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Monetary Policy Implementation: Common Goals but Different Practices

Marlene Amstad and Antoine Martin

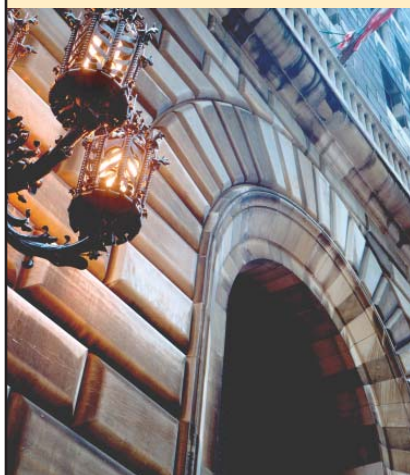
While the goals that guide monetary policy in different countries are very similar, central banks diverge in their methods of implementing policy. This study of the policy frameworks of four central banks—the Federal Reserve, the European Central Bank, the Bank of England, and the Swiss National Bank—focuses on two notable areas of difference. The first is the choice of an interest rate target, a standard feature of conventional monetary policy. The second is the choice of instruments for managing the central banks' expanded balance sheets—a decision made necessary by the banks' unconventional practice of acquiring large quantities of assets during the financial crisis.

Central banks around the world have similar monetary policy goals—most notably, a mandate to achieve price stability. Despite their shared objectives, however, these institutions often implement monetary policy in different ways, both when the economy is strong and when it is in crisis. Understanding these differences, together with the costs and benefits of each approach, can be useful to policymakers, especially when a central bank adopts a new or unconventional practice.

In this edition of *Current Issues*, we examine how four central banks—the Federal Reserve, the European Central Bank, the Bank of England, and the Swiss National Bank—approach the choice of a targeted rate of interest, or “operational target”—a key feature of conventional monetary policy. In addition, we consider how the same central banks are managing the expanded balance sheets they assumed when they adopted the unconventional practice of acquiring large quantities of assets. This practice was intended to provide much-needed liquidity to the markets and restore market functioning during the peak of the 2007-09 financial crisis and to ease monetary conditions to support nominal demand, thereby reducing the risk that inflation would fall substantially below target. The asset acquisitions created substantial volumes of reserves that increased the size of the central banks' balance sheets, altering the conditions in which the banks conduct monetary policy.¹ We provide a discussion of the trade-offs for the alternative choices available to the banks—both with regard to interest rate targets and balance sheet management—and describe the approaches that the individual banks have taken.

Our look at central bank approaches to operational targets focuses on the choice between short-term and longer-term rates. In particular, we compare the Swiss National Bank's adoption of a longer-term interest rate target with the other Banks' use of an overnight rate.

¹ The large supply of reserves has sparked a debate regarding whether or not these exceptional central bank policies are inflationary or likely to lead to excessive lending by banks (see McAndrews [2011] and Martin, McAndrews, and Skeie [2011]).



Our review of the central banks' methods of managing their large balance sheets centers on the choice of particular instruments that would allow the banks to adjust interest rates without regard to the quantity of reserves.² Among these instruments are the payment of interest on excess reserves at the policy rate, the issuance of central bank bills, and the use of reverse repurchase agreements (reverse repos).³

Interestingly, the Federal Reserve, the European Central Bank, the Bank of England, and the Swiss National Bank have adopted different combinations of these instruments. The Fed pays interest on excess reserves at the policy rate, but is not allowed to issue bills. The European Central Bank does not remunerate excess reserves kept in the counterparties' current account at the central bank, but it could immediately issue bills, an action that it has not taken thus far.⁴ The Bank of England pays interest on reserves at the policy rate and has issued bills. And the Swiss National Bank has issued bills but does not pay interest on reserves, although it has the authority to do so. It is too early to tell whether these differences in practice will affect the desired policy outcomes.

Implementation in Normal Times: The Operational Target

A central bank faces a basic trade-off when choosing an operational target, which is typically an interest rate target.⁵ Although a longer-term money market rate is more challenging to target than a shorter-term rate, the former is more relevant to economic activity because it more directly influences firms' investment choices and households' real estate decisions. Longer-term money market rates are more challenging to target in part because a larger number of market participants determine the supply of and demand for such funds. Most central banks, including the Federal Reserve, the European Central Bank, and the Bank of England, target an overnight rate, whether implicitly or explicitly, while the Swiss National Bank targets a range for the three-month London interbank offered rate (Libor) for the Swiss franc.⁶ Because the Swiss central bank's choice of a longer-term rate as its target is unusual, we give it particular attention in this section.

² We do not discuss the central banks' ability to raise or lower interest rates, which we believe is not in question, but the mechanics of central banks' instruments to adjust rates.

³ A repurchase agreement is a sale of securities coupled with an agreement to repurchase them at a specified price at a later date (see Garbade [2006]). A reverse repurchase agreement is a purchase of securities coupled with an agreement to resell them at a specified price at a later date.

⁴ The European Central Bank does pay interest, however, on excess (surplus) reserves placed at its deposit facility, at a rate lower than its policy rate.

⁵ The Bank for International Settlements (2007) and Sturm (2010) discuss the monetary policy implementation frameworks cited in this article.

⁶ Libor is the offered rate for unsecured interbank lending in the London interbank market and is calculated for different currencies by the British Bankers' Association.

Choosing an Operational Target

The operational target is the instrument the central bank uses to achieve its objectives and to communicate the stance of its monetary policy. The link between the operational target and the central bank's objective needs to be tight so that changes in the target can influence the economy's performance in the long run. The central bank's ability to keep the interest rate close to this target also signals how well the bank is fulfilling its mandate. Such a signal is important because a more direct measure of the central bank's performance—for example, its ability to maintain price stability—may be observable only with a long lag.

Having control over the operational target is also important because it facilitates the central bank's communication with financial market participants. In normal market conditions, central banks can control the overnight rate tightly because they have a precise estimate of both the demand for overnight reserves and the supply of those reserves. In many countries, the demand for overnight reserves stems from the banking system's required (or voluntary) level of reserves.⁷ In such cases, the central bank can estimate with some precision the amount of reserves the banking system needs to hold over a given period. In countries where there are no reserve requirements, the demand for overnight reserves is typically at very low levels, which the central bank can also estimate.⁸

Meanwhile, the supply of reserves is determined by the central bank, subject to "autonomous factors" outside its control. These factors include payments that can affect the supply of reserves on a given day, such as payments into and out of a treasury account. Typically, central banks can form accurate estimates of these autonomous factors.⁹ Accordingly, with detailed knowledge of demand and with control over the supply of reserves, the central bank can meet its operational target with precision.

It is more difficult to target longer-term money rates or even capital market rates because several factors outside of the central bank's control influence the supply of and demand for reserves in these markets. Nevertheless, if credit-risk premia—the increased compensation investors require to hold riskier assets—and the term structure of interest rates are sufficiently stable, intervention in the overnight market, or in other very short-term markets, will allow the central bank to steer longer-term rates. In these circumstances, targeting the overnight rate will influence longer-term rates in a predictable manner.

⁷ Where reserves are voluntarily held, the demand to hold them will be a function of the remuneration rate, among other things.

⁸ In principle, the aggregate demand for reserves should be zero. Indeed, absent reserve requirements, any bank holding positive reserves should be able to lend those reserves to a bank having an exactly offsetting negative position. In practice, because of frictions in the interbank market and payment needs, demand remains for a small quantity of reserves.

⁹ Keister, Martin, and McAndrews (2008) provide more details about monetary policy implementation with an overnight rate as the operational target.

If credit-risk premia or the term structure of interest rates is unstable, which is likely to happen in times of market stress, stabilizing the overnight rate can be more difficult. And stabilizing the overnight rate will not prevent longer and more economically relevant interest rates from fluctuating with credit-risk or liquidity premia, the latter reflecting the increased compensation investors require to hold less-liquid assets. For example, if credit risk or liquidity risk suddenly increases, then monetary policy will be more constraining and less stabilizing than desired, for any given level of the overnight rate.

In principle, a central bank could choose the overnight rate as its operational target in normal times, when changes in short-term rates influence longer-term rates in a predictable manner, and switch to a longer rate during a crisis. By focusing on a longer rate in troubled times, the central bank could partly offset the volatility of credit-risk and liquidity premia. Changing the operational target during a crisis is unappealing, however, as such a change would make communication with financial market participants difficult and raise market uncertainty precisely at a time when it would be least desirable.

*The Swiss Approach*¹⁰

The Swiss National Bank appears to have done well using a range for a longer-term rate as its operational target.¹¹ We show that this central bank has been able to target the three-month Libor effectively. To assess how the bank has fared with this framework, we track a measure of stress in the money market during the 2007–09 financial crisis. While this measure does not provide direct evidence about the suitability of the central bank's framework for implementing monetary policy, we argue that if the framework were inadequate, it would likely be reflected in interbank market stress during the crisis. Finally, we illustrate a potential benefit of targeting a longer-term rate as opposed to an overnight rate.

When the Swiss central bank introduced its current monetary policy implementation framework at the end of 1999, few Swiss franc money-market segments were liquid and sufficiently developed to accommodate the needs of monetary policy implementation.¹² The three-month Swiss franc Libor market was viewed as the best candidate, since it was the most liquid money market as well as the one most relevant to economic activity.

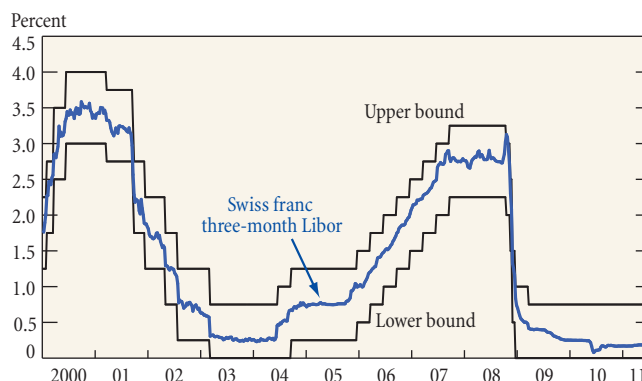
¹⁰ Since September 6, 2011, the Swiss National Bank has implemented a minimum exchange rate in addition to its operational target. Because the central bank's experience with the minimum exchange rate has been very limited, we focus only on the time before September.

¹¹ Jordan, Peytrignet, and Rossi (2010) provide an overview of the Swiss National Bank's experience since adopting this operational target.

¹² Before 1999, the Swiss National Bank had a medium-term target for the seasonally adjusted monetary base. The change in concept was necessary because measures of money demand became increasingly unstable. Every quarter since 2000, the central bank has published a target range (comprising a percentage point) for the three-month Swiss franc Libor; the Swiss National Bank generally aims to keep Libor in the middle of that range.

Chart 1

Swiss Franc Three-Month Libor and Target Range



Sources: Swiss National Bank Market Analysis Platform; Bloomberg L.P.

Note: Libor is London interbank offered rate.

The Swiss National Bank uses a variety of instruments to steer the three-month Swiss franc Libor within its targeted range.¹³ Before the crisis, these instruments were mainly daily one-week repos. Since the outbreak of the crisis, longer-term repos, foreign-exchange swaps and purchases, reverse repos, and central bank bills have been used to steer liquidity provision and ensure that the three-month Libor remains in the targeted range. The mechanics are very similar to those used by other central banks to influence the overnight rate. When the Swiss National Bank injects reserves into the banking system, it expects the three-month Libor to fall; when the bank reduces the quantity of reserves in the system, it expects the three-month Libor to rise. Both before and during the crisis, the bank maintained tight control over its operational target (Chart 1).¹⁴

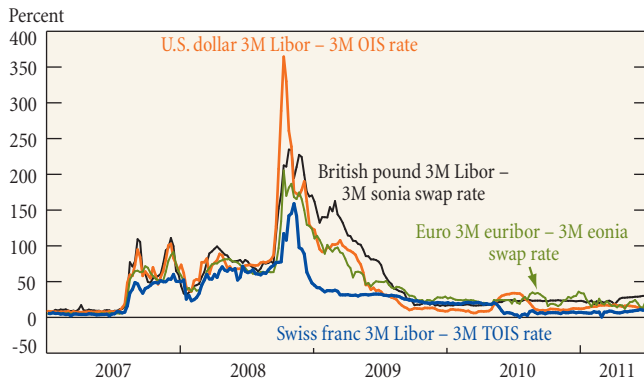
Next, we look at the Swiss central bank's experience during the crisis. We focus on the risk premia in money markets, as measured by the spread between Libor and the rate on overnight index swaps (OIS).¹⁵ These spreads were widely used as indicators of financial market stress during the crisis because they reflect the difference between collateralized and uncollateralized rates and therefore provide an indicator of the trust banks have

¹³ Over the course of the crisis, the liquidity regime of Switzerland changed from a structural liquidity deficit to a structural liquidity surplus. Therefore, the instruments chosen to steer the three-month Libor changed from liquidity-providing to liquidity-absorbing instruments.

¹⁴ Abbassi, Nautz, and Offermanns (2010) present a statistical analysis that reinforces this view; see, for example, their Tables 1 and 3. Further evidence is provided by developments in August 2011, when the Swiss National Bank's announcement that it would substantially increase reserves was followed by a marked fall in the three-month Libor.

¹⁵ OIS is a fixed/floating interest rate swap with the floating leg tied to daily rates—specifically, the federal funds rate for U.S. dollars, the euro overnight index average (eonia) for euros, the sterling overnight index average (sonia) for British pounds, and the tomorrow next overnight index swap (TOIS) rate for Swiss francs.

Chart 2
Risk Premia



Source: Bloomberg L.P.

Notes: Libor is London interbank offered rate; OIS is overnight index swap; sonia is sterling overnight index average; euribor is euro-area interbank offered rate; eonia is euro overnight index average; TOIS is tomorrow next overnight index swap; 3M is three-month.

in their interbank counterparties. Numerous factors could have influenced these spreads, so they provide only indirect evidence of the central bank’s performance.

We compare the Libor-OIS spread for the European Central Bank, the Swiss National Bank, the Bank of England, and the Federal Reserve. In the months prior to the crisis, the risk premium in each currency was approximately 5 basis points. All spreads increased in August 2007, at the onset of the crisis, but remained in a range of 25 to 100 basis points for most of the period until September 2008, when Lehman Brothers filed for bankruptcy. All spreads rose dramatically after Lehman’s collapse and reached their peak shortly thereafter. During this period, the spreads for the British pound and U.S. dollar were the highest and most volatile, while the Swiss franc spreads were generally below the spreads for the other currencies; euro spreads were somewhere in between (Chart 2). As noted above, this does not provide direct evidence of the central bank’s performance. The mean, median, maximum, minimum, and standard deviation of Libor-OIS spreads for each currency before and during the crisis are reported in Table 1.

There is a potential benefit in using a three-month rate as a target: It can allow the central bank to stabilize the more economically relevant long-term rate, while letting shorter rates fluctuate to absorb changes in risk or liquidity premia. Chart 3 plots the one-week Swiss franc repo rate and the one-week euribor as well as the three-month Libor for each currency at the onset of the crisis. In the euro market, the three-month Libor exhibited some volatility, while the rate in the European Central Bank’s one-week auction, the one-week euribor, was quite stable. In contrast, in the

Table 1
Risk Premia
Basis Points

	Swiss Franc	Euro	British Pound	U.S. Dollar
Mean	35.8	56.2	64.9	56.7
Median	30.7	45.7	48.5	41.3
Maximum	174.1	206.9	298.9	364.4
Minimum	-0.6	4.4	7.1	6.0
Standard deviation	28.9	37.0	54.8	57.6

Source: Bloomberg L.P.

Note: The sample period is June 2007–August 2011.

Swiss franc market, the three-month Libor was kept much more stable while the one-week repo rate fluctuated.

Some attribute the movements in these rates to volatile credit-risk or liquidity premia during the period under consideration. The Swiss National Bank was able to move its repo rates to cushion the changes in credit-risk and/or liquidity premia, thereby keeping the three-month Libor as stable as possible.¹⁶ Large changes in the one-week repo rate did not create any communication difficulties since they are not the focus of the Swiss framework for monetary policy implementation. In contrast, the European Central Bank’s practice is to stabilize short-term rates. Hence, the one-week euribor was stable and changes in the credit-risk or liquidity premia were reflected in the three-month Libor.

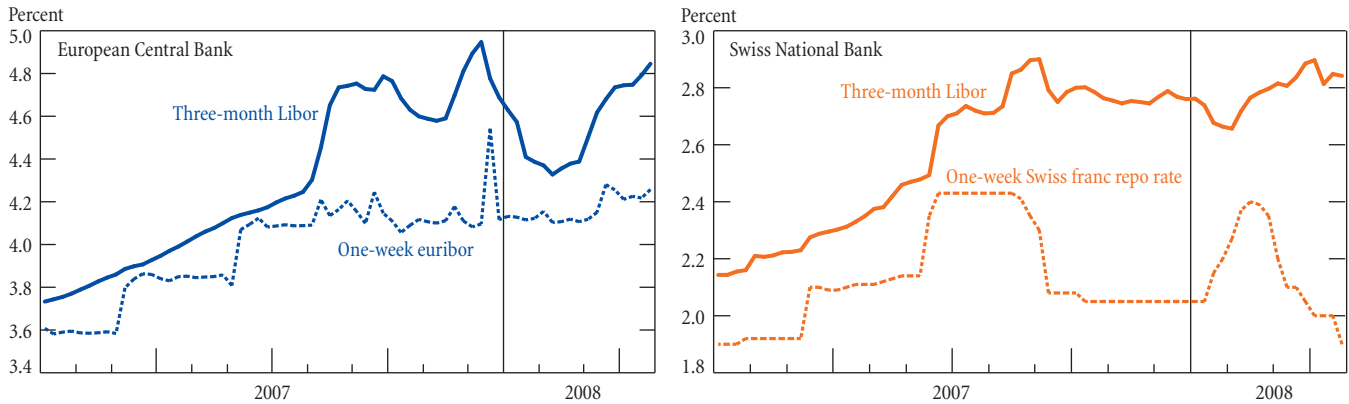
The longer-term target comes with the additional advantage that varying short-term instruments can be used for its implementation. The Swiss central bank announced in August 2011 that it would aim to keep the three-month Libor as close to zero as possible. To reach this goal, the bank could use various short-term instruments (such as foreign exchange swaps and the buyback of central bank bills) without causing communication difficulties.

The experience of the Swiss National Bank suggests that it is possible to target longer-term interest rates, even during times of stress in the money markets. However, this finding does not imply that central banks targeting overnight rates should reconsider their monetary policy implementation frameworks, especially if these frameworks have performed reliably. Nevertheless, the Swiss National Bank’s experience in steering an uncollateralized longer-term rate could be instructive for central banks that are considering modifying their monetary policy implementation framework.

¹⁶ Both credit risk and liquidity risk can occur as the Swiss National Bank steers an uncollateralized longer-term rate, the three-month Libor, with a collateralized shorter-term rate, the (typically one-week) repo rate.

Chart 3

One-Week Rates and Three-Month Libor



Source: Bloomberg L.P.

Notes: Libor is London interbank offered rate; euribor is euro-area interbank offered rate.

Implementation in Unusual Times: Interest on Reserves, Central Bank Bills, and Exit Strategy

The different practices adopted by central banks during the crisis are especially interesting because all of the institutions discussed here implemented exceptional or unconventional measures. In particular, they acquired large quantities of assets, thereby increasing the size of their balance sheets, as shown in Chart 4. This section focuses on some options central banks have at their disposal to manage these large balance sheets.¹⁷

A direct consequence of these asset purchases has been an increase in reserves held by the banking sector or, more precisely, by all institutions with an account at a central bank.¹⁸ This situation has prompted many central banks to consider how they will implement monetary policy when they need to raise interest rates from their current low levels. The banks' common goal is to conduct monetary policy effectively as they increase interest rates toward more usual levels, even if their balance sheets are still large. In this section, we discuss the instruments available and how they can be used.

Before the crisis, central banks would typically implement monetary policy by setting the supply of reserves equal to the demand for reserves at the desired interest rate.¹⁹ The demand for reserves can have different origins. The Federal Reserve, the European Central Bank, and the Swiss National Bank impose

reserve requirements, obliging banks to hold a certain level of reserves if they wish to avoid penalties. The Bank of England allows banks to set voluntary reserve targets.

Reserves held in excess of the required or targeted amount were remunerated at an interest rate lower than the policy rate, if at all.²⁰ For that reason, an increase in the amount of reserves supplied by the central bank could lead to a decrease in short-term interest rates, as banks tried to sell excess reserves to limit the opportunity cost of holding them. This, in turn, would put pressure on longer term rates because banks understand that an alternative to borrowing at a longer term is to roll over shorter-term loans. Hence, if banks anticipate that they can borrow at low short-term rates in the interbank market, longer-term rates will have to decrease accordingly.

In some cases, a decrease in the level of short-term interest rates was indeed observed as central banks increased the supply of reserves during the crisis.²¹ This was not necessarily a problem, because many central banks had lowered their target interest rate in response to the crisis. At some point in time, however, central banks have to think about how they can raise interest rates when it becomes appropriate to do so.

One possibility would be to sell the assets they have purchased or allow temporary operations to mature and simply return to a state similar to that prevailing before the crisis. However, selling so many assets in a short period could move asset prices in

¹⁷ We do not discuss other exceptional measures, such as the central bank dollar swap facilities. For a discussion of these facilities, see Goldberg, Kennedy, and Miu (2011) and Fleming and Klagge (2010).

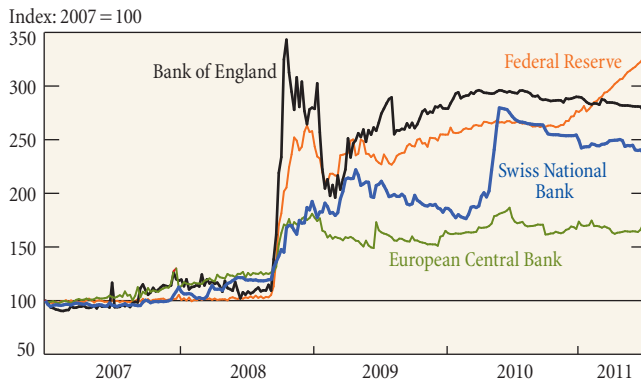
¹⁸ See Keister and McAndrews (2009).

¹⁹ Keister, Martin, and McAndrews (2008) provide an introduction to monetary policy implementation, with and without interest paid on excess reserves. In this section, we summarize the key ideas.

²⁰ Reserves are remunerated if the central bank pays interest on these reserves. In some cases, reserves may be remunerated at a range above the required or targeted amount of reserves.

²¹ The Bank of England remunerated all reserves at the policy rate and, for that reason, did not experience sustained episodes during which short-term market interest rates were below the policy rate.

Chart 4

Central Banks' Total Assets

Source: Bloomberg L.P.

financial markets in unexpected and potentially disruptive ways. Hence, central banks will want to consider a broader range of options for raising interest rates.

Given their monetary policy implementation frameworks, the Federal Reserve, the European Central Bank, the Bank of England, and the Swiss National Bank have two broad choices if they see a need to increase interest rates as their economies recover. They can increase the rate they pay on reserves, to keep it equal to the desired level of the policy rate, or they can take steps (for example, by issuing central bank bills) to reduce the level of reserves, potentially to pre-crisis levels, so that the banking system will not need to hold excessively high levels of reserves.

Costs and Benefits of a Large Balance Sheet

From an implementation perspective, there are benefits and some potential costs when central banks hold a large balance sheet on a permanent basis. The benefits stem from the fact that reserves are the only means by which large-value payments can be settled with finality (notes are impractical for such payments).²² Increasing the amount of reserves in the system reduces the need for banks to borrow reserves from the central bank intraday to make payments and reduces the incentives bank have to delay payments. Another benefit of a large supply of reserves is that it may help banks meet the new Basel III requirements for holding safe assets. However, too many reserves could be a problem for the banking system. Only institutions that have an account at the central bank can hold reserves and, collectively, these institutions must hold all the reserves that the central bank issues.²³ In other

²² Following others, we define finality in this context as legal finality. In an economic sense, finality comes about only when a settlement has taken place, with the parties agreeing to settle the transaction with any asset, not necessarily reserves.

²³ See Keister and McAndrews (2009).

words, as the central bank issues more reserves, the aggregated balance sheet of the banking system—or, more precisely, of all central bank account holders—must increase.

In principle, the increase in the level of reserves held by the banking sector need not be worrisome. Reserves are a perfectly liquid and risk-free asset, so they should carry no cost of economic capital and should not affect leverage ratios negatively. Nevertheless, market observers have raised the concern that banks may face increased costs if excess reserves “clog up” their balance sheets.²⁴ Moreover, banks may incur higher costs from the size of their balance sheets because of agency costs or regulatory requirements on a bank’s capital or leverage.

Instruments Available to Central Banks with Large Balance Sheets

Central banks have several instruments that can help them manage the size of their balance sheets and implement monetary policy even with a large balance sheet. This section focuses on three instruments: interest on reserves, central bank bills, and reverse repos.

Interest on Reserves

The quantity of reserves supplied by a central bank will affect the bank’s ability to reach its target only if the demand for reserves is downward sloping at that quantity, as illustrated in Exhibit 1. The diagram depicts the demand curve for reserves in blue. The demand for reserves is nil above the central bank’s lending rate, since banks will prefer to borrow reserves at the central bank rather than pay a higher price in the market.²⁵ Similarly, the demand for reserves becomes elastic at the central bank’s deposit rate, as banks prefer to earn the interest on reserves paid by the central bank rather than lend the reserves in the market at a lower rate. The supply of reserves by the central bank is represented in the diagram as a vertical line, and the interbank market rate is determined by the intersection of the supply of, and the demand for, reserves.

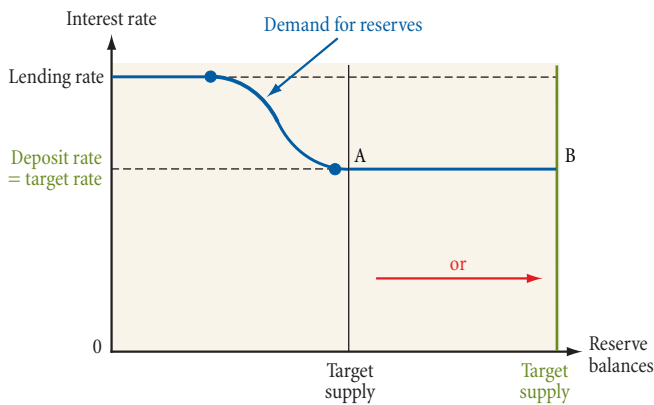
If the supply of reserves is sufficiently large, then the supply curve intersects the demand curve in a section where it is roughly flat. In Exhibit 1, the interest rate is the same whether the supply of reserves intersects demand at point A or at point B. If the central bank does not pay interest on reserves, the demand curve will be flat around a zero interest rate. If the central bank does pay interest on excess reserves, then the demand curve will be flat at a level that is close to the interest paid on excess reserves.

²⁴ This concern was noted by Wrightson ICAP (2008). See also Wrightson ICAP (2009).

²⁵ Exhibit 1 assumes that there is no stigma associated with borrowing at the central bank’s lending facility.

Exhibit 1

Supply of and Demand for Reserves



Accordingly, a central bank could implement monetary policy while holding a large supply of reserves simply by changing the interest it pays on excess reserves. This process is particularly straightforward for central banks that target an overnight rate, since they can set their target close to the interest rate they pay on reserves. For a central bank targeting a longer-term operating target, the process could be a little more complicated to implement, because the central bank will need to learn how to set the interest it pays on reserves to support its longer-term objective.²⁶

Central Bank Bills

Public sector assets that are a close substitute for reserves as a store of value could be used to relieve pressure on the banking sector's balance sheet, provided institutions that do not have a reserve account can hold these assets. For example, institutions outside the banking sector can hold short-term government debt.²⁷

Central bank bills can play the same role because these assets are similar to government debt. These bills change the composition but not the size of the central bank's balance sheet.²⁸ They allow the central bank to reduce the level of reserves, which can

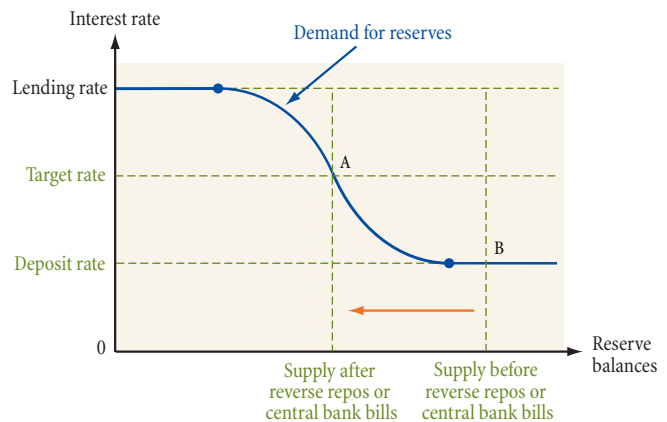
²⁶ If a central bank pays interest on reserves, this reserve rate could become the key policy rate.

²⁷ The issuance and sale of this debt could be used to reduce the level of reserves held by the banking sector, if the necessary coordination with the U.S. Treasury Department can be established. Such an action was taken in the United States in the fall of 2008, when the Supplementary Financing Program (SFP) was initiated. (See Haubrich and Lindner [2009] for more details about this program.) The reserves acquired in the sale of Treasury securities from the SFP are removed from the banking system's aggregate balance sheet and replaced by the Treasury securities. Since these securities can be held outside the banking system, this action can reduce the size of the banking system's aggregate balance sheet.

²⁸ On the liability side of the central bank's balance sheet, the newly issued bills replace the reserves that are acquired from the sale of bills. Recall that reserves are a liability of the central bank. Hence, the size of the central bank's balance sheet is unaffected.

Exhibit 2

Effect of Reverse Repos and Central Bank Bills



be held only by the banking sector, by replacing reserves with assets that can be held by other institutions. When the bills are sold to institutions outside the banking system, the aggregate size of the banking sector's balance sheet shrinks.

Central bank bills are a more convenient instrument than the issuance and sale of government debt because they do not require close coordination between a country's central bank and its treasury. Nevertheless, the issuance of central bank bills should not interfere with the issuance of government debt. To limit the risk of interference, central banks that issue bills typically choose shorter-term maturities, such as one week up to maximum of one year, and relatively large denominations, which are convenient for financial institutions but not for retail investors. Government bills, by contrast, have longer maturities, ranging from one or three months to (most typically) years. Moreover, government bills are often available in relatively small denominations to accommodate retail investors.

Reverse Repos

Reverse repos have also been used by central banks to reduce the level of reserves. Like the issuance of central bank bills, the use of reverse repos changes the composition of the liability side of the central bank's balance sheet without changing its size.²⁹

In contrast to central bank bills, which can be transferred from institutions that have a central bank account to institutions that do not, reverse repos typically cannot be transferred to additional parties. Hence, in the case of reverse repos, the banking sector and the central banks are not able to reduce the size of their balance sheets. Partly for that reason, the Federal Reserve plans to engage in reverse repos with an expanded set of counterparties,

²⁹ In the initial leg of the reverse repo, the central bank receives money from its repo counterparty and pledges collateral. When the reverse repo matures, the central bank returns the reserves to its counterparty and gets back the collateral.

Table 2

Summary of Central Bank Practices

	Federal Reserve	European Central Bank	Bank of England	Swiss National Bank
Key policy rate	Uncollateralized interbank rate target (federal funds rate) ^a	Minimum bid rate in main refinancing operation	Official bank rate paid on commercial bank reserves	Swiss franc three-month Libor
Operational target	Uncollateralized interbank rate (federal funds rate)	No official target	Overnight interest rates to be in line with the bank's official rate	Target range for Swiss franc three-month Libor
Pay interest on reserves?	Yes ^b	No ^c	Yes, at bank rate ^d	No ^e
Issue bills?	No	No	Yes	Yes

^aBeginning in December 2008, the policy rate objective was established as a range.

^bInterest payments on reserves commenced October 9, 2008. Currently, the rate paid on required reserve balances is the targeted federal funds rate.

^cThe European Central Bank remunerates required reserve balances at the main operations rate; excess reserves are remunerated at a rate lower than the implicit policy rate.

^dThe Bank of England does not require depository institutions to hold reserves. Excess reserves are remunerated if they are within a specified range of a voluntary target.

^eThe Swiss National Bank has reserve requirements, but does not remunerate reserves.

including institutions that do not have an account at the Fed.³⁰ This move would allow the use of reverse repos to reduce the level of reserves held by the banking system.

Exhibit 2 shows how engaging in reverse repos with an extended set of counterparties or issuing central bank bills will reduce the level of reserves. Like Exhibit 1, this diagram represents the demand for reserves in blue and the supply of reserves as a vertical line. If a central bank does not pay interest on reserves at the policy rate and its supply of reserves is large, the supply and demand for reserves will intersect at point B, which does not correspond to the target rate. Reducing the supply of reserves through reverse repos or the issuance of central bank bills can allow the intersection to occur at point A, the target rate.

Central Bank Practice

This section discusses how—or even whether—the four central banks studied here have used the instruments described above. Interestingly, each of these central banks has adopted a different mix of the instruments (Table 2).

The Federal Reserve

The Federal Reserve received the authority to pay interest on reserves in October 2008 and has been paying interest on required and excess reserves ever since. The federal funds rate has been slightly below the interest rate paid on reserves because some financial institutions are not eligible to receive interest on the reserves they hold in their accounts at the Fed. In particular, government-sponsored enterprises such as Fannie Mae and Freddie Mac do not receive interest on reserves. Nevertheless, the Fed should be able to raise the federal funds rate by increasing the interest rate it pays on reserves.³¹

³⁰ For more information, see http://www.ny.frb.org/markets/rrp_counterparties.html.

³¹ See Bech and Klee (2009) for a discussion.

The Federal Reserve does not have the authority to issue central bank bills, so it cannot use that instrument to reduce the supply of reserves. Instead, the Fed could decrease reserves by engaging in reverse repos with an expanded set of counterparties.

The European Central Bank

The European Central Bank has the authority to pay interest on reserves and to issue bills, known as debt certificates. Banks earn interest on required reserves held at the European Central Bank, but excess reserves placed in banks' reserve accounts at the central bank do not earn interest. Excess (surplus) reserves can earn some interest, however, if they are placed in the European Central Bank's deposit facility, although the rate of interest earned is lower than the policy rate. The European Central Bank has not modified this practice during the crisis even as it has supplied an increased amount of reserves. Moreover, the central bank has not issued debt certificates since its inception.

The European Central Bank would be immediately able to start issuing bills if it felt the need to do so, but it would require a modification of its operational framework to start paying interest on excess reserves at the policy rate. So far, it has not used either instrument, in contrast to the other central banks discussed in this article.

The Bank of England

The Bank of England has the authority to pay interest on reserves and to issue central bank bills. Of the four central banks discussed here, it is the only one to have used both instruments during the crisis. It has also engaged in some reverse repos.

Before the crisis, the Bank of England paid interest on reserves held by banks if the quantity of reserves held was close to the voluntary targets set by the banks. After launching its asset purchase program during the crisis, however, the Bank of England decided to pay the policy rate for all reserves held by banks as the supply

of reserves increased. It can continue this practice if it opts to increase interest rates without reducing the supply of reserves. If the Bank of England wants to return to a framework whereby it supplies only the amount of reserves consistent with banks' voluntary targets, it may have to find ways to reduce the supply of reserves—for example, by expanding its issuance of bills.

The Swiss National Bank

The Swiss National Bank has the authority to pay interest on reserves and to issue central bank bills. It does not currently pay interest on reserves, but it has issued bills and used reverse repos.³² Although this central bank has long had the authority to issue bills, it did not do so until the recent crisis. Several factors led to the introduction of bills on October 16, 2008—a relatively early stage in the crisis.

Issuing bills at that time allowed financial markets to familiarize themselves with this new instrument, even if there was no immediate and explicit need to use it to manage rates. Market familiarity with the instrument was to prove valuable as the Swiss National Bank chose to rely on it more heavily as the crisis continued.

While the issuance of bills was primarily intended to absorb liquidity, the Swiss central bank also saw this step as a means of furthering financial stability. During the crisis, the Swiss banking system was split into two distinct groups. Some large international banks were facing a shortage of liquidity, while many domestic banks had huge inflows of liquidity. Since trading activity between these two groups of banks had declined, central bank bills took on an intermediary role. The Swiss National Bank provided reserves to banks facing liquidity shortages and absorbed the excess liquidity from domestic banks by issuing central bank bills. When needed, these bills could in turn be used in repo transactions with the Swiss National Bank or in the Swiss franc repo market as collateral. The bills thus made it possible for the central bank to step in and support a stressed unsecured money market.

Conclusion

Some central banks responded to the recent financial crisis by making considerable changes to their frameworks for implementing monetary policy. In the process, they increased the size of their balance sheets to unprecedented levels.

³² In response to recent developments, the Swiss National Bank has stopped using reverse repos and started to buy back its central bank bills as of August 2011.

The Swiss National Bank has also issued its bills in U.S. dollars. However, this instrument has been used not to mop up liquidity but rather to refinance the Swiss National Bank's StabFund (a "bad bank" initiated in October 2008 to take over illiquid assets from UBS). In this article, we refer only to those bills issued in Swiss francs.

Interestingly, the four central banks we focus on here have used different approaches to achieve their objectives—a reflection, perhaps, of the unique institutional setting in which each one operates. It is too early to tell if the various practices they use to manage their large balance sheets will lead to divergent outcomes. Nevertheless, it is interesting to note that all four central banks have chosen a slightly different mix of instruments. And it is possible that some of the authorized instruments not currently being used by the banks will be employed at some point in the future.

By observing the diversity of central bank approaches, we can learn more about the operation of monetary policy implementation frameworks. This is particularly important for new aspects of these frameworks, such as the management of large balance sheets. This study explores some of the variation across central bank practices, with the hope of expanding our awareness of the policy instruments and strategies that are possible.

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ABOUT THE AUTHORS

Marlene Amstad is deputy director and head of Investment Strategy and Financial Market Analysis at the Swiss National Bank; Antoine Martin is an assistant vice president in the Money and Payments Studies Function of the Federal Reserve Bank of New York.

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The Great Escape? A Quantitative Evaluation of the Fed's Liquidity Facilities

Marco Del Negro, Gauti Eggertsson, Andrea Ferrero, and Nobuhiro Kiyotaki
Staff Reports, no. 520, October 2011

The authors introduce liquidity frictions into an otherwise standard DSGE model with nominal and real rigidities, explicitly incorporating the zero bound on the short-term nominal interest rate. Within this framework, they ask: Can a shock to the liquidity of private paper lead to a collapse in short-term nominal interest rates and a recession like the one associated with the 2008 U.S. financial crisis? Once the nominal interest rate reaches the zero bound, what are the effects of interventions in which the government exchanges liquid government assets for illiquid private paper? The authors find that the effects of the liquidity shock can be large, and they show some numerical examples in which the liquidity facilities prevented a repeat of the Great Depression in 2008-09.

A Note on Bank Lending in Times of Large Bank Reserves

Antoine Martin, James McAndrews, and David Skeie
Staff Reports, no. 497, May 2011

The amount of reserves held by the U.S. banking system reached \$1.5 trillion in April 2011. Some economists argue that such a large quantity of bank reserves could lead to overly expansive bank lending as the economy recovers, regardless of the Federal Reserve's interest rate policy. In contrast, the authors of this paper show that the size of bank reserves has no effect on bank lending in a frictionless model of the current banking system, in which interest is paid on reserves and there are no binding reserve requirements. The authors also examine the potential for balance sheet cost frictions to distort banks' lending decisions. They find that large reserve balances do not lead to excessive bank credit and may instead be contractionary.

Large-Scale Asset Purchases by the Federal Reserve: Did They Work?

Joseph Gagnon, Matthew Raskin, Julie Remache, and Brian Sack
Staff Reports, no. 441, March 2010

Since December 2008, the Federal Reserve's traditional policy instrument, the target federal funds rate, has been effectively at its lower bound of zero. In order to further ease the stance of monetary policy as the economic outlook deteriorated, the Federal Reserve purchased substantial quantities of assets with medium and long maturities. This paper explains how these purchases were implemented and discusses the mechanisms through which they can affect the economy. The authors present evidence that the purchases led to economically meaningful and long-lasting reductions in longer-term interest rates on a range of securities, including securities that were not included in the purchase programs. These reductions in interest rates primarily reflect lower risk premiums, including term premiums, rather than lower expectations of future short-term interest rates.

The Mechanics of a Graceful Exit: Interest on Reserves and Segmentation in the Federal Funds Market

Morten L. Bech and Elizabeth Klee
Staff Reports, no. 416, December 2009

To combat the financial crisis that intensified in the fall of 2008, the Federal Reserve injected a substantial amount of liquidity into the banking system. The resulting increase in reserve balances exerted downward price pressure in the federal funds market, and the effective federal funds rate began to deviate from the target rate set by the Federal Open Market Committee. In response, the Federal Reserve revised its operational framework

for implementing monetary policy and began to pay interest on reserve balances in an attempt to provide a floor for the federal funds rate. Nevertheless, following the policy change, the effective federal funds rate remained below not only the target but also the rate paid on reserve balances. The authors of this paper develop a model to explain this phenomenon and use data from the federal funds market to evaluate it empirically. In turn, they show how successful the Federal Reserve may be in raising the federal funds rate even in an environment with substantial reserve balances.

Why Are Banks Holding So Many Excess Reserves?

Todd Keister and James McAndrews
Current Issues in Economics and Finance, vol. 15, no. 8, December 2009

The buildup of reserves in the U.S. banking system during the financial crisis has fueled concerns that the Federal Reserve's policies may have failed to stimulate the flow of credit in the economy: banks, it appears, are amassing funds rather than lending them out. However, a careful examination of the balance sheet effects of central bank actions shows that the high level of reserves is simply a by-product of the Fed's new lending facilities and asset purchase programs. The total quantity of reserves in the banking system reflects the scale of the Fed's policy initiatives, but conveys no information about the initiatives' effects on bank lending or on the economy more broadly.

Divorcing Money from Monetary Policy

Todd Keister, Antoine Martin, and James McAndrews
Economic Policy Review, vol. 14, no. 2, September 2008

Many central banks implement monetary policy in a way that maintains a tight link between the stock of money and the short-term interest rate. In particular, their implementation procedures require that the supply of reserve balances be set precisely in order to implement the target interest rate. Because bank reserves play other key roles in the economy, this link can create tensions with other important objectives, especially in times of acute market stress. This article considers an alternative approach to monetary policy implementation—known as a “floor system”—that can reduce or even eliminate these tensions. The authors explain how this approach, in which the central bank pays interest on reserves at the target interest rate, “divorces” the supply of money from the conduct of monetary policy. The quantity of bank reserves can then be set according to the payment or liquidity needs of financial markets. By removing the opportunity cost of holding reserves, the floor system also encourages the efficient allocation of resources in the economy.