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Why Are Banks Holding So Many Excess Reserves?

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Abstract

The quantity of reserves in the U.S. banking system has risen dramatically since September 2008. Some commentators have expressed concern that this pattern indicates that the Federal Reserve's liquidity facilities have been ineffective in promoting the flow of credit to firms and households. Others have argued that the high level of reserves will be inflationary. We explain, through a series of examples, why banks are currently holding so many reserves. The examples show how the quantity of bank reserves is determined by the *size* of the Federal Reserve's policy initiatives and in no way reflects the initiatives' *effects* on bank lending. We also argue that a large increase in bank reserves need not be inflationary, because the payment of interest on reserves allows the Federal Reserve to adjust short-term interest rates independently of the level of reserves.

Key words: bank reserves, central bank liquidity facilities, money multiplier

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Introduction

Since September 2008, the quantity of reserves in the U.S. banking system has grown dramatically, as shown in Figure 1.[1] Prior to the onset of the financial crisis, required reserves were about $40 billion and excess reserves were roughly $1.5 billion. Excess reserves spiked to around $9 billion in August 2007, but then quickly returned to pre-crisis levels and remained there until the middle of September 2008. Following the collapse of Lehman Brothers, however, total reserves began to grow rapidly, climbing above $900 billion by January 2009. As the figure shows, almost all of the increase was in excess reserves. While required reserves rose from $44 billion to $60 billion over this period, this change was dwarfed by the large and unprecedented rise in excess reserves.

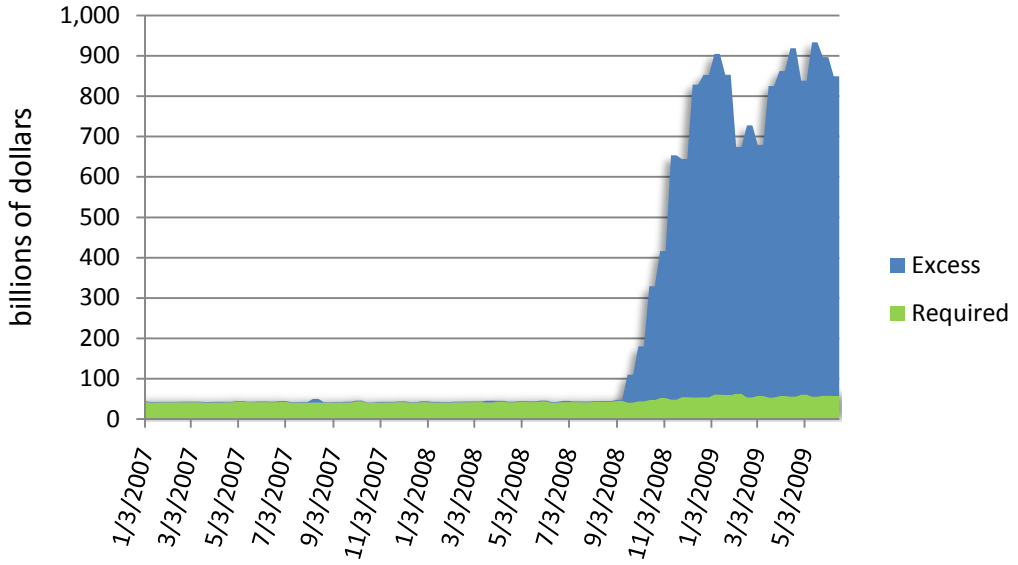

Figure 1: Aggregate Reserves of Depository Institutions

Source: Federal Reserve Statistical Release H.3

Why are banks holding so many excess reserves? What do the data in Figure 1 tell us about current economic conditions and about bank lending behavior? Some observers claim that the large increase in excess reserves implies that many of the policies introduced by the Federal Reserve in response to the financial crisis have been ineffective. Rather than promoting the flow of credit to firms and households, it is argued, the data shown in Figure 1 indicate that the money lent to banks and other intermediaries by the Federal Reserve since September 2008 is simply sitting idle in banks' reserve accounts. Edlin and Jaffee (2009), for example, identify the high level of excess reserves as either the "problem" behind the continuing credit crunch or "if not the problem, one heckuva symptom" (p.2). Commentators have asked why banks are choosing to

[1] *Reserves* (sometimes called *bank reserves*) are funds held by depository institutions that can be used to meet the institution's legal reserve requirement. These funds are held either as balances on deposit at the Federal Reserve or as cash in the bank's vault or ATMs. Reserves that are applied toward an institution's legal requirement are called *required*, while any additional reserves are called *excess*.

hold so many reserves instead of lending them out, and some claim that inducing banks to lend their excess reserves is crucial for resolving the credit crisis.

This view has lead to proposals aimed at discouraging banks from holding excess reserves, such as placing a tax on excess reserves (Sumner, 2009) or setting a cap on the amount of excess reserves each bank is allowed to hold (Dasgupta, 2009). Mankiw (2009) discusses historical concerns about people hoarding money during times of financial stress and mentions proposals that were made to tax money holdings in order to encourage lending. He relates these historical episodes to the current situation by noting that "[w]ith banks now holding substantial excess reserves, [this historical] concern about cash hoarding suddenly seems very modern."

In this edition of *Current Issues*, we examine how the types of policies recently implemented by the Federal Reserve, such as lending to banks and other firms, should be expected to affect the level of excess reserves. We use a series of simple examples to illustrate the impact such policies have on the balance sheets of individual banks and on the level of reserves, both required and excess, in the banking system. The examples show that the answer to the question in our title is actually quite simple. The total level of reserves in the banking system is determined almost entirely by the actions of the central bank and is not affected by private banks' lending decisions. The liquidity facilities introduced by the Federal Reserve in response to the crisis have created a large quantity of reserves. While changes in bank lending behavior may lead to small changes in the level of required reserves, the vast majority of the newly-created reserves will end up being held as excess reserves almost no matter how banks react. In other words, the quantity of excess reserves depicted in Figure 1 reflects the *size* of the Federal Reserve's policy initiatives, but says little or nothing about their *effects* on bank lending or on the economy more broadly.

This conclusion may seem strange, at first glance, to readers familiar with textbook presentations of the money multiplier. After presenting our examples, we discuss the traditional view of the money multiplier and why it does not apply in the current environment, where reserves have increased to unprecedented levels *and* the Federal Reserve has begun paying interest on those reserves. We also argue that a large increase in the quantity of reserves in the banking system need not be inflationary, since the central bank can adjust short-term interest rates independently of the level of reserves.

Central bank lending: A simple example

To see how the types of policies that have been implemented by the Federal Reserve over the course of the financial crisis affect bank reserves, it is useful to consider a simple example. Suppose there are two banks, A and B, whose balance sheets in normal times are depicted in Figure 2. Focus first on the items in black. On the liabilities side of the balance sheet, each bank has started with $10 of capital and has taken in $100 in deposits. On the asset side of the balance sheet, both banks hold reserves and make loans. To keep things simple, suppose the banks are required to hold reserves equaling 10% of their deposits, and that each bank holds exactly $10 in reserves.

Bank A				Bank B			
Reserves	10	Deposits	100	Reserves	10	Deposits	100
Loans	50			Loans	130	Due to	
Due from						Bank A	40
Bank B	40						
Securities	10	Capital	10	Securities	10	Capital	10

Figure 2: Bank balance sheets during normal times

Suppose that, for whatever reason, Bank B has access to a larger pool of lending opportunities. It might be the case, for example, that Bank B is located in an area with a high concentration of firms that actively rely on bank loans or that it has a particular expertise in evaluating certain types of loan applications. Whatever the underlying source of this difference, suppose that Bank B has found it profitable at the current level of interest rates to make $130 of loans, while Bank A has only found it profitable to make $50 of loans. To be able to make this higher quantity of loans, Bank B has borrowed $40 from Bank A. This interbank loan is represented by the blue entries in the banks' balance sheets. The loan is an asset for Bank A, which will receive the repayment in the future, and is a liability for Bank B. Notice the important economic role of the interbank market in this example: it allows funds to flow to their most productive uses, regardless of which bank received the initial deposits. The balance sheets in Figure 2 reflect the normal state of affairs in this example, when the interbank market is performing this function efficiently. Also note that total reserves in the banking system are $20, all of which are required reserves. In this simple example, no excess reserves are held in normal times.

Now suppose that the financial system enters a period of turmoil that disrupts the normal pattern of interbank lending. Such a market "freeze" might reflect uncertainty about the creditworthiness of Bank B or uncertainty on Bank A's part about its own future funding needs. Regardless of the reason, suppose Bank A is unwilling to continue lending to Bank B. This disruption places a severe strain on Bank B when it must repay Bank A: if it is unable to obtain a similar loan elsewhere, or quickly raise new deposits, it will be forced to decrease its loans by $40. This decrease in lending would be accompanied by a decline in total deposits, as borrowers scramble for funds to repay the loans, and by a sharp contraction in economic activity.[2]

One way the central bank could react to this market freeze is by using the standard tool of monetary policy: changing interest rates. Central banks typically implement monetary policy by

[2] Alternatively, Bank A might be willing to continue lending to Bank B, but at a significantly higher interest rate to compensate for the increased credit risk or the uncertainty surrounding its own future funding needs. A key feature of the current financial crisis has been the unusually large spread between the interest rate on term interbank loans, as measured by the London InterBank Offered Rate (Libor), and benchmark measures of the overnight interest rate. The effects of such a scenario would be similar to the market "freeze" discussed above: at a higher interest rate, Bank B would choose to borrow less from Bank A and would decrease its level of lending to its customers, leading to a contraction in economic activity.

setting a target for a particular short-term interest rate.[3] When the central bank lowers this target rate, other interest rates tend to decrease as well, which stimulates economic activity. As a result, some lending opportunities that were previously unattractive become profitable. In our example, a decrease in interest rates would lead Bank A to make more loans as it receives repayment from Bank B, partially offsetting the decline in Bank B's lending.

Given the nature of the problem in our example, however, the central bank might be able to intervene more effectively in another way. Suppose that instead of lowering its target interest rate, the central bank lends $40 to Bank B. In making this loan, the central bank credits $40 to Bank B's reserve account. Bank B can then use these funds to repay Bank A without decreasing its lending. The banks' balance sheets after these actions take place are depicted in Figure 3, where the changes from the earlier figure are in red. For Bank B, the loan from the central bank has replaced the interbank loan. Bank A holds the funds that it previously lent to Bank B as reserves. Notice the change in reserve holdings: total reserves have increased to $60, and excess reserves are now equal to $40.

Bank A

Reserves	50	Deposits	100
Loans	50		
Securities	10	Capital	10

Bank B

Reserves	10	Deposits	100
Loans	130	Due to CB	40
Securities	10	Capital	10

Figure 3: Bank balance sheets after central bank lends to Bank B

The goal of the central bank's lending policy here is to mitigate the effects of the disruption in the interbank market by maintaining the flow of credit from the banking sector to firms and households. The policy is highly effective in this regard: it prevents Bank B from having to reduce its lending by $40. This simple example illustrates how such a policy creates, as a byproduct, a large quantity of excess reserves. Looking at aggregate data on bank reserves, one might be tempted to conclude that the central bank's policy did nothing to promote bank lending, since all of the $40 lent by the central bank ended up being held as excess reserves. The point of the example is that such a conclusion would be completely unwarranted.

Excess reserves and interest rates

Traditionally, bank reserves did not earn any interest. If Bank A earns no interest on the reserves it is holding in Figure 3, it will seek to lend out its excess reserves or use them to buy other short-term assets. These activities will, in turn, decrease the short-term market interest rate. Recall,

[3] In the U.S., for example, the Federal Open Market Committee (FOMC) sets a target for the federal funds rate, which is the market interest rate on *overnight* interbank loans. It is worth noting that the special features of the federal funds market, including the very short duration of the loans, make it less susceptible to freezes and other disruptions than longer-term lending markets.

however, that we assumed that the central bank has not changed its target interest rate. The central bank thus has two distinct and potentially conflicting policy objectives in our example. The appropriate short-term interest rate is determined by macroeconomic conditions, while the appropriate lending policy is determined by the size of the problem in the interbank market. [4]

If the amount of central bank lending is relatively small, this conflict can be resolved using open market operations. In particular, the central bank could *sterilize* the effects of its lending by selling bonds from its portfolio to remove the excess reserves. Starting from Figure 3, suppose that the central bank sells $40 worth of government bonds from its portfolio. To keep things simple, suppose that these bonds are all purchased by Bank A. Then Bank A will pay $40 in reserves to the central bank and excess reserves in the banking system will return to zero. Bank A will then be holding interest-bearing bonds instead of reserves and, therefore, will have no incentive to change its lending behavior. Notice, however, that this approach is limited by the quantity of bonds that the central bank is able to sell from its portfolio.

Another way the central bank can eliminate the tension between its conflicting policy objectives is to pay interest on reserves. When banks earn interest on their reserves, they have no incentive to lend at interest rates lower than the rate paid by the central bank. The central bank can, therefore, adjust the interest rate it pays on reserves to steer the market interest rate toward its target level. The Federal Reserve began paying interest on reserves, for the first time in its history, in October 2008. This action was taken to "give the Federal Reserve greater scope to use its lending programs to address conditions in credit markets while also maintaining the federal funds rate close to the target established by the Federal Open Market Committee" (Federal Reserve Board, 2008).[5]

Returning to our example in Figure 3, suppose the central bank sets the interest rate it pays on reserves equal to its target for the market interest rate. This policy, which removes the opportunity cost of holding reserves, has been advocated by Goodfriend (2002), Woodford (2000) and others. The interest Bank A earns by holding $40 of excess reserves will now be approximately equal to what it previously earned by lending to Bank B. As a result, Bank A has no incentive to change its pattern of lending to firms and households. In this case, the central bank's lending policy generates a large quantity of excess reserves without changing interest rates or banks' incentives to lend to firms and households.

[4] In practice, the conditions that led to the freeze in the interbank market might change the central bank's forecast for the factors influencing inflation and economic growth and, hence, its desired short-term interest rate. Even in such a case, however, the central bank's target rate is likely to be different from the rate that would result from Bank A's efforts to lend out its excess reserves.

[5] Many other central banks also pay interest on reserves as part of their procedure for implementing monetary policy. See Goodfriend (2002) and Keister, Martin and McAndrews (2008) for a discussion of how paying interest on reserves allows a central bank to separate the quantity of bank reserves from its monetary policy objectives. See Ennis and Keister (2008) for a more formal treatment of the process of monetary policy implementation and the effects of paying interest on reserves. Goodfriend (2009) proposes a new way of classifying a central bank's policy tools. In his terminology, *monetary policy* refers to changes in the monetary base (reserves plus currency in circulation) while *interest rate policy* refers to changes in the interest rate paid on reserves.

Other lending/purchase policies

In addition to lending to banks as in Figure 3, central banks have implemented a range of other policy responses to the financial crisis, including lending directly to firms and purchasing certain types of assets. The Federal Reserve, for example, has implemented programs for lending to primary dealers and other financial institutions, opened currency swap lines with foreign central banks, purchased mortgage-backed securities guaranteed by certain government-sponsored enterprises (GSEs) and directly purchased debt issued by housing-related GSEs. How do these other types of *liquidity facilities* affect the level of reserves?

The answer to this question can be seen by extending our simple example. Suppose now that the central bank lends $40 directly to Firm X, and suppose that this firm holds a deposit account at Bank A. In making this loan, the central bank credits $40 to Bank A's reserve account and Bank A, in turn, credits $40 to Firm X's deposit account. The bank balance sheets after these transactions have taken place are presented in Figure 4.

Bank A

Reserves	90	Deposits	140
Loans	50		
Securities	10	Capital	10

Bank B

Reserves	10	Deposits	100
Loans	130	Due to CB	40
Securities	10	Capital	10

Figure 4: Bank balance sheets after central bank lends to Firm X

As the figure shows, both the deposits and the reserves of Bank A have increased by $40. Total reserves in the banking system have now risen to $100. Even though the central bank made this loan directly to Firm X instead of to a bank, the loan still creates an equal amount of reserves in the banking system. This is a general principle: loans to banks, loans to other firms, and direct asset purchases by the central bank all increase the level of reserves in the banking system by exactly the same amount.

[See box on *Sources of Bank Reserves* on page 11]

Bank lending and total reserves

When interpreting data such as that in Figure 1, it is important to keep in mind that total reserves in the banking system are determined almost entirely by the central bank's actions. An individual bank can reduce its reserves by lending them out or using them to purchase other assets, but these actions do not change the total level of reserves in the banking system. A discussion of this somewhat counterintuitive point can be found in most textbooks on money and banking, but its importance in the current environment leads us to offer a brief treatment here as well.

Starting from the situation in Figure 4, suppose that Bank A gives a new loan of $20 to Firm X, which continues to hold a deposit account with Bank A. Bank A does this by crediting Firm X's account by $20. The bank now has a new asset (the loan to Firm X) and an offsetting liability (the increase in Firm X's deposit at the bank). Importantly, Bank A still has $90 of reserves in its account. In other words, the loan to Firm X does not decrease Bank A's reserve holdings at all.

Next, suppose that Firm X uses the $60 it has borrowed the central bank and from Bank A to purchase goods and services from Firm Y. Suppose further that Firm Y holds its deposit account with Bank B. A payment, either in check or electronic form, will be made that debits $60 from Bank A's reserve account and credits $60 to Bank B's reserve account. Bank B will then credit these funds to Firm Y's deposit account, so that Bank B has larger assets (a $60 increase in reserves) and larger liabilities (a $60 increase in deposits). Meanwhile, Bank A's reserves have fallen by $60, as have its deposits. The balance sheets of the two banks after these transactions have been completed are depicted in Figure 6. Notice that the total amount of reserves in the banking system has not changed: it is still $100. The $20 loan and the subsequent $60 purchase by Firm X have simply transferred funds from the reserve account of Bank A to that of Bank B.[6]

Bank A

Reserves	30	Deposits	100
Loans	70		
Securities	10	Capital	10

Bank B

Reserves	70	Deposits	160
Loans	130	Due to CB	40
Securities	10	Capital	10

Figure 6: Bank balance sheets with increased lending by Bank A

The general idea here should be clear: while an individual bank may be able to decrease the level of reserves it holds by lending to firms and/or households, the same is **not** true of the banking system as a whole. No matter how many times the funds are lent out by the banks, used for purchases, etc., total reserves in the banking system do not change. The quantity of reserves is determined almost entirely by the central bank's actions, and in no way reflect the lending behavior of banks.[7]

[6] In principle, Bank B could use the reserves it is holding in Figure 6 to repay some or all of its loan from the central bank, which would reduce total reserves in the banking system. In practice, however, it might choose not to do so if, for example, it faces uncertainty about future changes in its reserve holdings.

[7] Some of the factors that change the level of total reserves are not under the control of the central bank, such as payments into and out of the Treasury's account at the central bank or changes in the amount of currency held by the public. However, the changes in these *autonomous factors* have been very small compared to the changes in reserves depicted in Figure 1. For the purposes of the discussion here it is safe to abstract from these other factors and focus solely on how the level of reserves is affected by the size of the central bank's liquidity facilities.

Required vs. excess reserves

While lending by banks does not change the total level of reserves in the banking system, it does affect the composition of that total between required reserves and excess reserves. In the situations in Figures 4 and 5, for example, the new loans made to Firm X and the corresponding increase in deposits will raise the level of required reserves. Nevertheless, it is easy to see that our example matches the pattern in Figure 1, where the vast majority of the newly-created reserves are held as excess reserves.

Assuming that the required reserve ratio is 10% for all deposits, required reserves for the two banks together will increase from $20 to $26 as we move from Figure 2 to Figure 5. Total reserves in the banking system have increased from $20 to $100, which implies that excess reserves have increased from zero to $74. In other words, the central bank's lending policies in this example have generated a dramatic increase in excess reserves even though bank lending has increased by more than 10% above its *pre-crisis* level.

What about the money multiplier?

The idea that banks will hold a large quantity of excess reserves conflicts with the traditional view of the money multiplier. According to this view, an increase in bank reserves should be "multiplied" into a much larger increase in the broad money supply as banks expand their deposits and lending activities. The expansion of deposits, in turn, should raise reserve requirements until there are little or no excess reserves in the banking system. This process has clearly not occurred following the increase in reserves depicted in Figure 1. Why has the money multiplier "failed" here?

The textbook presentation of the money multiplier assumes that banks do not earn interest on their reserves. As described above, a bank holding excess reserves in such an environment will seek to lend out those reserves at any positive interest rate, and this additional lending will decrease the short-term interest rate. This lending also creates additional deposits in the banking system and thus leads to a small increase in reserve requirements, as described in the previous section. Because the increase in required reserves is small, however, the supply of excess reserves remains large. The process then repeats itself, with banks making more new loans and the short-term interest rate falling further.

This multiplier process continues until one of two things happens. It could continue until there are no more excess reserves, that is, until the increase in lending and deposits has raised required reserves all the way up to the level of total reserves. In this case, the money multiplier is fully operational. However, the process will stop before this happens if the short-term interest rate reaches zero. When the market interest rate is zero, banks no longer face an opportunity cost of holding reserves and, hence, no longer have an incentive to lend out their excess reserves. At this point, the multiplier process halts.

As discussed above, however, most central banks now pay interest on reserves. When reserves earn interest, the multiplier process described above stops sooner. Instead of continuing to the point where the market interest rate is zero, the process will now stop when the market interest rate reaches the rate paid by the central bank on reserves. If the central bank pays interest on reserves at its *target* interest rate, as we assumed in our example above, the money multiplier completely disappears. In this case, banks never face an opportunity cost of holding reserves and, therefore, the multiplier process described above does not even start.

It is important to keep in mind that the excess reserves in our example were **not** created with the goal of lowering interest rates or increasing bank lending significantly relative to pre-crisis levels. Rather, these reserves were created as a byproduct of lending policies designed to mitigate the effects of a disruption in financial markets. In fact, the central bank paid interest on reserves to *prevent* the increase in reserves from driving market interest rates below the level it deemed appropriate given macroeconomic conditions. In such a situation, the absence of a money-multiplier effect should be neither surprising nor troubling.

Is the large quantity of reserves inflationary?

Some observers have expressed concern that the large quantity of reserves will lead to an increase in the inflation rate unless the Federal Reserve acts to remove them quickly once the economy begins to recover. Meltzer (2009), for example, worries that "the enormous increase in bank reserves — caused by the Fed's purchases of bonds and mortgages — will surely bring on severe inflation if allowed to remain." Feldstein (2009) expresses similar concern that "when the economy begins to recover, these reserves can be converted into new loans and faster money growth" that will eventually prove inflationary. Under a traditional operational framework, where the central bank influences interest rates and the level of economic activity by changing the quantity of reserves, this concern would be well justified. Now that the Federal Reserve is paying interest on reserves, however, matters are different.

When the economy begins to recover, firms will have more profitable opportunities to invest, increasing their demands for bank loans. Consequently, banks will be presented with more lending opportunities that are profitable at the current level of interest rates. As banks lend more, new deposits will be created and the general level of economic activity will increase. Left unchecked, this growth in lending and economic activity may generate inflationary pressures. Under a traditional operating framework, where no interest is paid on reserves, the central bank must remove nearly all of the excess reserves from the banking system in order to arrest this process. Only by removing these excess reserves can the central bank limit banks' willingness to lend to firms and households and cause short-term interest rates to rise.

Paying interest on reserves breaks this link between the quantity of reserves and banks' willingness to lend. By raising the interest rate paid on reserves, the central bank can increase market interest rates and slow the growth of bank lending and economic activity without changing the quantity of reserves. In other words, paying interest on reserves allows the central bank to follow a path for short-term interest rates that is independent of the level of reserves. By choosing this path appropriately, the central bank can guard against inflationary pressures even if financial conditions lead it to maintain a high level of excess reserves.

This logic applies equally well when financial conditions are normal. A central bank may choose to maintain a high level of reserve balances in normal times because doing so offers some important advantages, particularly regarding the operation of the payments system. For example, when banks hold more reserves they tend to rely less on daylight credit from the central bank for payments purposes. They also tend to send payments earlier in the day, on average, which reduces the likelihood of a significant operational disruption or of gridlock in the payments system. To capture these benefits, a central bank may choose to create a high level of reserves as a part of its normal operations, again using the interest rate it pays on reserves to influence market interest rates. The Reserve Bank of New Zealand has used this type of framework since 2006.[8]

Conclusion

We began this article with a question: Why are banks holding so many excess reserves? We then used a simple example to illustrate the answer to this question in two steps. First, the Federal Reserve's new liquidity facilities have created, as a byproduct, a large quantity of reserves and these reserves can only be held by banks. Second, while the lending decisions and other activities of banks may result in small changes in the level of required reserves, the vast majority of the newly-created reserves will end up being held as excess reserves almost no matter what banks do. The central message of the article is that the data in Figure 1 only reflect the *size* of the Federal Reserve's policy initiatives; they say almost nothing about the *effects* these initiatives have had on bank lending or on the level of economic activity.

We also discussed the importance of paying interest on reserves when the level of excess reserves is unusually high, as the Federal Reserve began to do in October 2008. Paying interest on reserves allows a central bank to maintain its influence over market interest rates independent of the quantity of reserves created by its liquidity facilities. The central bank can then let the size of these facilities be determined by conditions in the financial sector, while setting its target for the short-term interest rate based on macroeconomic conditions. This ability to separate monetary policy from the quantity of bank reserves is particularly important during the recovery from a financial crisis. If inflationary pressures begin to appear while the liquidity facilities are still in use, the central bank can use its interest-on-reserves policy to raise interest rates without necessarily removing all of the reserves created by the facilities.

[8] See Ennis and Weinberg (2007) for an analysis of the relationships between paying interest on reserves, the level of reserve balances, and the operation of the payments system. See Nield (2008) for a detailed discussion of the Reserve Bank of New Zealand's operating framework.

Sources of Bank Reserves

Figure 5 illustrates the link between the size of the Federal Reserve's liquidity facilities and the quantity of reserves in the banking system. The top half of this figure presents the total assets of the Federal Reserve System, divided into broad categories, while the bottom half presents the total liabilities of the System. Before the crisis, the Federal Reserve's assets were predominantly Treasury securities, as indicated by the dark blue area in the top half of the figure. Its liabilities were predominantly currency in circulation, represented by the dark green area in the bottom half of the figure. Reserve balances, the light grey area at the bottom of the chart, were small enough to be almost unnoticeable in the figure.[9]

The Federal Reserve began introducing its new liquidity facilities in December 2007; the total size of these facilities is represented by the light purple area at the top of the chart. Between December 2007 and September 2008, the Federal Reserve actively sterilized these facilities through open market operations, selling securities from its portfolio to remove the newly-created reserves. This activity can be seen in the top half of the figure, where the quantity of Treasury securities falls in a way that offsets the growth of the liquidity facilities.

Beginning in September 2008, however, the Federal Reserve increased the scale of its liquidity facilities substantially in the face of rapidly deteriorating financial conditions. The size of the new programs quickly became larger than the Fed's holdings of Treasury securities, so that sterilization through open market operations was no longer possible. As a result, reserve balances began to increase. To partially offset this growth in reserves, the U.S. Treasury introduced the Supplementary Financing Program (SFP), which is represented by the dark grey area in the figure. Under this program, the Treasury issued new securities and left the proceeds from the sale of these securities on deposit at the Federal Reserve; the net effect of this operation was to remove reserves from the banking system. The size of this program was limited, however, and aAs the liquidity facilities continued to expand, reserve balances began to grow rapidly. The figure shows how total reserve balances have evolved in a way that closely mirrors the change in the size of the facilities.

The Federal Reserve's large-scale purchases of assets, first announced in November 2008, can also be seen in the figure. As the programs for purchasing agency mortgage-backed securities, agency debt, and then longer-term Treasury debt became operational in early 2009, the amount of securities held outright (the dark blue area) began to increase. Such purchases tend to increase the level of reserve balances. However, the size of the liquidity facilities declined over this period, leaving the total level of reserve balances roughly unchanged.[10]

[9] The light grey area in Figure 5 represents only those reserves that are held as balances on deposit at the Federal Reserve. Reserves that are held as cash in a bank's vault or ATM network are counted as currency in circulation and included in the dark green area. This latter component of reserves has been relatively constant over the course of the crisis; almost all of the increase in reserves shown in Figure 1 came through an increase in reserve balances.

[10] We are grateful to Ruth Judson, who created the original design for this diagram and generously shared her expertise with us. The *liquidity facilities* category in Figure 5 includes the following items from Federal Reserve Statistical Release H.4.1: Term auction credit, Other loans (including discount window loans, the Asset-Backed Commercial Paper Money Market Mutual Fund Liquidity Facility, credit extended to American International Group Inc., and the Term Asset-Backed Securities Loan Facility), Net portfolio holdings of the Commercial Paper Funding Facility, Net portfolio holdings of the various Maiden Lane LLCs, and Central bank liquidity swaps.

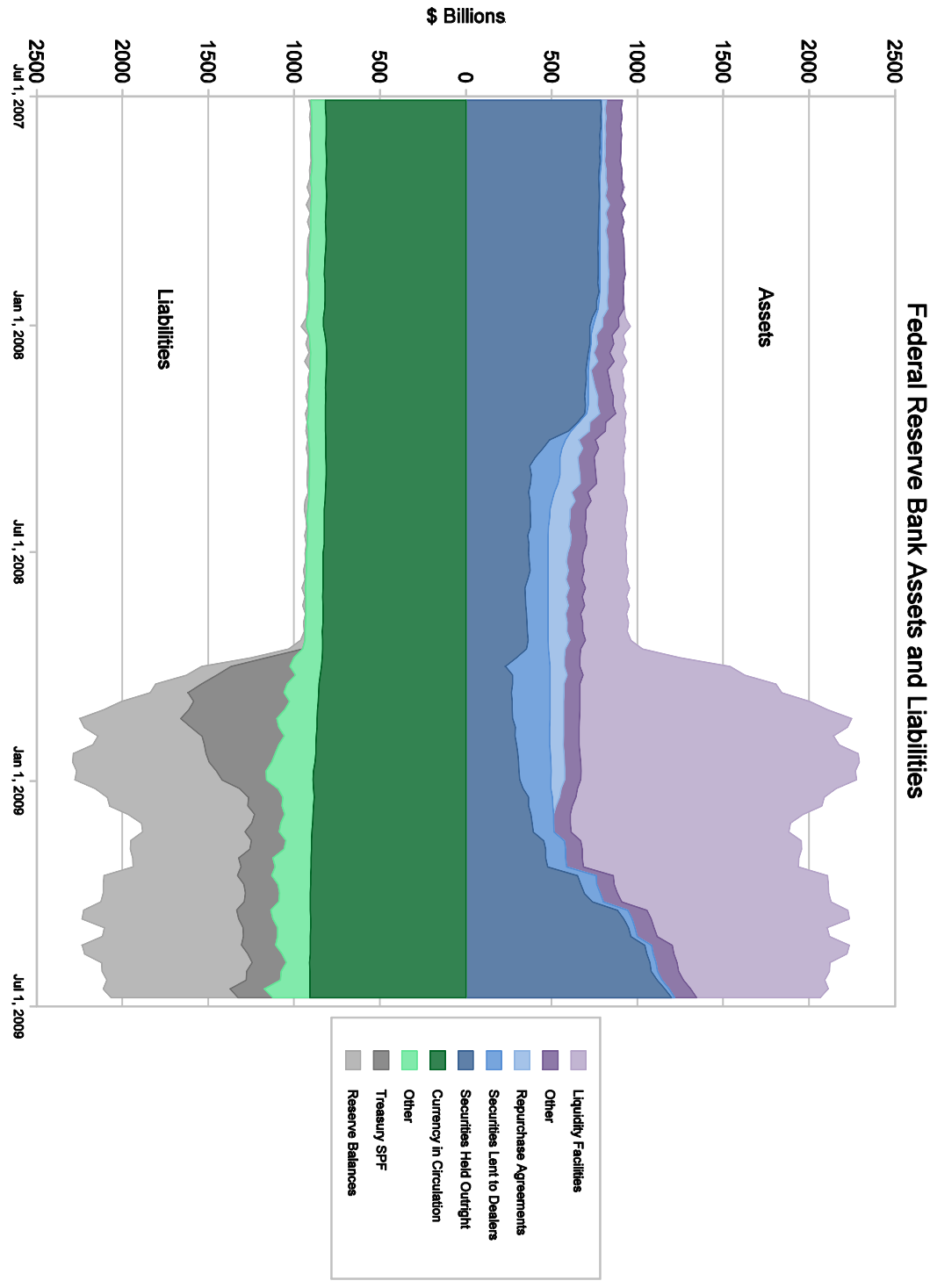

Figure 5: Assets and Liabilities of the Federal Reserve System

Source: Federal Reserve Statistical Release H.4.1

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