount of overnight balances are demanded at a fixed interest rate.[9] The interest rate is set above the target policy rate to impose a penalty on depository institutions that borrow from the central bank rather than in the interbank market.

The final element of a corridor system is the floor established under the overnight rate. This floor can be thought of in two different ways. First, it could be viewed as a standing facility in which depository institutions can deposit their excess reserves overnight at a fixed interest rate. Analogous to the discount rate, the deposit rate would be set below the target policy rate to provide an incentive for the depository institution to invest surplus funds in the overnight interbank market instead of at the central bank. Equivalently, the floor could be viewed in the more traditional sense as the interest rate paid on reserves, which also is typically set below the target interest rate.

With a ceiling and floor established, a corridor is defined that limits fluctuations in the overnight policy rate.[10] When depository institutions are short on required reserve balances, they would have no reason to pay a rate higher than the discount rate to borrow funds overnight. And, when holding excess balances, they would have no reason to accept a rate lower than the deposit rate (or rate on excess reserves) offered by the central bank. Moreover, at rates between the ceiling and the floor, depository institutions with a shortage of funds have an incentive to borrow from institutions that have excess funds, establishing an active private market for overnight liquidity. As a result, regardless of the supply of reserves, the central bank can tightly control the interest rate on overnight funds.

Figure 1 illustrates how the system works. The overnight interest rate, i, is on the vertical axis, and the quantity of reserves, R, is on the horizontal axis. The demand schedule for reserve balances, D, is perfectly elastic (horizontal) at the discount rate, i^d, because no depository institution would be willing to borrow funds in the interbank market at a higher rate than the central bank is charging. The demand schedule is also perfectly elastic at the interest rate on excess reserves, i^r, because no institution would be willing to loan overnight funds in the interbank market at a lower rate than the central bank is offering to pay.

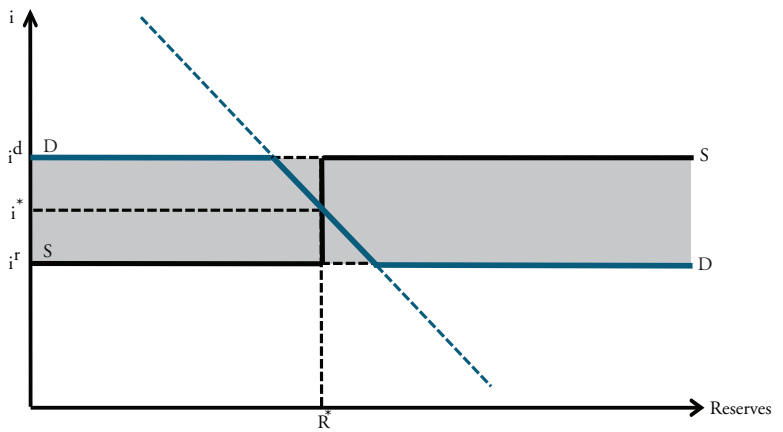
Between the discount rate and the rate on excess reserves, the demand schedule is downward sloping. In this area, depository institutions balance the potential costs of falling short of their reserve or settlement requirements—and therefore having to borrow on the interbank market—against the cost of having excess reserves. As the rate on overnight funds falls, the opportunity cost of holding excess reserves as a precaution against a shortfall of reserves falls. As a result, the demand schedule is downward sloping.

The supply of reserves is traced out by the schedule labeled S. The vertical segment of the supply curve, located at R^*, is determined by the central bank and influenced by open market operations. Open market purchases increase reserves and shift the vertical segment to the right. Open market sales have the opposite effect, shifting the vertical segment to the left. The position of the horizontal segment to the left of R^* is determined by the deposit rate or rate on excess reserves. This rate puts a floor under the overnight rate regardless of how low the demand for central bank balances may fall.

The position of the horizontal segment to the right of R^* is determined by the discount rate, i^d. As the demand for central bank balances increases, the resulting increase in the interbank rate is limited by the rate the central bank charges at it lending facility. Once this rate is hit, all additional demand for reserves is met through central bank lending. This occurs because no depository institution would be willing to pay a higher rate than what the central bank was charging.

The equilibrium overnight rate is determined by the intersection of the supply and demand schedules. As shown in Figure 1, that intersection occurs at interest rate i^* and reserve balances R^*. Regardless of how volatile the demand for central bank balances might be, fluctuations in

Figure 1
THE CORRIDOR OPERATING FRAMEWORK

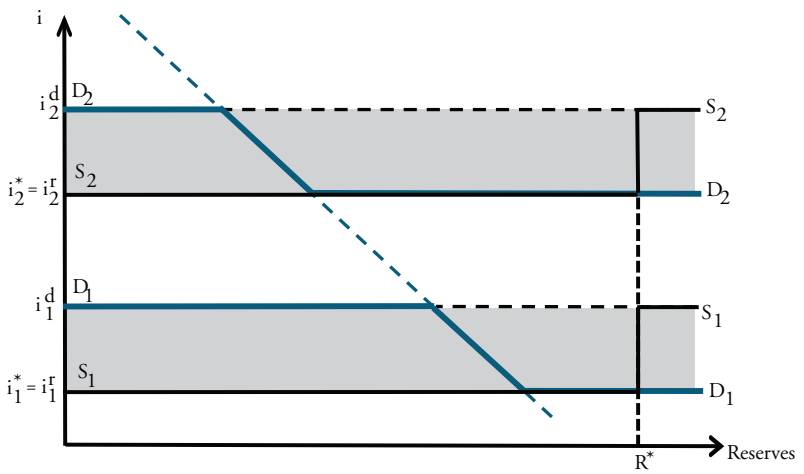


the overnight rate will be limited to a range from i^r to i^d. Fluctuations in the overnight rate can be further limited by open market operations that move the supply of reserves to offset anticipated shifts in the demand for central bank balances. In this way, fairly tight control can be maintained over the target rate.

When reserves are sufficiently plentiful that the supply curve intersects the demand curve in its horizontal region at the interest rate on reserves, the policy rate falls to the floor of the corridor. Conducting monetary policy in this region of the demand curve is a variant of the corridor system referred to as a floor operating system. In a floor system, the interest rate on reserves becomes the target rate for monetary policy. Such a system has the advantage of allowing the central bank to change its target policy rate without necessarily changing the supply of reserves as in the traditional operating framework (Keister, Martin, and McAndrews; Goodfriend).

As shown in Figure 2, in a corridor system, the central bank can change the target policy rate by simply announcing a change in floor and ceiling of the corridor. For example, to raise the target policy rate, the central bank could simply raise the discount rate from i_1^d to i_2^d and the rate on excess reserves by an equal amount from i_1^r to i_2^r. The policy rate would rise from i_1^* to i_2^*, with the supply of reserves remaining unchanged at R^*. This flexibility could be important in a system without

Figure 2
INTEREST ON RESERVES AS A POLICY INSTRUMENT



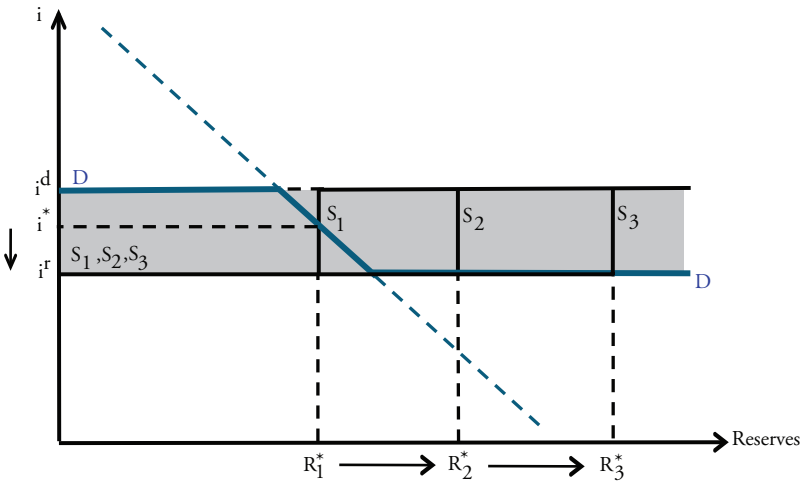
reserve requirements where depository institutions' demand for reserves stemmed only from their demand for settlement balances. Flexibility could also be important during a financial crisis, where the central bank needed to greatly increase the liquidity in the banking system.

The corridor system also allows the central bank to change the supply of reserves while maintaining control over the policy rate. When the central bank increases the supply of reserves, the supply schedule shifts to the right, as illustrated in Figure 3 by the shift from S_1 to S_2. In the traditional framework (not shown in the figure), such an increase in reserves would cause the policy rate to decline along a continuously downward-sloping demand curve. As the supply was steadily increased, the policy rate would eventually fall to the zero lower bound. In the corridor system, however, the decline in the policy rate is limited by floor of the corridor—the interest rate on excess reserves. As shown in the figure, as the supply of reserves increases from S_1 to S_2, the policy rate falls from i^* to i^r. As the supply of reserves increases even further from S_2 to S_3, the policy rate remains anchored at the interest rate on reserves, i^r.

The corridor system and, in particular, the corridor floor, allow the central bank to separate interest rate policy from liquidity policy.

Figure 3

A CHANGE IN THE SUPPLY OF RESERVES WITHOUT A CHANGE IN THE POLICY RATE



This separation can be important in a liquidity crisis when the central bank might need to pump an unusually large quantity of reserves into the banking system. Without the interest rate floor established by the corridor, such an injection of reserves could push the policy rate well below its target. This phenomenon occurred in the United States when the terrorist attacks of 9/11 prompted the Federal Reserve to temporarily pump a large amount of reserves into the system (as shown in Chart 1). Because the Federal Reserve paid no interest on reserves at the time, the injection of liquidity led to a decline in the federal funds rate below its target rate that lasted several days.

More recently, in response to the financial crisis of 2008-09, the Federal Reserve's injections of reserves have literally been "off the chart" (as shown in Chart 1). As noted earlier (and shown in Chart 3), this increase in the supply of reserves initially led to the funds rate falling below its target rate. The introduction of interest on reserves in October 2008 eventually helped anchor the funds rate near the FOMC's target rate. Since December 2008, when the FOMC lowered the funds rate target to a range of 0 to 25 basis points and lowered the interest rate on reserves to 25 basis points, the federal funds rate has traded close to, but still below, the rate on excess reserves. Nevertheless, the payment of

interest on reserves has allowed the Federal Reserve to vastly increase the size of its balance sheet while generally keeping the funds rate slightly above zero and maintaining activity in the interbank market.

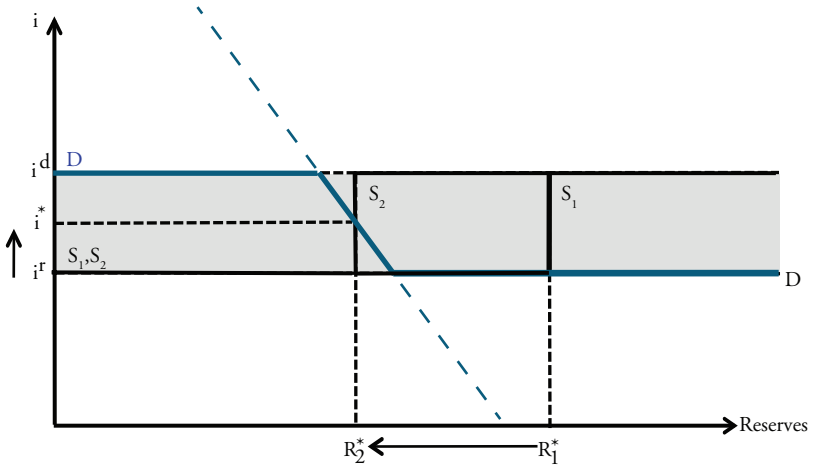
The floor established by the interest rate on reserves will, in theory, also help the Federal Reserve exit from its current highly accommodative policy stance when the time comes. As shown in Figure 2, the Federal Reserve can raise the overnight interbank rate by announcing an increase in the interest rate on reserves. This action can be implemented without a reduction in the supply of reserves, allowing the Fed to independently determine the appropriate speed with which to shrink its balance sheet. Combined with various tools to shrink the balance sheet, the payment of interest on reserves will allow the Federal Reserve to eventually renormalize monetary policy.[11] Once the supply of reserves has fallen within the range of the downward-sloping portion of the demand curve for reserves, monetary policy can potentially operate under a pure corridor system, as depicted in Figure 4.

International experience

While the Federal Reserve is currently relying on the interest rate on reserves to help keep the federal funds rate above its zero lower limit, the Fed has not formally adopted a corridor system. In contrast, a number of central banks—including the Bank of Canada, Bank of England, Bank of Japan, European Central Bank (ECB), Norges Bank, Reserve Bank of Australia, Reserve Bank of New Zealand, and the Swedish Riksbank—have for some time operated under various versions of the corridor system. In the recent financial crisis, however, the ECB, Bank of Japan, Bank of England, Bank of Canada, and the Norges Bank have all moved to a floor system. The other central banks have maintained their policy rates near the center of their respective corridors. This section describes the operating frameworks of a bank that is currently operating at the floor—the ECB—and of a bank that has maintained a more traditional corridor framework—the Riksbank. The interest rate corridors of the other central banks—as they have evolved over time—are shown in the charts in the appendix.[12]

The ECB implemented a corridor system when it came into existence in June 1998. The system became operative with the launch of the euro in 1999. The ECB's two standing facilities form the floor

Figure 4
A "RENORMALIZATION" OF MONETARY POLICY

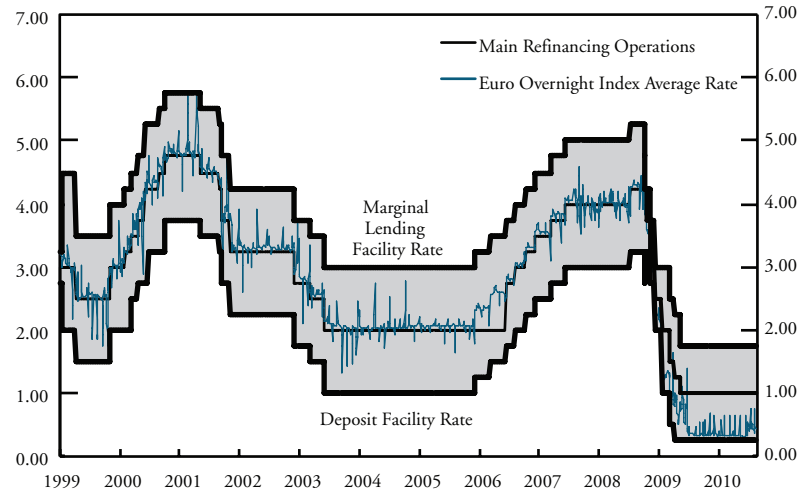


and ceiling of the overnight interest rate corridor. The floor is set by the bank's deposit facility. This facility allows financial institutions to make overnight deposits with the national central banks. Under normal circumstances, the deposit facility rate is less than the market rate, discouraging the facility's use. The ceiling rate is determined by the ECB's marginal lending facility, which allows banks to obtain overnight liquidity at a penalty to market rates. Since there is generally no credit limit at the marginal lending facility, it has served as an effective upper limit on overnight rates.[13]

Typically, the Governing Council of the ECB determines the stance of monetary policy at its first meeting each month, setting both its target rate and the width of the corridor around the target. Given the target overnight rate, the council chooses how much higher than the target the bank will lend at its marginal lending facility, and how much lower than the target it will set the deposit facility rate. The ECB then uses a number of open market instruments to steer overnight rates.

The interest rate corridor was originally uneven, with the marginal lending facility set 150 basis points higher than the target rate and the deposit facility rate set 100 basis points below the target (Chart 4). However, accompanying its April 8, 1999 rate cut, the corridor was narrowed

Chart 4
EUROPEAN CENTRAL BANK



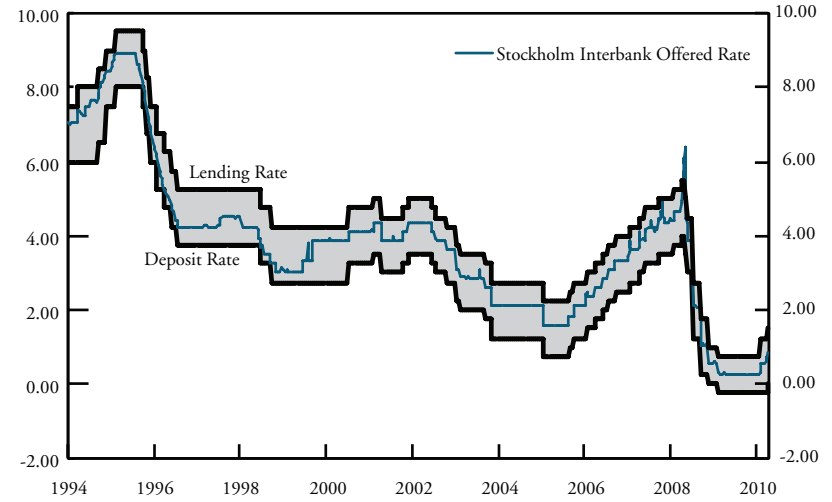
Source: European Central Bank

to 200 basis points, with the target rate at the center. This corridor was, for the most part, maintained until the recent financial crisis. During the crisis, actual overnight rates were driven near the floor of the corridor due to the ECB's efforts to boost liquidity. The corridor was temporarily narrowed to 100 basis points in October 2008. It was restored to 200 basis points in early 2009, but narrowed slightly after the ECB's meeting on May 7, 2009, to its present width of 150 basis points.

The Riksbank introduced its corridor system in June 1994 following the elimination of reserve requirements on April 1, 1994 (Chart 5). As originally conceived, the governor of the Riksbank would set the repo rate within a corridor determined by the Governing Board of the bank. This structure was adopted to allow flexibility in setting interest rates in response to fluctuations in exchange rates. When the corridor system was first introduced, the corridor was asymmetric, with the ceiling rate set 55 basis points above the repo rate and the deposit rate set 95 basis points below the lending rate. Because the corridor was set by the Governing Board, while the repo rate was determined by the governor, the target rate and the corridor did not always move in tandem.

In 1999, the Swedish government granted the Riksbank greater independence, and monetary policy became the responsibility of a new

Chart 5
RIKSBANK



Source: Sveriges Riksbank

Executive Board. The rate corridor remained asymmetric until December 7, 2000, when the Executive Board indicated that the deposit and lending rates would no longer be used to signal monetary policy. Instead, the repo rate would signal policy and would normally be set at the center of an interest rate corridor 150 basis points wide.

As the Riksbank eased policy in response to the global financial crisis, the interest rate corridor was temporarily narrowed. On April 22, 2009, the corridor was narrowed to 100 basis points as the repo rate was cut from 1 percent to 0.5 percent. This action placed the floor of the corridor at the zero lower interest rate bound. Three months later, on July 8, the repo rate was cut to 25 basis points, placing the deposit rate at -25 basis points. Despite the disincentive to hold balances at the central bank from a negative deposit rate, banks continued to maintain unusually large deposits.

At its July 7, 2010 meeting, the Riksbank's Executive Board began to reverse course and raised the repo rate to 0.5 percent. In addition, it once again widened the corridor to 150 basis points, thereby maintaining the negative deposit rate. The Riksbank stated that the negative deposit rate has not greatly affected the quantity of deposits, in part because the Bank maintains a narrower (20 basis points wide) interday

corridor for "fine-tuning operations." At its September 2010 meeting, the Riksbank's executive board raised rates once again, placing the floor of the corridor back in non-negative territory.[14]

In general, researchers have found that the corridor system has been successful in limiting fluctuations in overnight rates and in allowing central banks to provide considerable liquidity to the banking system during financial crises. For example, in studying eight central banks operating under some version of the corridor system, Bowman, Gagnon, and Leahy find that "in cases in which central bank balances were abundant and a central bank's target for the overnight market rate was at or close to the policy rate meant to serve as a floor for the overnight rate, these policy rate floors appeared to contain downward movements in market interest rates."[15]

In addition, Bowman and others find several examples over the past ten years where central banks tightened policy without reducing reserve balances. In these cases, the central bank raised the floor under the policy rate, lifting other rates with it. "On balance, we read the evidence as indicating that interest paid on excess reserve balances (or the equivalent) can be used by a central bank to tighten monetary policy and reduce reliance on supporting operations to drain reserves."

Challenges for the Federal Reserve

While the corridor and floor systems appear to have been used effectively in a number of central banks, the effectiveness of such a system is not established for the Federal Reserve. Three issues in particular may limit the effectiveness of a corridor system in the United States—a soft floor, a porous ceiling, and a diverse decision-making structure.

A soft floor. As noted earlier, the Federal Reserve began paying interest on reserves in October 2008. A month later, it began setting the rate on excess balances equal to the lowest FOMC target rate in effect during the reserve maintenance period.[16] Since that time, however, the federal funds rate has persistently traded below the rate paid on reserves. As a result, interest on reserves has proven to be a soft floor in the United States. Why any financial institution would make a risky loan in the federal funds market to another institution at a rate below the risk-free rate paid by the Federal Reserve is puzzling.

The answer to the puzzle is likely found in the institutional characteristics of the federal funds market.[17] In particular, the soft floor is likely due to the presence of financial institutions in the overnight market that, under current law, are not eligible to receive interest on reserves held at the Federal Reserve. In particular, the government-sponsored enterprises (GSEs)—including Fannie Mae and Freddie Mac—and some international institutions have accounts at the Reserve Banks but receive no interest on the reserves held in those accounts. As a result, these institutions have an incentive to lend overnight funds to other institutions willing to pay a positive rate of return.

Normally, banks might be expected to be willing to pay up to the interest rate on reserves to borrow from the GSEs. A bank could borrow from the GSE at a rate below what it receives from the Federal Reserve and deposit the funds at the Fed. In this transaction, the bank would earn a return equal to the difference between the rate of interest on reserves and the rate paid to borrow from the GSE. As banks competed to borrow from the GSEs, the overnight rate paid to the GSEs might be expected to rise up to the level of the interest rate on reserves. However, this arbitrage opportunity has not been fully exploited, and the funds rate has tended to trade below the floor established by the interest rate on reserves.

Among a number of explanations offered for this anomalous behavior, the most common view is that the GSEs have limited their lending to a small number of banks. They have done this because their overnight loans are not collateralized and therefore carry some risk of default. Especially in the current situation, where many banks have failed, the risk of default has apparently made the GSEs cautious about which banks to lend to and how much they lend. While the risk to the GSEs is likely small, it has allowed the banks to exert some market power over the GSEs which in turn has allowed the banks to pay a lower rate on overnight funds than the rate on reserves.[18]

The question now is whether the soft floor under the federal funds rate will limit the effectiveness of the interest rate on reserves as a policy tool. When the time comes to begin removing the extraordinary monetary accommodation put in place during the financial crisis, will the Fed be able to push up market rates by increasing interest on reserves?

Although the answer will not be known for sure until the FOMC begins to exit its highly accommodative policy stance, international evidence is reassuring.[19] Bowman and others argue that, while limited access to interest-earning deposit accounts at central banks may weaken the link between the floor and market rates, it need not significantly reduce the effectiveness of interest on reserves as a policy tool. Even if the interest rate on reserves is not a solid floor, arbitrage in the interbank market should maintain a tight link between the policy rate and the market rate. "Our case studies do not provide examples of tightening when the spread is inverted, but they do support the finding that the positive spreads that prevailed during tightening episodes generally remained stable (that is, market rates typically rose in step with increases in the interest rate paid on excess reserves or its equivalent)" (p. 4). In addition, the Fed can drain reserves through various temporary operations or through outright sales of securities to provide additional support under the funds rate.

A porous ceiling. Another concern for the Federal Reserve is the effectiveness of the discount rate in establishing a ceiling for the federal funds rate. With the federal funds rate currently trading below its floor, this concern is of little relevance today. However, once the Federal Reserve's balance sheet returns to a more normal size, so that the supply of reserves intersects the downward sloping segment of the demand schedule, a porous ceiling could lead to occasional spikes in the federal funds rate. Such spikes could occur when the supply of reserves or settlement balances unexpectedly falls or demand increases and banks are left short of funds to meet reserve requirements or settle payments. If for some reason, banks are reluctant to borrow from the Federal Reserve and instead go to the interbank market for overnight funds, the funds rate could be driven higher than the discount rate.

But why would a financial institution pay more than the discount rate charged by the Fed to instead borrow from other institutions on the interbank market? One reason is that banks may perceive a stigma associated with discount window borrowing.[20] This stigma stems from concerns that discount window borrowing could signal to other financial institutions, investors, and regulators that the borrowing institution is financially distressed. Although the Federal Reserve does not immediately disclose to the public which institutions have borrowed from

the discount window, the interconnectedness of the interbank market may make it possible for banks to figure out which institutions have borrowed from the discount window.[21]

Evidence suggests such a stigma does in fact inhibit discount window borrowing, even though primary credit is extended only to depository institutions that are in generally sound financial condition.[22] For example, Furfine finds that the volume of borrowing from the discount window after 2003—when the Fed introduced a penalty discount rate—was lower than interbank borrowing behavior would have predicted.[23] In addition, in August 2007, at the beginning of the recent financial crisis, the Board of Governors lowered the discount rate from 100 basis points above the target federal funds rate to 50 basis points. Nevertheless, despite severe liquidity shortages, borrowing remained weak.[24] Finally, the federal funds rate has occasionally spiked above the discount rate. For example, in September and October of 2008, the federal funds rate rose above the discount rate on several days in the wake of the Lehman Brothers bankruptcy and the debate, and ultimate passage, in Congress of the Treasury's Troubled Asset Relief Program (TARP).

Whether the discount rate will provide an effective ceiling on rates in the future (in the event the Federal Reserve moves more formally toward a corridor operating system) is unclear. Particularly in times of financial stress, depository institutions may continue to be reluctant to borrow from the Fed, limiting the discount window's effectiveness in moderating deviations in the federal funds rate from target. That said, to the extent stigma remains a concern, policymakers may need to take further actions to encourage depository intuitions to view the discount window as a standing facility from which sound institutions with sound collateral may borrow without administrative restrictions or stigma.

Diverse decision-makers. A final issue for the Federal Reserve, especially as it unwinds its current highly accommodative policy, is the sequencing of policy actions by the FOMC, the Board of Governors, and the Reserve Bank Boards of Directors. Traditionally, the stance of policy is signaled by the federal funds rate target. With the current abundance of reserves in the banking system, though, the funds rate has fallen to the soft floor established by the interest rate on reserves. While the FOMC determines the target federal funds rate, the Board of

Governors establishes the interest rate on reserves. Thus, the sequencing of actions by the FOMC and Board of Governors could affect the actual stance of policy. If the FOMC acts to raise the federal funds rate target without a corresponding action by the Board to raise the interest rate on reserves, the funds rate would likely remain stuck at the floor established by the interest rate on reserves. Conversely, if the Board of Governors acts to raise the interest rate on reserves, the federal funds rate could rise in lock step without any action taken by the FOMC. Clearly, a mechanism will be needed to coordinate these moves.

A coordination mechanism may also be needed when monetary policy has been normalized and the funds rate target is again within the corridor established by the discount rate at the ceiling and the interest rate on reserves at the floor. Typically, in a corridor system, the target policy rate is set in the middle of the corridor and serves as the key signal of the stance of policy. The ceiling and floor rates are typically set a fixed increment above and below the target rate and move in lock step with any change in the policy target. As suggested above, if the Federal Reserve were to adopt a formal corridor system, the framework would likely require coordination between the FOMC and Board of Governors in establishing the floor rate. In addition, coordination will be required with the Reserve Bank Boards of Directors, which recommend discount rate changes subject to the approval of the Board of Governors.

While these coordination issues may complicate the operation of a corridor system in the United States, they are not likely to be insurmountable. After all, the FOMC encompasses the members of the Board of Governors and five of the Reserve Bank presidents who serve as voting members of the FOMC on a rotating basis. The Reserve Bank presidents in turn recommend discount rate actions to their respective Boards of Directors. Thus, while complex, there are established interrelationships among the FOMC members who determine the federal funds rate target, the Boards of Directors of the Reserve Banks who recommend discount rate changes, and the Board of Governors who approve discount rate changes and establish the interest rate on reserves.

III. CONCLUSIONS

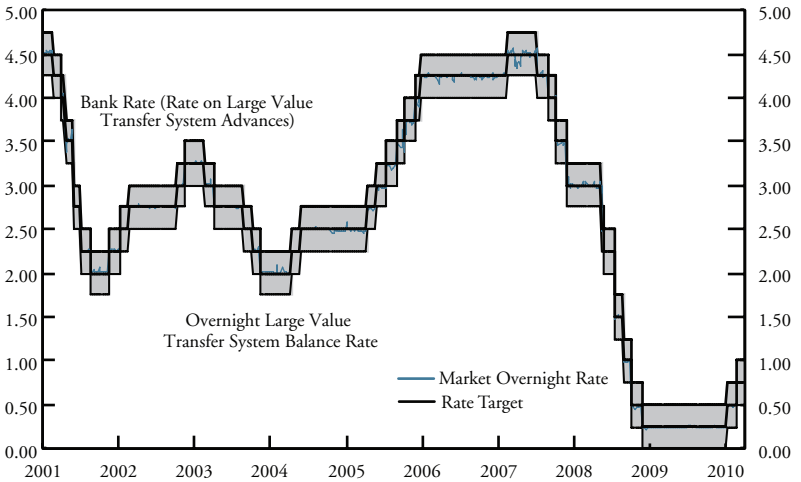
The Federal Reserve's unprecedented easing of monetary policy in the global financial crisis resulted in a huge increase in reserves and

drove the federal funds rate virtually to zero. These actions also rendered the Federal Reserve's traditional mechanism for setting the target federal funds rate unworkable. Reserves became so abundant that the funds rate eventually became insensitive to changes in the supply of reserves. Unless the Federal Reserve drains a substantial amount of these reserves from the banking system—through temporary operations or outright asset sales—control over the funds rate now largely depends on the floor established by the interest rate paid on reserves. The interest rate on reserves will therefore likely be an important tool of monetary policy as the Federal Reserve eventually exits from its highly accommodative policy stance.

With the establishment of a discount rate set above the target federal funds rate, along with interest on reserves, the Federal Reserve now has in place the basic elements of a corridor operating system. Such a system is already in operation at a number of other central banks, including the ECB. Once monetary policy in the United States is normalized so that the federal funds rate again becomes sensitive to changes in the supply of reserves, the Federal Reserve may want to consider formally moving toward a corridor system. A corridor system would have the advantage of potentially providing tighter control over the federal funds rate target in a banking system in which reserve requirements are nonbinding. In addition, in times of financial stress, a corridor system could allow the Federal Reserve to inject a large amount of liquidity into the banking system while maintaining control over the funds rate target via interest on reserves.

Chart A1

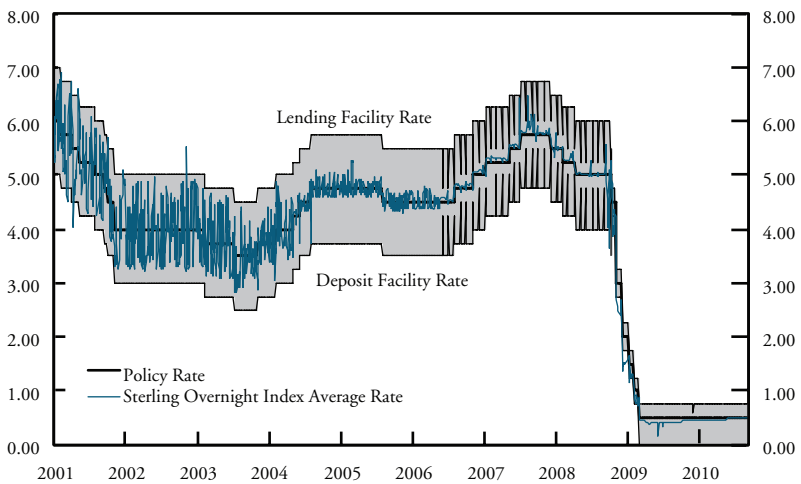
BANK OF CANADA



Source: Bank of Canada

Chart A2

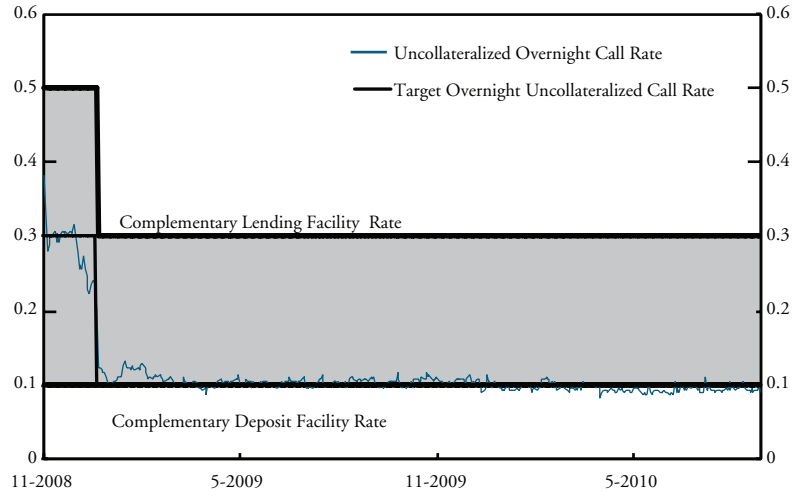
BANK OF ENGLAND



Source: Bank of England

Chart A3

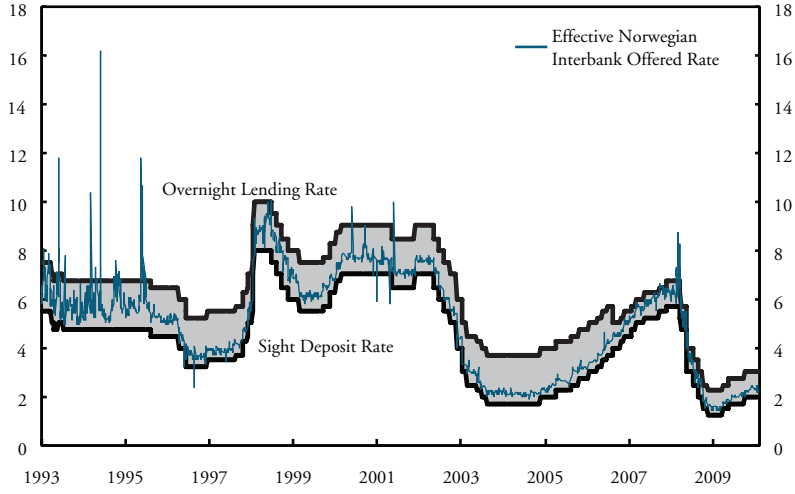
BANK OF JAPAN



Source: Bank of Japan

Chart A4

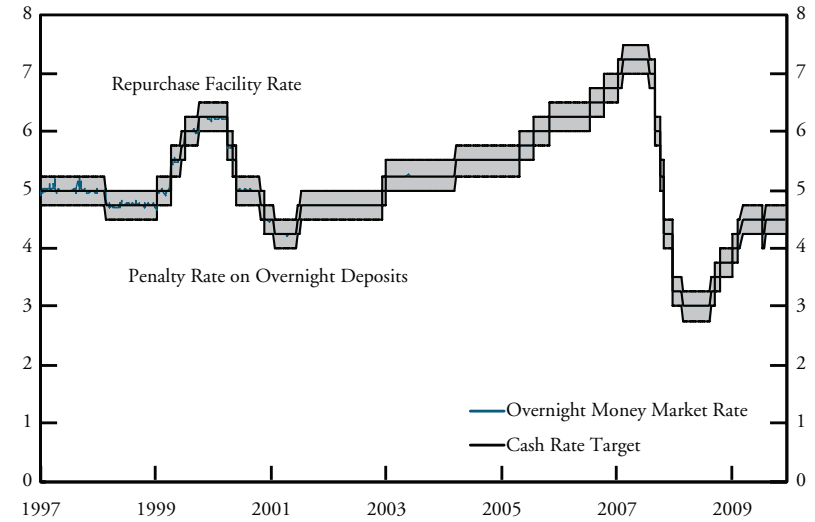
NORGES BANK



Source: Norges Bank

Chart A5

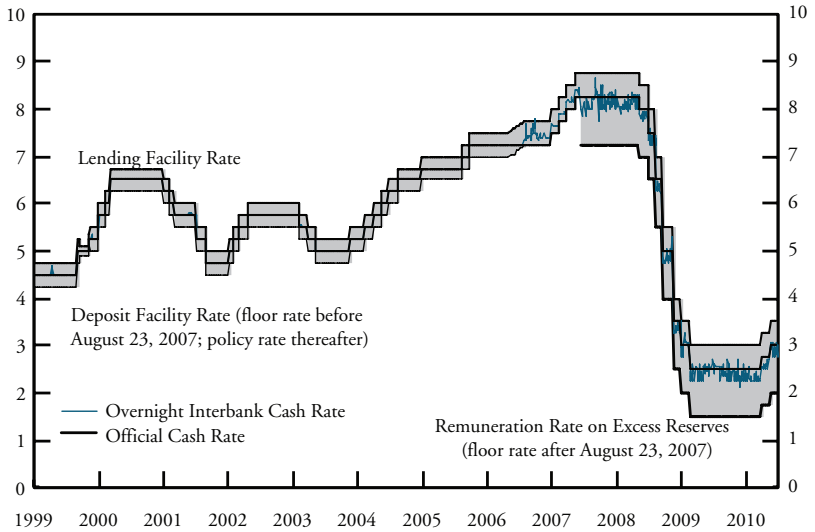
RESERVE BANK OF AUSTRALIA



Source: Reserve Bank of Australia

Chart A6

RESERVE BANK OF NEW ZEALAND



Source: Reserve Bank of New Zealand

ENDNOTES

[1]The FOMC's policy mandate is defined in the Federal Reserve Act, which requires that: "The Board of Governors of the Federal Reserve System and the Federal Open Market Committee shall maintain long-run growth of the monetary and credit aggregates commensurate with the economy's long-run potential to increase production, so as to promote effectively the goals of maximum employment, stable prices, and moderate long-term interest rates."

[2]This section draws on Board of Governors of the Federal Reserve System (2005) and Sellon and Weiner (1996). See these sources or Bernanke (2005) for a more detailed discussion of the traditional operating framework.

[3]In a sweep account, funds are automatically transferred from deposit accounts with reserve requirements to accounts, such as money market deposit accounts, that do not have reserve requirements.

[4]Volatility could be exacerbated if the demand for settlement balances were less interest sensitive than the traditional demand for reserve balances (Sellon and Weiner, 1996).

[5]More recently, in November 2010, the FOMC announced that it planned to purchase an additional $600 billion of longer-term Treasury securities by the end of the second quarter of 2011.

[6]More technically, the rate on required reserves was calculated as the average targeted federal funds rate established by the FOMC over each reserve maintenance period less ten basis points, and the rate on excess reserves was the lowest targeted federal funds rate for each reserve maintenance period less 75 basis points.

[7]This section draws on Woodford. Also, see Berentsen and Monet, and Whitesell for more technical discussions of a corridor system.

[8]For ease of exposition and to simplify, the analysis will focus only on reserve balances—that is, total reserves less applied vault cash. In addition, the analysis abstracts from contractual clearing balances under which depository institutions hold, under contractual agreements, an amount of reserves in excess of requirements in exchange for credits for priced services provided by the Federal Reserve banks. With the quantity of reserves currently well above required reserves, as well as the reserves needed for settlement and clearing, this simplification does not affect the qualitative analysis.

[9]Under the Federal Reserve's current procedures, as established in January 2003, credit is made available to help depository institutions make short-term adjustments to their balance sheets and as an alternative source of funds in the event of a shortfall in the supply of Federal Reserve balances. With an above-market rate and the provision of funds only to financially sound institutions with collateral satisfactory to the Reserve Bank making the loan, "primary credit" is extended largely without administrative restrictions. Nevertheless, it is intended as a backup source of credit, not a regular source of funding.

The Federal Reserve also provides a "secondary credit facility," through which it lends funds at a higher rate to less-sound financial institutions to "meet backup liquidity needs when its use is consistent with the borrowing institution's timely return to a reliance on market sources of funding or with the orderly resolution of a troubled institution's difficulties."

Finally, the Federal Reserve has a "seasonal credit facility" designed to help small depository institutions manage seasonal fluctuations in their loans and deposits (Federal Reserve Board of Governors, pp. 46-50).

For monetary policy purposes, the primary credit facility is the one relevant in limiting upward pressure on the federal funds rate when there is a shortage of reserves. The interest rate on primary credit—commonly referred to as the "discount rate"—is the rate that forms the ceiling in a corridor system.

[10]Berentsen, Marchesiani, and Waller provide a theoretical argument showing that a positive spread between the floor and ceiling of the corridor is socially optimal. "[W]ith restrictions on the central bank's ability to extract tax revenue, the optimal policy necessitates setting the deposit rate strictly below the target rate. Moreover, it always involves a strictly positive interest-rate spread. The optimality of a non-zero corridor arises because it improves risk sharing and hence welfare by shifting central bank money to those market participants who need it most urgently" (p. 3).

[11]These tools include term deposit accounts at the Federal Reserve, large-scale reverse repurchase operations, and outright asset sales.

[12]Bowman, Gagnon, and Leahy provide a detailed description of the experience of these eight central banks in using interest on reserves in a corridor or floor operating system, especially in tightening monetary policy. Sellon and Weiner (1997) discuss the experiences of the Bank of Canada, the Bank of England, and the Reserve Bank of New Zealand in conducting monetary policy in the absence of reserve requirements.

[13]For a comprehensive description of the ECB's monetary policy framework, see European Central Bank (2008).

[14]*http://www.riksbank.com/templates/Page.aspx?id=12498,www.riksbank.se/templates/Page.aspx?id=32731.*

[15]An exception was the United Kingdom, where in 2009 and 2010 the sterling rate has traded below the policy rate floor. As will be discussed later, the United Kingdom is similar to the United States in that the market for overnight funds includes institutions that are not eligible for payment of interest on reserves (Bowman, Gagnon, and Leahy, p. 1).

[16]The rate on required reserves was set equal to the average target federal funds rate over the reserve maintenance period.

[17]Bech and Klee discuss the heterogeneity across participants in the federal funds market and the resulting market segmentation.

[18]In addition, as Bech and Klee point out, "the GSEs have become a larger share of the federal funds market in recent history and hence have pulled down the weighted average federal funds rate" (p. 3).

[19]International evidence comes from the Bank of England, the Bank of Canada, and the Norges Bank, all of which "monitor or target a measure of market rates that include lending rates for institutions without access to interest on deposits at the central bank, so by those metrics, failures of policy rate floors are potentially more likely" (Bowman, Gagnon, and Leahy, p. 3).

[20]There is also a cost associated with providing collateral for a discount window loan that may cause the effective rate on the loan to be higher than the discount rate.

[21]The Board of Governors does release a weekly report providing aggregate borrowings from the Reserve Banks' discount windows. Moreover, effective July 21, 2010, under the terms of the Dodd-Frank Wall Street Reform and Consumer Protection Act, the Federal Reserve will begin publicly disclosing, with a lag of about two years, the names of institutions borrowing from the discount window, the amount borrowed, the interest rate paid, and information on the types and amount of collateral pledged. This information will be released quarterly and may be disclosed with less than a two-year lag if the chairman of the Federal Reserve Board determines it to be in the public's interest and it does not harm the operation of the window *(www.frbdiscountwindow.org*).

[22]Institutions that do not qualify for primary credit are eligible for secondary credit (*www.frbdiscountwindow.org*). For evidence that stigma has resulted in a porous ceiling, see Courtois and Ennis.

[23]Furfine, as summarized in Courtois and Ennis.

[24]In response to these shortages, the Federal Reserve introduced, on a temporary basis, the Term Auction Facility (TAF) under which the Fed conducted biweekly auctions of term funds to depository institutions. These auctions reduced the perceived stigma of borrowing from the Fed since they were widely subscribed to and the names of borrowers were not publicly released. The final TAF auction was conducted on March 8, 2010.

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