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Staff Reports

A Note on Bank Lending in Times of Large Bank Reserves

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Staff Report no. 497
May 2011

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A Note on Bank Lending in Times of Large Bank Reserves

Antoine Martin, James McAndrews, and David Skeie

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Abstract

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, we 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. We also examine the potential for balance-sheet cost frictions to distort banks' lending decisions. We find that large reserve balances do not lead to excessive bank credit and may instead be contractionary.

Key words: Banking, lending, reserves, interest on reserves, Federal Reserve

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1 Introduction

The amount of reserves held by the U.S. banking system reached \$1.5 trillion in April 2011. That level will increase further as the Federal Reserve completes its purchase of \$600 billion of Treasury securities in June 2011. In this note, we present a basic model of the current U.S. banking system, in which interest is paid on bank reserves and there are no binding reserve requirements. We find that, absent any frictions, lending is unaffected by the amount of reserves in the banking system. The key determinant of bank lending is the difference between the return on loans and the opportunity cost of making a loan. We show that this difference does not depend on the quantity of reserves. Moreover, if banks have positive balance-sheet cost frictions, increases in reserves may actually reduce bank lending.

These results are important because several economists and financial market participants claim that large levels of bank reserves will lead to overly expansive bank lending.² Despite such concerns, little formal analysis has been conducted to show such an effect under the current banking system. It is incumbent on commentators claiming otherwise to specify how large reserves would lead to excessive lending.

The current banking system in the United States and worldwide no longer resembles the traditional textbook model of fractional reserve banking. Historically, the quantity of reserves supplied by a central bank determines the amount of bank loans. Through the “money multiplier,” banks expand loans to equal the amount of reserves divided by the reserve requirement. However, in many countries, reserve requirements have been reduced either to zero, or to such small levels that they are no longer binding.³

Starting in the late 1980s, the Federal Reserve supplied the quantities of reserves

²In an interview, Philadelphia Fed President Charles Plosser expressed concern about what would occur “were all those excess reserves to start flowing out into the economy in the form of loans or purchases of other assets,” and in a speech Dallas Fed President Richard Fisher also said that “the Fed must be ‘wary’ of excess reserves sparking an expansion of bank credit,” Beckner (2009). Meltzer (2010) expresses similar concerns.

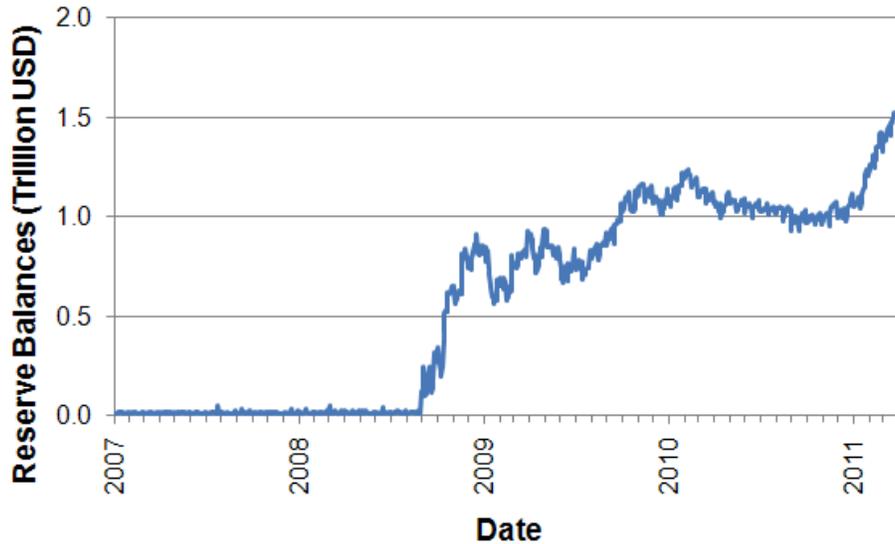
³Bennett and Peristiani (2002) show that reserve requirements have been largely avoided in the United States since the 1980s by sweep accounts, and that the remaining reserve requirements are largely met by vault cash that banks hold at branches and ATMs. Required reserves were \$71 billion, just 0.6 percent of total bank assets. Vault cash satisfied \$43 billion of these requirements.

needed to maintain its policy target—the federal funds rate—which is the interest rate at which banks lend reserves to each other in the interbank market. The Fed did not target the amount of reserves, the quantity of deposits or loans on banks' balance sheets, or broad measures of the money supply. In that regime, the federal funds rate represents a bank's alternative return on assets and hence is the required marginal return on bank lending. Banks expand their balance sheets so long as the marginal cost of funding is less than the marginal return on bank lending. The federal funds rate sets the level of the required marginal return.

From 2007 through 2010, the Fed greatly expanded the scope of its tools to address the financial crisis and severe recession in pursuit of its dual mandate to stabilize unemployment and inflation at low levels. Bank reserves increased rapidly after the Fed provided unprecedented unsterilized lending through several facilities after the bankruptcy of Lehman Brothers. Reserves continued to increase as the Fed purchased roughly \$1.75 trillion in Treasury securities, agency mortgage-backed securities, and agency debt. Between September 2008 and October 2009, bank reserves grew from \$30 billion to over \$1 trillion, as illustrated in Figure 1. To allow the Fed to continue targeting its policy rate even with large reserves outstanding, Congress accelerated previously granted authority for the Federal Reserve to pay interest on reserves in the Emergency Economic Stabilization Act of 2008. The Federal Reserve began paying interest on reserves on October 9, 2008. Paying interest on reserves allows the Fed to choose the required return on banks' reserves independently from the quantity of reserves in the banking system.

We develop a simple model of the current banking system that includes interest on reserves and no binding reserve requirements. We show that, with no frictions, bank lending quantities and interest rates are invariant to the level of reserves chosen by the central bank. Banks lend up to the point where the marginal return on loans equals the return on holding reserves, which is equal to the interest rate on reserves set by the central bank. This provides an indifference result for the quantity of reserves. In particular, while the sizes of banks' balance sheets expand with

Figure 1: Large quantity of reserves left in the banking system



increases in reserves, all else equal, the lending decision for a bank is determined by the same marginal return condition as with the former method of monetary policy implementation. A loan is made at the margin if its return exceeds the marginal opportunity cost of reserves, whether that is the federal funds rate as with the prior regime, or the rate of interest on reserves as in the current regime.

We also study balance-sheet costs in the banking sector to examine whether, under this friction, the level of reserves affects bank lending. The concern that banks may face balance-sheet costs has been raised by market observers.⁴ Banks may have costs that are increasing in the size of their balance sheets because of agency costs or regulatory requirements for capital or leverage ratios. During the recent crisis, banks worked to reduce the size of their balance sheets and were slow to raise equity capital, suggesting an increase in balance-sheet costs. The analysis shows that, with these increasing costs, large quantities of reserves may, surprisingly, have a contractionary effect on bank lending.

⁴For example, Wrightson ICAP (2008) expressed the concern that excess reserves could “clog up bank balance sheets.” See also Wrightson ICAP (2009).

2 Model

We consider a competitive economy with a real sector, a combination of households and firms, a banking sector, a central bank, and a government. The government issues bonds (B) that can be held by the real sector (B^r), the banking sector (B^b), or the central bank (B^{cb}):

$$B = B^r + B^b + B^{cb}. \quad (1)$$

The banking sector offers deposits (D), which can be held by the real sector (D^r) or the central bank (D^{cb}):

$$D = D^r + D^{cb}. \quad (2)$$

The central bank issues reserves ($M > 0$), and only banks can hold these reserves. The central bank pays interest (R) on reserves.

Since the real sector can invest in both government bonds and deposits, they must have the same return for any interior solution. In such cases, we write $R^D = R^G$. Indeed, we assume that the government is a price taker when issuing bonds.

The banking sector can lend to the real sector. There is an exogenous demand for loans that pay a decreasing return. The marginal return on a volume (L) of loans is $r(L)$, where $r(L) < r(L')$ if $L > L'$.

2.1 The banking sector's problem

Now we can write the problem faced by the banking sector, which for ease of graphical illustration we model as a single representative bank. The banking sector receives deposits ($D = D^r + D^{cb}$) and must choose how many loans to finance (L), as well as how many reserves (M) and how many bonds to hold. The problem is

$$\max_{L, M, B^b} r(L)L + RM + R^B B^b - R^D D - \int_D c(\hat{D})d\hat{D}, \quad (3)$$

where $c(D) \geq 0$ is the marginal cost associated with the size (D) of the bank's balance sheet; $c(D) \geq c(D')$ if $D > D'$.

The banks' balance sheet requires that $D = L + M + B^b$, so we can write

$$\max_{L, M, B^b} r(L)L + RM + R^G B^b - R^D(L + M + B^b) - \int_{L+M+B^b} c(\hat{D})d\hat{D}. \quad (4)$$

The first-order conditions are

$$L [r(L) - R^D - c(D)] = 0, \quad (5)$$

$$M [R - R^D - c(D)] = 0, \quad (6)$$

$$B^b [R^G - R^D - c(D)] = 0. \quad (7)$$

3 Results

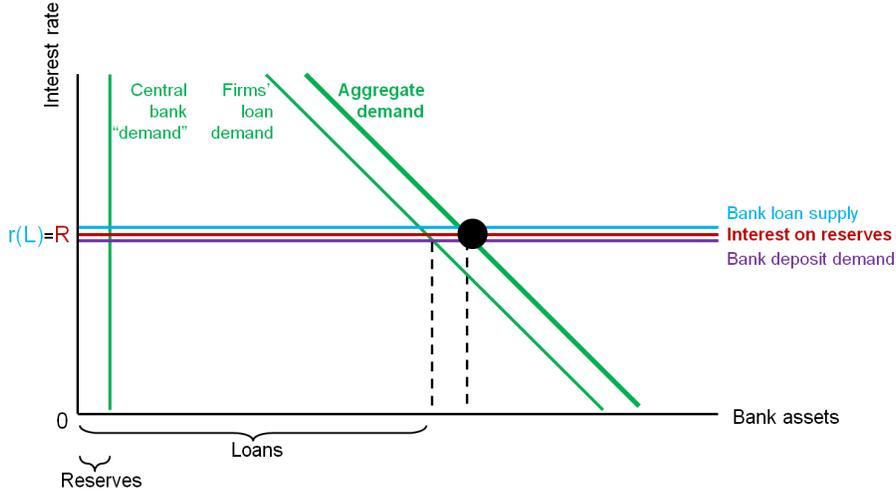
3.1 Benchmark case

We first consider the benchmark case with no balance-sheet costs, $c(D) = 0$. Since M and L must be strictly positive, we have $r(L) = R$ in an interior solution. The marginal loan financed by the banking sector has a return exactly equal to the interest rate paid on reserves. The return on the marginal loan, $r(L)$, and hence the quantity of loans financed, L , is independent of the quantity of reserves, M , that the central bank chooses to issue. This provides our first basic result.

Proposition 1 *In the benchmark case with no balance-sheet costs, the quantity, L , and marginal return, $r(L)$, of lending by the banking sector are independent of the quantity of reserves, M , issued by the central bank.*

This invariance result is illustrated in Figure 2 for the case of zero balance-sheet costs, $c(D) = 0$. The figure shows that banks have an elastic demand for deposits and an elastic supply of loans at the interest rate on reserves, R . There are two components of bank assets: loans to firms and reserves. (For simplicity, we do not illustrate government bonds held by banks in this figure.) Loan demand by firms is decreasing in the loan rate, which reflects that $r(L)$ is decreasing in L . Since the central bank chooses the quantity of reserves, M , in the banking sector, reserves

Figure 2: Benchmark model with few reserves



act as an inelastic central bank “demand.” Aggregate demand is the summation of firms’ loan demand.

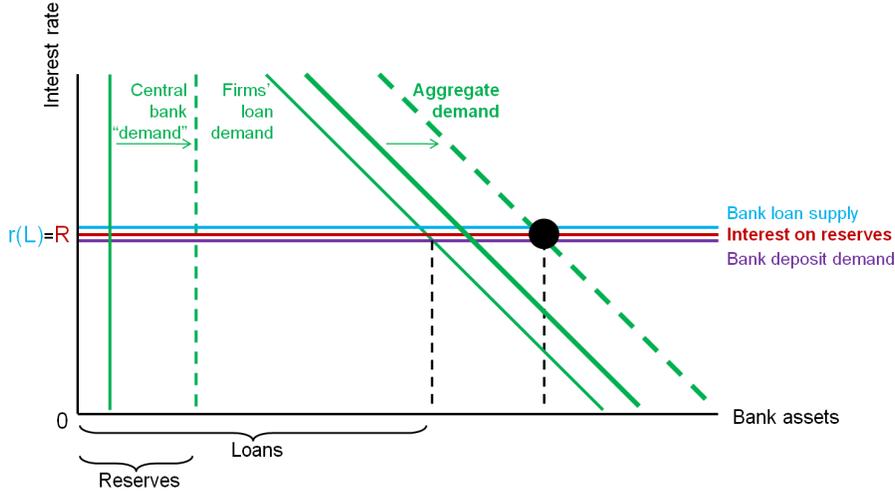
The equilibrium amount of bank loans to firms, L , corresponds to the intersection of the demand curve for loans and the central bank’s choice of interest on reserves, so that $r(L) = R$. The aggregate size of the banking sector’s balance sheet equals the equilibrium quantity of loans, L , plus the quantity of reserves, M . The quantity of bank lending is independent of the quantity of bank reserves. Consider Figure 3, which shows through arrows and dashed lines an increase in the supply of reserves, corresponding to an increase in the central bank “demand” curve. Aggregate demand increases by an equal amount. However, loans to firms are unchanged.

In addition, if the banking sector holds government bonds, then it must be the case that $r(L) = R = R^G = R^D$. The return on the marginal loan, the interest on reserves, the interest the banking sector pays on deposits, and the interest on government bonds must all be equal.

3.2 Balance-sheet costs

Next, we consider the case of positive bank balance-sheet costs. This is an important and natural friction to consider since market participants raised concern that banks’

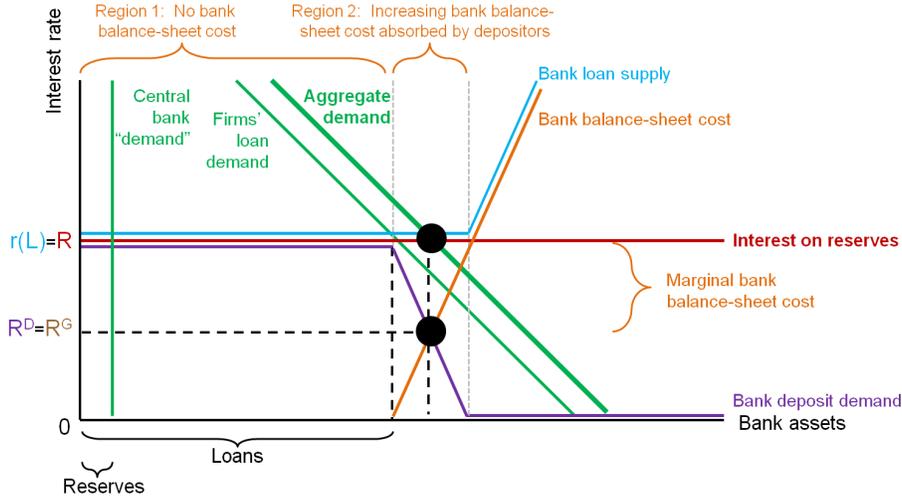
Figure 3: Benchmark model with many reserves



balance sheets may be too large (Wrightson ICAP, 2008 and 2009). Here we do not use subscripts for individual banks, but consider all banks to be representative. If $c(D) > 0$, then a bank will try to reduce the size of its balance sheet by selling bonds. If $B^b = 0$ and $c(D) > 0$, then the bank will reduce the amount it pays on deposits. In that case, with representative banks, we have $r(L) = R > R^D$. The real sector is at a corner solution, since it holds all the government bonds not held by the central bank. A positive balance-sheet cost for banks $c(D) > 0$ does not necessarily affect the number of loans financed by the banking sector. For moderate balance-sheet costs and reserve quantities, $r(L) = R$ still holds. Instead, the banking sector reduces the return on deposits, $R^D < R = r(L)$. The banking sector's return on the marginal loan, which determines the amount of bank credit, is not equal to banks' marginal funding costs, but rather is equal to the return on alternative assets that banks can invest in: namely, reserves.

Proposition 2 *For moderate balance-sheet costs, $c(D)$, and reserve levels, M , the marginal return, $r(L)$, of lending by the banking sector equals the interest rate paid on reserves, R , which may be greater than the return on deposits, R^D . The amount of banking sector lending is determined according to $r(L) = R$ and is independent of reserves, M .*

Figure 4: Balance sheet costs with few reserves

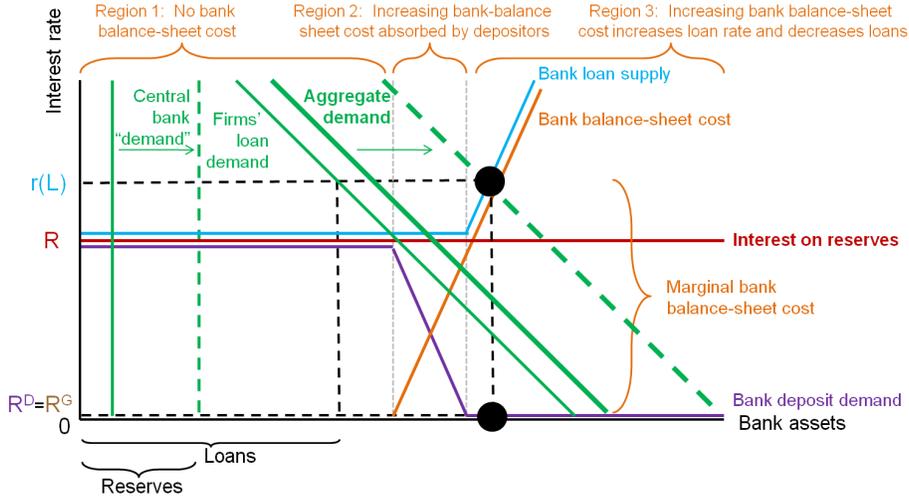


The invariance result of moderate balance-sheet costs and reserves on bank lending is illustrated in Figure 4. Bank balance-sheet costs are zero in Region 1 and increasing in balance-sheet size in Region 2. The equilibrium returns on deposits and government bonds are equal and below the interest rate on reserves: $R^D = R^G < R$. The return on deposits absorbs the balance-sheet cost, which implies that the banking sector does not have to pass on the balance-sheet cost through higher lending rates. The quantity of bank lending is unchanged from the benchmark case of zero balance-sheet costs.

For large enough reserves and balance-sheet costs, the deposit rate falls to zero and cannot fully absorb the costs. This result is demonstrated in Region 3 of Figure 5. The bank lending rate increases above the interest rate on reserves, $r(L) > R$, and the quantity of bank loans falls from the benchmark case.

Proposition 3 *For large enough balance-sheet costs, bank lending is contractionary in the quantity of reserves. The return on deposits and government bonds falls to zero, $R^D = R^G = 0$, and the marginal return, $r(L)$, of lending increases above the interest rate on reserves, $r(L) > R$.*

Figure 5: Balance sheet costs with many reserves



4 Conclusion

Perhaps because of its novelty, the large quantity of reserves in the banking system has generated a great amount of concern and debate. However, there is little analysis of how reserves impact bank lending when interest is paid on reserves.

This paper presents a simple model of the current U.S. banking system that includes interest on reserves and no binding reserve requirements. The exercise is important because of expressed concerns that large reserves could lead to excessive lending by banks, despite little formal analysis of the issue. We show that the amount of lending is independent of the amount of reserves in the banking system. The intuition is that the level of interest on reserves set by the central bank determines the marginal lending rate the banking sector charges to the real sector. In turn, the marginal bank lending rate determines the quantity of loans to the real sector. Since the interest paid on reserves is independent of the quantity of reserves, so too is the marginal bank lending rate.

We have kept our model simple and elementary in order to illustrate that the key determinant of bank lending is not fundamentally affected by the quantity of reserves. This point has been obscured by the traditional textbook model of the

money multiplier, which, while simple, is not an elementary model. Rather, that model assumes that a particular constraint—namely, the money multiplier—is always binding.

Our conclusion is likely to hold in more sophisticated models. While we cannot exclude the possibility that a more complicated model would overturn this result, it is incumbent on those economists concerned that large reserves will generate excessive lending to articulate precisely which frictions in a banking model will necessarily lead to this result. In contrast to such concerns, we study a friction under which the quantity of reserves could crowd out bank lending. Banks may have increasing costs in the size of their balance sheets because of agency costs or regulatory requirements on capital or leverage. Under such a friction, the effect of large reserves is contractionary rather than expansionary.

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