15 The Money Supply Process

Learning Objectives

- List and describe the "three players" that influence the money supply.
- Classify the factors affecting the Federal Reserve's assets and liabilities.
- Identify the factors that affect the monetary base and discuss their effects on the Federal Reserve's balance sheet.
- Explain and illustrate the deposit creation process through T-accounts.
- List the factors that affect the money supply.
- Summarize how the "three players" can influence the money supply.
- Calculate and interpret changes in the money multiplier.

Preview

As we saw in Chapter 5 and will see in later chapters on monetary theory, movements in the money supply affect interest rates and inflation and thus affect us all. Because of its far-reaching effects on economic activity, it is important to understand how the money supply is determined. Who controls it? What causes it to change? How might control of it be improved? In this chapter, we start to answer these questions by providing a detailed description of the *money supply process*, the mechanism that determines the level of the money supply.

Because deposits at banks are by far the largest component of the money supply, learning how these deposits are created is the first step in understanding the money supply process. This chapter provides an overview of how the banking system creates deposits and describes the basic principles of the money supply, concepts that will form the foundation for the material presented in later chapters.

THREE PLAYERS IN THE MONEY SUPPLY PROCESS

The "cast of characters" in the money supply story is as follows:

1. The *central bank*—the government agency that oversees the banking system and is responsible for the conduct of monetary policy; in the United States, the Federal Reserve System
2. *Banks* (depository institutions)—the financial intermediaries that accept deposits from individuals and institutions and make loans: commercial banks, savings and loan associations, mutual savings banks, and credit unions
3. *Depositors*—individuals and institutions that hold deposits in banks

Of the three players, the central bank—the Federal Reserve System—is the most important. The Fed's conduct of monetary policy involves actions that affect its balance sheet (holdings of assets and liabilities), to which we turn now.

THE FED'S BALANCE SHEET

The operation of the Fed and its monetary policy involve actions that affect its balance sheet, or its holdings of assets and liabilities. Here we discuss a simplified balance sheet

that includes just four items that are essential to our understanding of the money supply process.[1]

Federal Reserve System

Assets	Liabilities
Securities	Currency in circulation
Loans to financial institutions	Reserves

Liabilities

The two liabilities on the balance sheet, currency in circulation and reserves, are often referred to as the *monetary liabilities* of the Fed. They are an important part of the money supply story, because increases in either or both will lead to an increase in the money supply (everything else held constant). The sum of the Fed's monetary liabilities (currency in circulation and reserves) and the U.S. Treasury's monetary liabilities (Treasury currency in circulation, primarily coins) is called the **monetary base** (also called **high-powered money**). When discussing the monetary base, we will focus only on the monetary liabilities of the Fed, because those of the Treasury account for less than 10% of the base.[2]

1. *Currency in circulation*. The Fed issues currency (those green-and-gray pieces of paper in your wallet that say "Federal Reserve Note" at the top). Currency in circulation is the amount of currency in the hands of the public. Currency held by depository institutions is also a liability of the Fed, but is counted as part of the reserves.

Federal Reserve notes are IOUs from the Fed to the bearer and are also liabilities, but unlike most liabilities, they promise to pay back the bearer solely with Federal Reserve notes; that is, they pay off IOUs with other IOUs. Accordingly, if you bring a $100 bill to the Federal Reserve and demand payment, you will receive two $50s, five $20s, ten $10s, one hundred $1 bills, or some other combination of bills that adds to $100.

People are more willing to accept IOUs from the Fed than from you or me because Federal Reserve notes are a recognized medium of exchange; that is, they are accepted as a means of payment and so function as money. Unfortunately, neither you nor I can convince people that our IOUs are worth anything more than the paper they are written on.[3]

[1]A detailed discussion of the Fed's balance sheet and the factors that affect the monetary base can be found in Appendix 1 to this chapter, which you can find on the Companion Website at http://www.pearsonglobaleditions.com/Mishkin.

[2]It is also safe to ignore the Treasury's monetary liabilities when discussing the monetary base because legal restrictions prevent the Treasury from actively supplying its monetary liabilities to the economy.

[3]The currency item on our balance sheet refers only to currency *in circulation*—that is, the amount in the hands of the public. Currency that has been printed by the U.S. Bureau of Engraving and Printing is not automatically a liability of the Fed. For example, consider the importance of having $1 million of your own IOUs printed. You give out $100 worth to other people and keep the other $999,900 in your pocket. The $999,900 of IOUs does not make you richer or poorer and does not affect your indebtedness. You care only about the $100 of liabilities from the $100 of circulated IOUs. The same reasoning applies to the Fed in regard to its Federal Reserve notes.

For similar reasons, the currency component of the money supply, no matter how it is defined, includes only currency in circulation. It does not include any additional currency that is not yet in the hands of the public. The fact that currency has been printed but is not circulating means that it is not anyone's asset or liability and thus cannot affect anyone's behavior. Therefore, it makes sense not to include it in the money supply.

2. *Reserves*. All banks have an account at the Fed in which they hold deposits. **Reserves** consist of deposits at the Fed plus currency that is physically held by banks (called *vault cash* because it is stored in bank vaults). Reserves are assets for the banks but liabilities for the Fed, because the banks can demand payment on them at any time and the Fed is required to satisfy its obligation by paying Federal Reserve notes. As you will see, an increase in reserves leads to an increase in the level of deposits and hence in the money supply.

Total reserves can be divided into two categories: reserves that the Fed requires banks to hold (**required reserves**) and any additional reserves the banks choose to hold (**excess reserves**). For example, the Fed might require that for every dollar of deposits at a depository institution, a certain fraction (say, 10 cents) must be held as reserves. This fraction (10%) is called the **required reserve ratio**.

Assets

The two assets on the Fed's balance sheet are important for two reasons. First, changes in the asset items lead to changes in reserves and the monetary base, and consequently to changes in the money supply. Second, because these assets (government securities and Fed loans) earn higher interest rates than the liabilities (currency in circulation, which pays no interest, and reserves), the Fed makes billions of dollars every year—its assets earn income, and its liabilities cost practically nothing. Although it returns most of its earnings to the federal government, the Fed does spend some of it on "worthy causes," such as supporting economic research.

1. *Securities*. This category of assets covers the Fed's holdings of securities issued by the U.S. Treasury and, in unusual circumstances (as discussed in Chapter 16), other securities. As we will see, the primary way in which the Fed provides reserves to the banking system is by purchasing securities, thereby increasing its holdings of these assets. An increase in government or other securities held by the Fed leads to an increase in the money supply.

2. *Loans to financial institutions*. The second way in which the Fed can provide reserves to the banking system is by making loans to banks and other financial institutions. The loans taken out by these institutions are referred to as *discount loans*, or alternatively *borrowings from the Fed* or as *borrowed reserves*. These loans appear as a liability on financial institutions' balance sheets. An increase in loans to financial institutions can also be the source of an increase in the money supply. During normal times, the Fed makes loans only to banking institutions, and the interest rate charged to banks for these loans is called the **discount rate**. (As we will discuss in Chapter 16, during the recent financial crisis, the Fed made loans to other financial institutions.)

CONTROL OF THE MONETARY BASE

The monetary base equals currency in circulation C plus the total reserves in banking system R.[4] The monetary base MB can be expressed as

$$MB = C + R$$

[4]Here, currency in circulation includes both Federal Reserve currency (Federal Reserve notes) and Treasury currency (primarily coins).

The Federal Reserve exercises control over the monetary base through its purchases or sales of securities in the open market, called **open market operations**, and through its extension of discount loans to banks.

Federal Reserve Open Market Operations

The primary way in which the Fed causes changes in the monetary base is through its open market operations. A purchase of bonds by the Fed is called an **open market purchase**, and a sale of bonds by the Fed is called an **open market sale**. Federal Reserve purchases and sales of bonds are always done through **primary dealers**, government securities dealers who operate out of private banking institutions.

Open Market Purchase Suppose the Fed purchases $100 million of bonds from a primary dealer. To understand the consequences of this transaction, we look at *T-accounts*, which list only the changes that occur in balance sheet items, starting from the initial balance sheet position.

When the primary dealer sells the $100 million of bonds to the Fed, the Fed adds $100 million to the dealer's deposit account at the Fed, so that reserves in the banking system go up by $100 million. The banking system's T-account after this transaction is:

Banking System

Assets		Liabilities
Securities	−$100 m	
Reserves	+$100 m	

The effects on the Fed's balance sheet are shown below. The balance sheet shows an increase of $100 million of securities in its assets column, along with an increase of $100 million of reserves in its liabilities column:

Federal Reserve System

Assets		Liabilities	
Securities	+$100 m	Reserves	+$100 m

As you can see, the Fed's open market purchase of $100 million causes an expansion of reserves in the banking system by an equal amount. Another way of seeing this is to recognize that open market purchases of bonds expand reserves because the central bank pays for the bonds with reserves. Because the monetary base equals currency plus reserves, an open market purchase increases the monetary base by an amount equal to the amount of the purchase.

Open Market Sale. Similar reasoning indicates that if the Fed conducts an open market sale of $100 million of bonds to a primary dealer, the Fed deducts $100 million

from the dealer's deposit account, so the Fed's reserves (liabilities) fall by $100 million (and the monetary base falls by the same amount). The T-account is now:

Federal Reserve System

Assets		Liabilities	
Securities	−$100 m	Reserves	−$100 m

Shifts from Deposits into Currency

Even when the Fed does not conduct open market operations, a shift from deposits to currency will affect the reserves in the banking system. However, such a shift will have no effect on the monetary base. This tells us that the Fed has more control over the monetary base than over reserves.

Let's suppose that during the Christmas season, the public wants to hold more currency to buy gifts and so withdraws $100 million in cash. The effect on the T-account of the nonbank public is:

Nonbank Public

Assets		Liabilities
Checkable deposits	−$100 m	
Currency	+$100 m	

The banking system loses $100 million of deposits and hence $100 million of reserves:

Banking System

Assets		Liabilities	
Reserves	−$100 m	Checkable deposits	−$100 m

For the Fed, the public's action means that $100 million of additional currency is circulating in the hands of the public, while reserves in the banking system have fallen by $100 million. The Fed's T-account is:

Federal Reserve System

Assets	Liabilities	
	Currency in circulation	+$100 m
	Reserves	−$100 m

The net effect on the monetary liabilities of the Fed is a wash; the monetary base is unaffected by the public's increased desire for cash. But reserves *are* affected. Random fluctuations of reserves can occur as a result of random shifts into currency and out of deposits, and vice versa. The same is not true for the monetary base, making it a more stable variable and more controllable by the Fed.

Loans to Financial Institutions

In this chapter so far, we have seen how changes in the monetary base occur as a result of open market operations. However, the monetary base is also affected when the Fed makes a loan to a financial institution. When the Fed makes a $100 million loan to the First National Bank, the bank is credited with $100 million of reserves from the proceeds of the loan. The effects on the balance sheets of the banking system and the Fed are illustrated by the following T-accounts:

Banking System

Assets		Liabilities	
Reserves	+$100 m	Loans (borrowings from the Fed)	+$100 m

Federal Reserve System

Assets		Liabilities	
Loans (borrowings from the Fed)	+$100 m	Reserves	+$100 m

The monetary liabilities of the Fed have now increased by $100 million, and the monetary base, too, has increased by this amount. However, if a bank pays off a loan from the Fed, thereby reducing its borrowings from the Fed by $100 million, the T-accounts of the banking system and the Fed are as follows:

Banking System

Assets		Liabilities	
Reserves	−$100 m	Loans (borrowings from the Fed)	−$100 m

Federal Reserve System

Assets		Liabilities	
Loans (borrowings from the Fed)	−$100 m	Reserves	−$100 m

The net effect on the monetary liabilities of the Fed, and hence on the monetary base, is a reduction of $100 million. We see that the monetary base changes in a one-to-one ratio with the change in the borrowings from the Fed.

Other Factors That Affect the Monetary Base

So far in this chapter, it seems as though the Fed has complete control of the monetary base through its open market operations and loans to financial institutions. However, the world is a little bit more complicated for the Fed. Two important items that affect the monetary base, but are not controlled by the Fed, are *float* and *Treasury deposits at*

the Fed. When the Fed clears checks for banks, it often credits the amount of the check to a bank that has deposited it (increases the bank's reserves) before it debits (decreases the reserves of) the bank on which the check is drawn. The resulting temporary net increase in the total amount of reserves in the banking system (and hence in the monetary base) caused by the Fed's check-clearing process is called **float**. When the U.S. Treasury moves deposits from commercial banks to its account at the Fed, leading to an increase in *Treasury deposits at the Fed*, it causes a deposit outflow at these banks such as that shown in Chapter 9, and thus causes reserves in the banking system and the monetary base to decrease. Thus *float* (affected by random events such as the weather, which influences how quickly checks are presented for payment) and *Treasury deposits at the Fed* (determined by the U.S. Treasury's actions) both affect the monetary base but are not controlled by the Fed at all. Decisions by the U.S. Treasury to have the Fed intervene in the foreign exchange market also affect the monetary base.

Overview of the Fed's Ability to Control the Monetary Base

Our discussion above indicates that two primary features determine the monetary base: open market operations and lending to financial institutions. Whereas the amount of open market purchases or sales is completely controlled by the Fed's placing orders with dealers in bond markets, the central bank cannot unilaterally determine, and therefore cannot perfectly predict, the amount of borrowings from the Fed. The Federal Reserve sets the discount rate (interest rate on loans to banks), and then banks make decisions about whether to borrow. The amount of lending, though influenced by the Fed's setting of the discount rate, is not completely controlled by the Fed; banks' decisions play a role, too.

Therefore, we might want to split the monetary base into two components: one that the Fed can control completely, and another that is less tightly controlled. The less tightly controlled component is the amount of the base that is created by loans from the Fed. The remainder of the base (called the **nonborrowed monetary base**) is under the Fed's control because it results primarily from open market operations.[5] The nonborrowed monetary base is formally defined as the monetary base minus borrowings from the Fed, which are referred to as **borrowed reserves**:

$$MB_n = MB - BR$$

where MB_n = nonborrowed monetary base
MB = monetary base
BR = borrowed reserves from the Fed

Factors not controlled at all by the Fed (for example, float and Treasury deposits with the Fed) undergo substantial short-run variations and can be important sources of fluctuations in the monetary base over time periods as short as a week. However, these fluctuations are usually predictable and so can be offset through open market operations. ***Although float and Treasury deposits with the Fed undergo substantial short-run fluctuations, which complicate control of the monetary base, they do not prevent the Fed from accurately controlling it.***

[5]Actually, other items on the Fed's balance sheet (discussed in Appendix 1 to Chapter 15 on the website) affect the magnitude of the nonborrowed monetary base. Because their effects on the nonborrowed base relative to open market operations are both small and predictable, these other items do not present the Fed with difficulties in controlling the nonborrowed base.

MULTIPLE DEPOSIT CREATION: A SIMPLE MODEL

With our understanding of how the Federal Reserve controls the monetary base and how banks operate (Chapter 9), we now have the tools necessary to explain how deposits are created. When the Fed supplies the banking system with $1 of additional reserves, deposits increase by a multiple of this amount—a process called **multiple deposit creation**.

Deposit Creation: The Single Bank

Suppose the $100 million open market purchase described earlier was conducted with the First National Bank. After the Fed has bought the $100 million in bonds from the First National Bank, the bank finds that it has an increase in reserves of $100 million. To analyze what the bank will do with these additional reserves, assume that the bank does not want to hold excess reserves because it earns little interest on them. We begin the analysis with the following T-account:

First National Bank

Assets		Liabilities	
Securities	−$100 m		
Reserves	+$100 m		

Because the bank has no increase in its checkable deposits, required reserves remain the same, and the bank finds that its additional $100 million of reserves means that its excess reserves have risen by $100 million. Let's say the bank decides to make a loan equal in an amount to the $100 million rise in excess reserves. When the bank makes the loan, it sets up a checking account for the borrower and puts the proceeds of the loan into this account. In this way, the bank alters its balance sheet by increasing its liabilities with $100 million of checkable deposits and at the same time increasing its assets with the $100 million loan. The resulting T-account looks like this:

First National Bank

Assets		Liabilities	
Securities	−$100 m	Checkable deposits	+$100 m
Reserves	+$100 m		
Loans	+$100 m		

The bank has created checkable deposits by its act of lending. Because checkable deposits are part of the money supply, the bank's act of lending has, in fact, created money.

In its current balance sheet position, the First National Bank still has excess reserves and so might want to make additional loans. However, these reserves will not stay at the

bank for very long. The borrowers took out loans not to leave $100 million sitting idle in a checking account at the First National Bank but to purchase goods and services from other individuals and corporations. When the borrowers make these purchases by writing checks, the checks will be deposited at other banks, and the $100 million of reserves will leave the First National Bank. ***As a result, a bank cannot safely make a loan for an amount greater than the excess reserves that it has before it makes the loan.***

The final T-account of the First National Bank is:

First National Bank

Assets		Liabilities	
Securities	−$100 m		
Loans	+$100 m		

The increase in reserves of $100 million has been converted into additional loans of $100 million at the First National Bank, plus an additional $100 million of deposits that have made their way to other banks. (All the checks written on accounts at the First National Bank are deposited in banks rather than converted into cash, because we are assuming that the public does not want to hold any additional currency.) Now let's see what happens to these deposits at the other banks.

Deposit Creation: The Banking System

To simplify the analysis, let's assume that the $100 million of deposits created by First National Bank's loan is deposited at Bank A, and that this bank and all other banks hold no excess reserves. Bank A's T-account becomes:

Bank A

Assets		Liabilities	
Reserves	+$100 m	Checkable deposits	+$100 m

If the required reserve ratio is 10%, this bank will now find itself with a $10 million increase in required reserves, leaving it $90 million of excess reserves. Because Bank A (like the First National Bank) does not want to hold on to excess reserves, it will make loans for the entire amount. Its loans and checkable deposits will then increase by $90 million, but when the borrowers spend the $90 million of checkable deposits, they and the reserves at Bank A will fall back down by this same amount. The net result is that Bank A's T-account will look like this:

Bank A

Assets		Liabilities	
Reserves	+$10 m	Checkable deposits	+$100 m
Loans	+$90 m		

If the money spent by the borrowers to whom Bank A lent the $90 million is deposited in another bank, such as Bank B, the T-account for Bank B will be:

Bank B

Assets		Liabilities	
Reserves	+$90 m	Checkable deposits	+$90 m

The checkable deposits in the banking system have risen by another $90 million, for a total increase of $190 million ($100 million at Bank A plus $90 million at Bank B). In fact, the distinction between Bank A and Bank B is not necessary to obtain the same result on the overall expansion of deposits. If the borrowers from Bank A write checks to someone who deposits them at Bank A, the same change in deposits occurs. The T-accounts for Bank B would just apply to Bank A, and its checkable deposits would increase by the total amount of $190 million.

Bank B will want to modify its balance sheet further. It must keep 10% of $90 million ($9 million) as required reserves and has 90% of $90 million ($81 million) in excess reserves and so can make loans of this amount. Bank B will make loans totaling $81 million to borrowers, who spend the proceeds from the loans. Bank B's T-account will be:

Bank B

Assets		Liabilities	
Reserves	+$ 9 m	Checkable deposits	+$90 m
Loans	+$81 m		

The $81 million spent by the borrowers from Bank B will be deposited in another bank (Bank C). Consequently, from the initial $100 million increase of reserves in the banking system, the total increase of checkable deposits in the system so far is $271 million (= $100 m + $90 m + $81 m).

Following the same reasoning, if all banks make loans for the full amount of their excess reserves, further increments in checkable deposits will continue (at Banks C, D, E, and so on), as depicted in Table 1. Therefore, the total increase in deposits from the initial $100 increase in reserves will be $1,000 million: The increase is tenfold, the reciprocal of the 10% (0.10) reserve requirement.

If the banks choose to invest their excess reserves in securities, the result is the same. If Bank A had taken its excess reserves and purchased securities instead of making loans, its T-account would have looked like this:

Bank A

Assets		Liabilities	
Reserves	+$10 m	Checkable deposits	+$100m
Securities	+$90 m		

TABLE 1 Creation of Deposits (assuming 10% reserve requirement and a $100 million increase in reserves)

Bank	Increase in Deposits ($)	Increase in Loans ($)	Increase in Reserves ($)
First National	0.00	100.00 m	0.00
A	100.00 m	90.00 m	10.00 m
B	90.00 m	81.00 m	9.00 m
C	81.00 m	72.90 m	8.10 m
D	72.90 m	65.61 m	7.29 m
E	65.61 m	59.05 m	6.56 m
F	59.05 m	53.14 m	5.91 m
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.
Total for all banks	1,000.00 m	1,000.00 m	100.00 m

When the bank buys $90 million of securities, it writes $90 million in checks to the sellers of the securities, who in turn deposit the $90 million at a bank such as Bank B. Bank B's checkable deposits increase by $90 million, and the deposit expansion process is the same as before. ***Whether a bank chooses to use its excess reserves to make loans or to purchase securities, the effect on deposit expansion is the same.***

You can now see the difference in deposit creation for a single bank versus the banking system as a whole. Because a single bank can create deposits equal only to the amount of its excess reserves, it cannot by itself generate multiple deposit expansion. A single bank cannot make loans greater in amount than its excess reserves, because the bank will lose these reserves as the deposits created by the loan find their way to other banks. However, the banking system as a whole can generate a multiple expansion of deposits, because when a bank loses its excess reserves, these reserves do not leave the banking system, even though they are lost to the individual bank. So as each bank makes a loan and creates deposits, the reserves find their way to another bank, which uses them to make additional loans and create additional deposits. As you have seen, this process continues until the initial increase in reserves results in a multiple increase in deposits.

The multiple increase in deposits generated from an increase in the banking system's reserves is called the **simple deposit multiplier**.[6] In our example, with a 10% required reserve ratio, the simple deposit multiplier is 10. More generally, the simple deposit multiplier equals the reciprocal of the required reserve ratio, expressed

[6]This multiplier should not be confused with the Keynesian multiplier, which is derived through a similar step-by-step analysis. That multiplier relates an increase in income to an increase in investment, whereas the simple deposit multiplier relates an increase in deposits to an increase in reserves.

as a fraction (for example, 10 = 1/0.10). So the formula for the multiple expansion of deposits can be written as follows:

$$\Delta D = \frac{1}{rr} \times \Delta R \tag{1}$$

where ΔD = change in total checkable deposits in the banking system
rr = required reserve ratio (0.10 in the example)
ΔR = change in reserves for the banking system ($100 million in the example)

Deriving the Formula for Multiple Deposit Creation

The formula for the multiple creation of deposits can be derived directly using algebra. We obtain the same result for the relationship between a change in deposits and a change in reserves.

Our assumption that banks do not hold on to any excess reserves means that the total amount of required reserves in the banking system *RR* will equal the total reserves in the banking system *R*:

$$RR = R$$

The total amount of required reserves equals the required reserve ratio *rr* times the total amount of checkable deposits *D*:

$$RR = rr \times D$$

Substituting $rr \times D$ for *RR* in the first equation,

$$rr \times D = R$$

and dividing both sides of the preceding equation by *rr* gives

$$D = \frac{1}{rr} \times R$$

Taking the change in both sides of this equation and using delta to indicate a change gives

$$\Delta D = \frac{1}{rr} \times \Delta R$$

which is the same formula for deposit creation given in Equation 1.[7]

[7]A formal derivation of this formula follows. Using the reasoning in the text, the change in checkable deposits is $100(=$\Delta R \times 1$) plus $90 [=$\Delta R \times (1 - rr)$] plus $81 [=$\Delta R \times (1 - rr)^2$] and so on, which can be rewritten as

$$\Delta D = \Delta R \times [1 + (1 - rr) + (1 - rr)^2 + (1 - rr)^3 + \cdots]$$

Using the formula for the sum of an infinite series found in footnote 3 of Chapter 4, this equation can be rewritten as

$$\Delta D = \Delta R \times \frac{1}{1 - (1 - rr)} = \frac{1}{rr} \times \Delta R$$

This derivation provides us with another way of looking at the multiple creation of deposits, because it forces us to examine the banking system as a whole rather than one bank at a time. For the banking system as a whole, deposit creation (or contraction) will stop only when excess reserves in the banking system are zero; that is, the banking system will be in equilibrium when the total amount of required reserves equals the total amount of reserves, as seen in the equation $RR = R$. When $rr \times D$ is substituted for RR, the resulting equation $rr \times D = R$ tells us how high checkable deposits must be for required reserves to equal total reserves. Accordingly, a given level of reserves in the banking system determines the level of checkable deposits when the banking system is in equilibrium (when $ER = 0$); put another way, the given level of reserves supports a given level of checkable deposits.

In our example, the required reserve ratio is 10%. If reserves increase by $100 million, checkable deposits must rise by $1,000 million for total required reserves also to increase by $100 million. If the increase in checkable deposits is less than this—say, $900 million—then the increase in required reserves of $90 million remains below the $100 million increase in reserves, so excess reserves still exist somewhere in the banking system. The banks holding the excess reserves will now make additional loans, thereby creating new deposits; this process will continue until all reserves in the system are used up, which occurs when checkable deposits rise by $1,000 million.

We can also see this by looking at the resulting T-account of the banking system as a whole (including the First National Bank):

Banking System

Assets		Liabilities	
Securities	−$ 100 m	Checkable deposits	+$1,000 m
Reserves	+$ 100 m		
Loans	+$1,000 m		

The procedure of eliminating excess reserves by loaning them out continues until the banking system (First National Bank and Banks A, B, C, D, and so on) has made $1,000 million of loans and created $1,000 million of deposits. In this way, $100 million of reserves supports $1,000 million (ten times the quantity) of deposits.

Critique of the Simple Model

Our model of multiple deposit creation seems to indicate that the Federal Reserve is able to exercise complete control over the level of checkable deposits by setting the required reserve ratio and the level of reserves. The actual creation of deposits is much less mechanical than the simple model indicates. If proceeds from Bank A's $90 million loan are not deposited but are kept in currency, nothing is deposited in Bank B and the deposit creation process ceases. The total increase in the money supply is now the $90 million increase in currency plus the initial $100 million of deposits created by First

National Bank's loans, which were deposited at Bank A, for a total of only $190 million—considerably less than the $1,000 million we calculated using the simple model above. In other words, currency does not lead to multiple deposit expansion, whereas deposits do. Thus, if some proceeds from loans are not deposited in banks but instead are used to raise the holdings of currency, less multiple expansion occurs overall, and the money supply does not increase by the amount predicted by our simple model of multiple deposit creation.

Another situation ignored in our model is one in which banks do not make loans or buy securities in the full amount of their excess reserves. If Bank A decides to hold on to all $90 million of its excess reserves, no deposits will be made in Bank B, and this will stop the deposit creation process. The total increase in deposits will be only $100 million, not the $1,000 million increase in our example. Hence, if banks choose to hold on to all or some of their excess reserves, the full expansion of deposits predicted by the simple model of multiple deposit creation again does not occur.

Our examples indicate that the Fed is not the only player whose behavior influences the level of deposits and therefore the money supply. Depositors' decisions regarding how much currency to hold and banks' decisions regarding the amount of excess reserves to hold also can cause the money supply to change.

FACTORS THAT DETERMINE THE MONEY SUPPLY

Our critique of the simple model shows how we can expand on it to discuss all the factors that affect the money supply. Let's look at changes in each factor in turn, holding all other factors constant.

Changes in the Nonborrowed Monetary Base, MB_n

As shown earlier in the chapter, the Fed's open market purchases increase the nonborrowed monetary base, and its open market sales decrease it. Holding all other variables constant, an increase in MB_n arising from an open market purchase raises the amount of the monetary base and reserves, so that multiple deposit creation occurs and the money supply increases. Similarly, an open market sale that reduces MB_n shrinks the amount of the monetary base and reserves, thereby causing a multiple contraction of deposits and a decrease in the money supply. We have the following result: ***The money supply is positively related to the nonborrowed monetary base MB_n.***

Changes in Borrowed Reserves, *BR*, from the Fed

An increase in loans from the Fed provides additional borrowed reserves and thereby increases the amount of the monetary base and reserves, so that multiple deposit creation occurs and the money supply expands. If banks reduce the level of their discount loans, all other variables held constant, the monetary base and amount of reserves fall, and the money supply decreases. The result is this: ***The money supply is positively related to the level of borrowed reserves, BR, from the Fed.***

Changes in the Required Reserve Ratio, *rr*

If the required reserve ratio on checkable deposits increases while all other variables, such as the monetary base, stay the same, we have seen that multiple deposit expansion is reduced and hence the money supply falls. If, on the other hand, the required reserve ratio falls, multiple deposit expansion is higher and the money supply rises.

We now have the following result: ***The money supply is negatively related to the required reserve ratio rr.*** In the past, the Fed sometimes used reserve requirements to affect the size of the money supply. In recent years, however, reserve requirements have become a less important factor in the determination of the money multiplier and the money supply, as we shall see in the next chapter.

Changes in Excess Reserves

When banks increase their holdings of excess reserves, those reserves are no longer being used to make loans, causing multiple deposit creation to stop dead in its tracks, resulting in less expansion of the money supply. If, on the other hand, banks choose to hold fewer excess reserves, loans and multiple deposit creation increase, and the money supply rises. ***The money supply is negatively related to the amount of excess reserves.***

Recall from Chapter 9 that the primary benefit to a bank of holding excess reserves is that they provide insurance against losses due to deposit outflows; that is, they enable the bank experiencing deposit outflows to escape the costs of calling in loans, selling securities, borrowing from the Fed or other corporations, or bank failure. If banks fear that deposit outflows are likely to increase (that is, if expected deposit outflows increase), they will seek more insurance against this possibility, and excess reserves will rise.

Changes in Currency Holdings

As shown before, checkable deposits undergo multiple expansion, whereas currency does not. Hence, when checkable deposits are converted into currency, as long as the amount of excess reserves are held constant, a switch is made from a component of the money supply that undergoes multiple expansion to one that does not. The overall level of multiple expansion declines, and the money supply falls. On the other hand, if currency holdings fall, a switch is made into checkable deposits that undergo multiple deposit expansion, so the money supply rises. This analysis suggests the following result: ***Holding excess reserves constant, the money supply is negatively related to currency holdings.***

OVERVIEW OF THE MONEY SUPPLY PROCESS

We now have a model of the money supply process in which all three of the players—the Federal Reserve System, depositors, and banks—directly influence the money supply. As a study aid, Summary Table 1 charts the money supply responses to the five factors discussed above and gives a brief synopsis of the reasoning behind them.

The variables are grouped by the player who is the primary influence behind the variable. The Federal Reserve, for example, influences the money supply by controlling the first two variables. Depositors influence the money supply through their decisions about holdings of currency, while banks influence the money supply with their decisions about borrowings from the Fed and excess reserves.

SUMMARY TABLE 1

Money Supply Response

Player	Variable	Change in Variable	Money Supply Response	Reason
Federal Reserve System	Nonborrowed monetary base, MB_n	↑	↑	More *MB* for deposit creation
	Required reserve ratio, *rr*	↑	↓	Less multiple deposit expansion
Banks	Borrowed reserves, *BR*	↑	↑	More *MB* for deposit creation
	Excess reserves	↑	↓	Less loans and deposit creation
Depositors	Currency holdings	↑	↓	Less multiple deposit expansion

Note: Only increases (↑) in the variables are shown. The effects of decreases on the money supply would be the opposite of those indicated in the "Money Supply Response" column.

THE MONEY MULTIPLIER

The intuition inherent in the preceding section is sufficient for you to understand how the money supply process works. For those of you who are more mathematically inclined, we can derive all of the above results using a concept called the **money multiplier**, denoted by *m*, which tells us how much the money supply changes for a given change in the monetary base. The relationship between the money supply *M*, the money multiplier, and the monetary base is described by the following equation:

$$M = m \times MB \tag{2}$$

The money multiplier *m* tells us what multiple of the monetary base is transformed into the money supply. Because the money multiplier is typically larger than 1, the alternative name for the monetary base, *high-powered money*, is logical: A $1 change in the monetary base typically leads to more than a $1 change in the money supply.

Deriving the Money Multiplier

Let's assume that the desired holdings of currency *C* and excess reserves *ER* grow proportionally with checkable deposits *D*; in other words, we assume that the ratios of these items to checkable deposits are constants in equilibrium, as the braces in the following expressions indicate:

$$c = \{C/D\} = \text{currency ratio}$$

$$e = \{ER/D\} = \text{excess reserves ratio}$$

We will now derive a formula that describes how the currency ratio desired by depositors, the excess reserves ratio desired by banks, and the required reserve ratio set by the Fed affect the multiplier *m*. We begin the derivation of the model of the money supply with the following equation:

$$R = RR + ER$$

which states that the total amount of reserves in the banking system *R* equals the sum of required reserves *RR* and excess reserves *ER*. (Note that this equation corresponds to the equilibrium condition $RR = R$ given earlier in the chapter, where excess reserves were assumed to be zero.)

The total amount of required reserves equals the required reserve ratio *rr* times the amount of checkable deposits *D*:

$$RR = rr \times D$$

Substituting $rr \times D$ for *RR* in the first equation yields an equation that links reserves in the banking system to the amount of checkable deposits and excess reserves they can support:

$$R = (rr \times D) + ER$$

A key point here is that the Fed sets the required reserve ratio *rr* to less than 1. Thus \$1 of reserves can support more than \$1 of deposits, and the multiple expansion of deposits can occur.

Let's see how this works in practice. If excess reserves are held at zero ($ER = 0$), the required reserve ratio is set at $rr = 0.10$, and the level of checkable deposits in the banking system is \$1,600 billion, then the amount of reserves needed to support these deposits is \$160 billion (=0.10 × \$1,600 billion). The \$160 billion of reserves can support ten times this amount in checkable deposits because multiple deposit creation will occur.

Because the monetary base *MB* equals currency *C* plus reserves *R*, we can generate an equation that links the amount of the monetary base to the levels of checkable deposits and currency by adding currency to both sides of the preceding equation:

$$MB = R + C = (rr \times D) + ER + C$$

Notice that this equation reveals the amount of the monetary base needed to support the existing amounts of checkable deposits, currency, and excess reserves.

To derive the money multiplier formula in terms of the currency ratio $c = \{C/D\}$ and the excess reserves ratio $e = \{ER/D\}$, we rewrite the last equation, specifying *C* as $c \times D$ and *ER* as $e \times D$:

$$MB = (rr \times D) + (e \times D) + (c \times D) = (rr + e + c) \times D$$

We next divide both sides of the equation by the term inside the parentheses to get an expression linking checkable deposits *D* to the monetary base *MB*:

$$D = \frac{1}{rr + e + c} \times MB \tag{3}$$

Using the M1 definition of the money supply as currency plus checkable deposits ($M = D + C$) and again specifying *C* as $c \times D$, we get

$$M = D + (c \times D) = (1 + c) \times D$$

Substituting in this equation the expression for D from Equation 3 yields

$$M = \frac{1 + c}{rr + e + c} \times MB \tag{4}$$

We have derived an expression in the form of our earlier Equation 2. As you can see, the ratio that multiplies MB is the money multiplier, which tells how much the money supply changes in response to a given change in the monetary base (high-powered money). The money multiplier m is thus

$$m = \frac{1 + c}{rr + e + c} \tag{5}$$

It is a function of the currency ratio set by depositors c, the excess reserves ratio set by banks e, and the required reserve ratio set by the Fed rr.

Intuition Behind the Money Multiplier

To get a feel for what the money multiplier means, let's construct a numerical example with realistic numbers for the following variables:

rr = required reserve ratio = 0.10

C = currency in circulation = \$1,200 billion

D = checkable deposits = \$1,600 billion

ER = excess reserves = \$2,500 billion

M = money supply (M1) = $C + D$ = \$2,800 billion

From these numbers we can calculate the values for the currency ratio c and the excess reserves ratio e:

$$c = \frac{\$1{,}200 \text{ billion}}{\$1{,}600 \text{ billion}} = 0.75$$

$$e = \frac{\$2{,}500 \text{ billion}}{\$1{,}600 \text{ billion}} = 1.56$$

The resulting value of the money multiplier is

$$m = \frac{1 + 0.75}{0.1 + 1.56 + 0.75} = \frac{1.75}{2.41} = 0.73$$

The money multiplier of 0.73 tells us that, given the required reserve ratio of 10% on checkable deposits and the behavior of depositors, as represented by $c = 0.75$, and banks, as represented by $e = 1.56$, a \$1 increase in the monetary base leads to a \$0.73 increase in the money supply (M1).

An important characteristic of the money multiplier is that it is far less than the simple deposit multiplier of 10 found earlier in the chapter. There are two reasons for this result. First, ***although deposits undergo multiple expansion, currency does not.*** Thus, if some portion of the increase in high-powered money finds its way into currency, this portion does not undergo multiple deposit expansion. In our simple model earlier in the chapter,

we did not allow for this possibility, and so the increase in reserves led to the maximum amount of multiple deposit creation. However, in our current model of the money multiplier, the level of currency does rise when the monetary base *MB* and checkable deposits *D* increase, because *c* is greater than zero. As previously stated, any increase in *MB* that goes into an increase in currency is not multiplied, so only part of the increase in *MB* is available to support checkable deposits that undergo multiple expansion. The overall level of multiple deposit expansion must be lower, meaning that the increase in *M*, given an increase in *MB*, is smaller than indicated by the simple model earlier in the chapter.

Second, since *e* is positive, ***any increase in the monetary base and deposits leads to higher excess reserves.*** When there is an increase in *MB* and *D*, the resulting increase in excess reserves means that the amount of reserves used to support checkable deposits does not increase as much as it otherwise would. Hence the increase in checkable deposits and the money supply are lower, and the money multiplier is smaller.

Prior to 2008, the excess reserves ratio *e* was almost always very close to zero (less than 0.001), and so its impact on the money multiplier (Equation 5) was essentially irrelevant. When *e* is close to zero, the money multiplier is always greater than 1, and it was around 1.6 during that period. However, as we will see in the next chapter, nonconventional monetary policy during the global financial crisis caused excess reserves to skyrocket to over $2 trillion. Such an extraordinarily large value of *e* caused the excess reserves factor in the money multiplier equation to become dominant, and so the money multiplier fell to below 1, as discussed above.

Money Supply Response to Changes in the Factors

By recognizing that the monetary base is $MB = MB_n + BR$, we can rewrite Equation 2 as

$$M = m \times (MB_n + BR) \tag{6}$$

Now we can show algebraically all the results given in Summary Table 1, which shows how the money supply responds to the changes in the factors.

As you can see from Equation 6, a rise in MB_n or *BR* raises the money supply *M* because the money multiplier *m* is always greater than zero. We can see that a rise in the required reserve ratio *rr* lowers the money supply by calculating the value of the money multiplier (using Equation 5) in our numerical example when *rr* increases from 10% to 15% (leaving all other variables unchanged). The money multiplier then becomes

$$m = \frac{1 + 0.75}{0.15 + 1.56 + 0.75} = \frac{1.75}{2.46} = 0.71$$

which, as we would expect, is less than 0.73.

Similarly, we can see that a rise in excess reserves lowers the money supply by calculating the money multiplier when *e* is increased from 1.56 to 3.0. The money multiplier decreases from 0.73 to

$$m = \frac{1 + 0.75}{0.1 + 3.00 + 0.75} = \frac{1.75}{3.85} = 0.45$$

We can also analyze what happens in our numerical example when there is a rise in the currency ratio *c* from 0.75 to 1.50. In this case, something peculiar happens. Instead of falling, the money multiplier rises from 0.73 to

$$m = \frac{1 + 1.50}{0.1 + 1.56 + 1.50} = \frac{2.50}{3.20} = 0.78$$

At first glance, this result might seem counterintuitive. After all, a dollar of monetary base that goes into currency only increases the money supply by one dollar, whereas a dollar of monetary base that goes into deposits leads to multiple deposit expansion that increases the money supply by a factor of 10. Thus it seems as though the shift from deposits to currency should lower the overall amount of multiple expansion and hence the money supply. This reasoning is correct, but it assumes a small value of the excess reserves ratio. Indeed, that is the case during normal times, when the excess reserves ratio is near zero. However, in our current situation, in which the excess reserves ratio e is abnormally high, when a dollar moves from deposits into currency, the amount of excess reserves falls by a large amount, which releases reserves to support more deposits, causing the money multiplier to rise.[8]

APPLICATION Quantitative Easing and the Money Supply, 2007–2014

When the global financial crisis began in the fall of 2007, the Fed initiated lending programs and large-scale asset-purchase programs in an attempt to bolster the economy. By June 2014, these purchases of securities had led to a quintupling of the Fed's balance sheet and a 377% increase in the monetary base. These lending and asset-purchase programs, discussed further in Chapter 16, resulted in a huge expansion of the monetary base and have been given the name "quantitative easing." As our analysis in this chapter indicates, such a massive expansion of the monetary base could potentially lead to a large expansion of the money supply. However, as shown in Figure 1, when the monetary base increased by more than 370%, the M1 money supply rose by less than 110%. How can we explain this result using our money supply model?

Figure 2 shows the currency ratio c and the excess reserves ratio e for the 2007–2014. We see that the currency ratio was relatively steady during this period and so was not a major source of changes in the money multiplier and the money supply. Instead, we have to look to the extraordinary rise in the excess reserves ratio e, which climbed by more than a factor of 1,000 during this period.

What explains this substantial increase in the excess reserves ratio e? The Fed's actions created far more reserves than were needed for banks to meet their reserve requirements. Banks were willing to hold the huge increases in excess reserves because, after the Fed began paying interest on these reserves starting in 2008, the interest rate on reserves often exceeded the rate at which the banks could lend them out in the federal funds market. Because excess reserves had a very small or even negative cost,

[8]All the above results can be derived more generally from the Equation 5 formula for m as follows. When rr or e increases, the denominator of the money multiplier increases, and therefore the money multiplier must decrease. As long as $rr + e$ is less than 1 (as is usually the case), an increase in c raises the denominator of the money multiplier proportionally by more than it raises the numerator. The increase in c causes the money multiplier to fall. On the other hand, when $rr + e$ is greater than 1 (the current situation), an increase in c raises the numerator of the money multiplier proportionally by more than it raises the denominator, so the money multiplier rises. For more background on the currency ratio c, consult the third Web appendix to this chapter at http://www.pearsonglobaleditions.com/Mishkin. Recall that the money multiplier in Equation 5 is for the M1 definition of money. Appendix 2 to Chapter 15 on the website discusses how the multiplier for M2 is determined.

MyEconLab Mini-lecture MyEconLab Real-time data

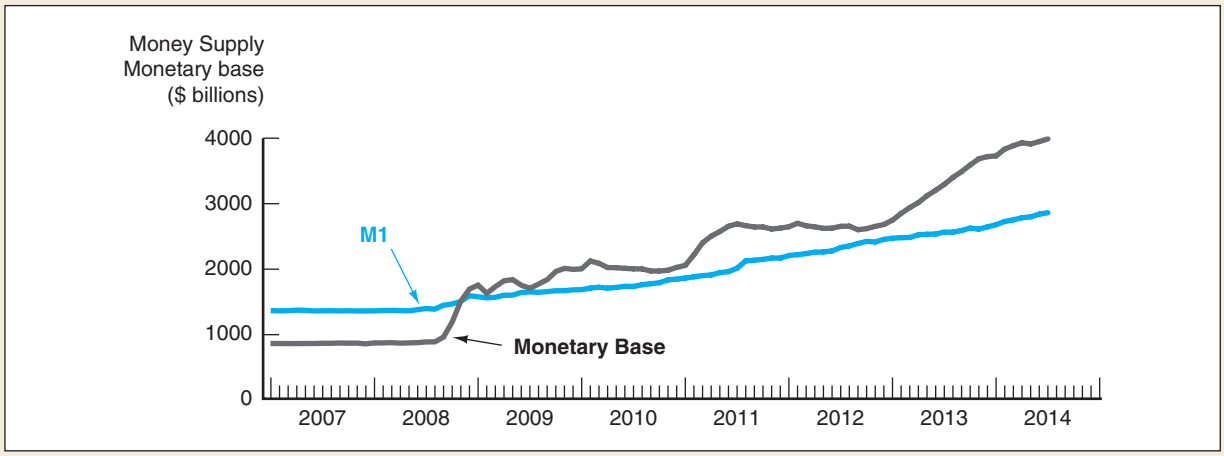

FIGURE 1 **M1 and the Monetary Base, 2007–2014**
The money supply rose by less than 110% despite the increase in the monetary base by over 370%.
Source: Federal Reserve Bank of St. Louis, FRED database: http://research.stlouisfed.org/fred2/.

banks were willing to tolerate a much higher excess reserves ratio e. As predicted by our money supply model, the huge increase in e sharply lowered the money multiplier, and so the money supply did not undergo that large an expansion, despite the huge increase in the monetary base. ◆

MyEconLab Mini-lecture MyEconLab Real-time data

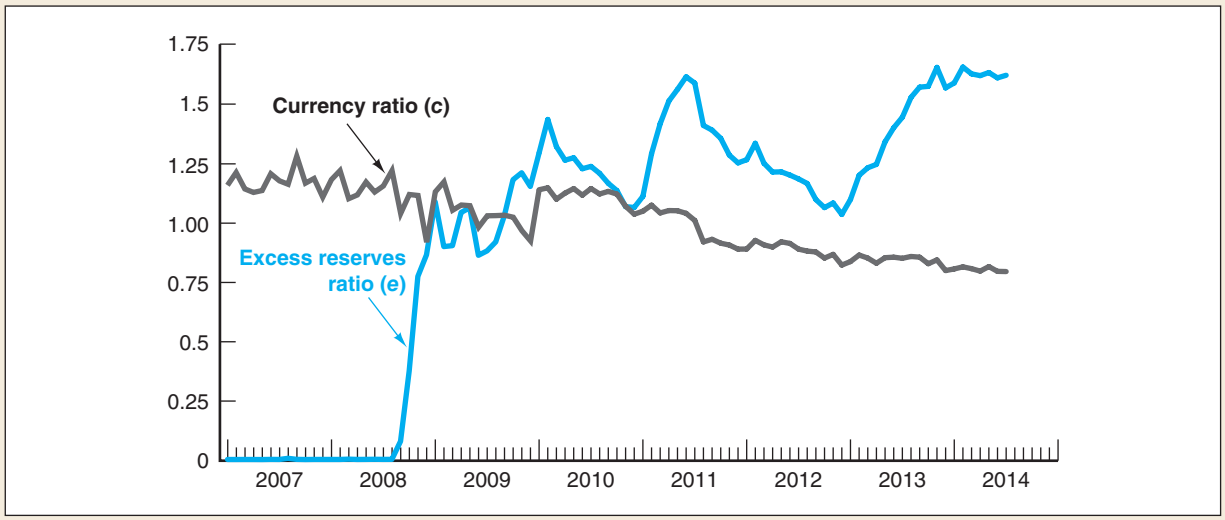

FIGURE 2 **Excess Reserves Ratio and Currency Ratio, 2007–2014**
The currency ratio c was relatively steady, whereas the excess reserves ratio e rose by a factor of over 1,000.
Source: Federal Reserve Bank of St. Louis, FRED database: http://research.stlouisfed.org/fred2/.

SUMMARY

1. The three players in the money supply process are the central bank, banks (depository institutions), and depositors.
2. Four items in the Fed's balance sheet are essential to our understanding of the money supply process: the two liability items, currency in circulation and reserves, which together make up the monetary base, and the two asset items, securities and loans to financial institutions.
3. The Federal Reserve controls the monetary base through open market operations and extensions of loans to financial institutions, and has better control over the monetary base than over reserves. Although float and Treasury deposits with the Fed undergo substantial short-run fluctuations, which complicate control of the monetary base, they do not prevent the Fed from accurately controlling it.
4. A single bank can make loans up to the amount of its excess reserves, thereby creating an equal amount of deposits. The banking system can create a multiple expansion of deposits, because as each bank makes a loan and creates deposits, the reserves find their way to another bank, which uses them to make loans and create additional deposits. In the simple model of multiple deposit creation, in which banks do not hold on to excess reserves and the public holds no currency, the multiple increase in checkable deposits (simple deposit multiplier) equals the reciprocal of the required reserve ratio.
5. The simple model of multiple deposit creation has serious deficiencies. Decisions by depositors to increase their holdings of currency or by banks to hold excess reserves will result in a smaller expansion of deposits than is predicted by the simple model. All three players—the Fed, banks, and depositors—are important in the determination of the money supply.
6. The money supply is positively related to the nonborrowed monetary base MB_n, which is determined by open market operations, and the level of borrowed reserves (lending) from the Fed, BR. The money supply is negatively related to the required reserve ratio, rr, and excess reserves. The money supply is also negatively related to holdings of currency, but only if excess reserves do not vary much when there is a shift between deposits and currency. The model of the money supply process takes into account the behavior of all three players in the money supply process: the Fed through open market operations and setting of the required reserve ratio; banks through their decisions to borrow from the Federal Reserve and hold excess reserves; and depositors through their decisions about the holding of currency.
7. The monetary base is linked to the money supply using the concept of the money multiplier, which tells us how much the money supply changes when the monetary base changes.

KEY TERMS

borrowed reserves, p. 392
discount rate, p. 388
excess reserves, p. 388
float, p. 392
high-powered money, p. 387
monetary base, p. 387
money multiplier, p. 401
multiple deposit creation, p. 393
nonborrowed monetary base, p. 392
open market operations, p. 389
open market purchase, p. 389
open market sale, p. 389
primary dealers, p. 389
required reserve ratio, p. 388
required reserves, p. 388
reserves, p. 388
simple deposit multiplier, p. 396

QUESTIONS

Select questions are available in MyEconLab *at* http://www.myeconlab.com. Unless otherwise noted, the following assumptions are made in all questions: The required reserve ratio on checkable deposits is 10%, banks do not hold any excess reserves, and the public's holdings of currency do not change.

1. Classify each of these transactions as an asset, a liability, or neither for each of the "players" in the money supply process—the Federal Reserve, banks, and depositors.
   a. You get a $10,000 loan from the bank to buy an automobile.

b. You deposit $400 into your checking account at the local bank.

c. The Fed provides an emergency loan to a bank for $1,000,000.

d. A bank borrows $500,000 in overnight loans from another bank.

e. You use your debit card to purchase a meal at a restaurant for $100.

2. The First National Bank receives an extra $100 of reserves but decides not to lend out any of these reserves. How much deposit creation takes place for the entire banking system?

3. Suppose the Fed buys $1 million of bonds from the First National Bank. If the First National Bank and all other banks use the resulting increase in reserves to purchase securities only and not to make loans, what will happen to checkable deposits?

4. If a bank depositor withdraws $1,000 of currency from an account, what happens to reserves, checkable deposits, and the monetary base?

5. If a bank sells $10 million of bonds to the Fed to pay back $10 million on the loan it owes, what is the effect on the level of checkable deposits?

6. If you decide to hold $100 less cash than usual and therefore deposit $100 more cash in the bank, what effect will this have on checkable deposits in the banking system if the rest of the public keeps its holdings of currency constant?

7. "The Fed can perfectly control the amount of reserves in the system." Is this statement true, false, or uncertain? Explain.

8. "The Fed can perfectly control the amount of the monetary base, but has less control over the composition of the monetary base." Is this statement true, false, or uncertain? Explain.

9. The Fed buys $100 million of bonds from the public and also lowers the required reserve ratio. What will happen to the money supply?

10. Describe how each of the following can affect the money supply: (a) the central bank; (b) banks; and (c) depositors.

11. "The money multiplier is necessarily greater than 1." Is this statement true, false, or uncertain? Explain your answer.

12. What effect might a financial panic have on the money multiplier and the money supply? Why?

13. During the Great Depression years from 1930–1933, both the currency ratio c and the excess reserves ratio e rose dramatically. What effect did these factors have on the money multiplier?

14. In October 2008, the Federal Reserve began paying interest on the amount of excess reserves held by banks. How, if at all, might this affect the multiplier process and the money supply?

15. The money multiplier declined significantly during the period 1930–1933 and also during the recent financial crisis of 2008–2010. Yet the M1 money supply *decreased* by 25% in the Depression period but *increased* by more than 20% during the recent financial crisis. What explains the difference in outcomes?

APPLIED PROBLEMS

Select applied problems are available in MyEconLab *at* http://www.myeconlab.com. Unless otherwise noted, the following assumptions are made in all of the applied problems: The required reserve ratio on checkable deposits is 10%, banks do not hold any excess reserves, and the public's holdings of currency do not change.

16. If the Fed sells $2 million of bonds to the First National Bank, what happens to reserves and the monetary base? Use T-accounts to explain your answer.

17. If the Fed sells $2 million of bonds to Irving the Investor, who pays for the bonds with a briefcase filled with currency, what happens to reserves and the monetary base? Use T-accounts to explain your answer.

18. If the Fed lends five banks a total of $100 million but depositors withdraw $50 million and hold it as currency, what happens to reserves and the monetary base? Use T-accounts to explain your answer.

19. Using T-accounts, show what happens to checkable deposits in the banking system when the Fed lends $1 million to the First National Bank.

20. Using T-accounts, show what happens to checkable deposits in the banking system when the Fed sells $2 million of bonds to the First National Bank.

21. If the Fed buys $1 million of bonds from the First National Bank, but an additional 10% of any deposit

is held as excess reserves, what is the total increase in checkable deposits? (*Hint:* Use T-accounts to show what happens at each step of the multiple expansion process.)

22. If reserves in the banking system increase by $1 billion because the Fed lends $1 billion to financial institutions, and checkable deposits increase by $9 billion, why isn't the banking system in equilibrium? What will continue to happen in the banking system until equilibrium is reached? Show the T-account for the banking system in equilibrium.

23. If the Fed reduces reserves by selling $5 million worth of bonds to the banks, what will the T-account of the banking system look like when the banking system is in equilibrium? What will have happened to the level of checkable deposits?

24. If the Fed sells $1 million of bonds and banks reduce their borrowings from the Fed by $1 million, predict what will happen to the money supply.

25. Suppose that the required reserve ratio is 9%, currency in circulation is $620 billion, the amount of checkable deposits is $950 billion, and excess reserves are $15 billion.

a. Calculate the money supply, the currency deposit ratio, the excess reserve ratio, and the money multiplier.

b. Suppose the central bank conducts an unusually large open market purchase of bonds held by banks of $1,300 billion due to a sharp contraction in the economy. Assuming the ratios you calculated in part (a) remain the same, predict the effect on the money supply.

c. Suppose the central bank conducts the same open market purchase as in part (b), except that banks choose to hold all of these proceeds as excess reserves rather than loan them out, due to fear of a financial crisis. Assuming that currency and deposits remain the same, what happens to the amount of excess reserves, the excess reserve ratio, the money supply, and the money multiplier?

Following the financial crisis in 2008, the Federal Reserve began injecting the banking system with massive amounts of liquidity, and at the same time, very little lending occurred. As a result, the Ml money multiplier was below I for most of the time from October 2008 through 2011. How does this relate to your answer to the previous step?

DATA ANALYSIS PROBLEMS

The Problems update with real-time data in MyEconLab *and are available for practice or instructor assignment.*

1. Go to the St. Louis Federal Reserve FRED database, and find the most current data available on Currency (CURRNS), Total Checkable Deposits (TCDNS), Total Reserves (RESBALNS), and Required Reserves (RESBALREQ).

a. Calculate the value of the currency deposit ratio *c*.

b. Use RESBALNS and RESBALREQ to calculate the amount of excess reserves, and then calculate the value of the excess reserve ratio *e*. Be sure the units of total and required reserves are the same when you do the calculations.

c. Assuming a required reserve ratio *rr* of 11%, calculate the value of the money multiplier *m*.

2. Go to the St. Louis Federal Reserve FRED database, and find data on the M1 Money Stock (M1SL) and the Monetary Base (AMBSL).

a. Calculate the value of the money multiplier using the most recent data available and the data from five years prior.

b. Based on your answer to part (a), how much would a $100 million open market purchase of securities affect the M1 money supply today and five years ago?

WEB EXERCISES

1. Go to http://www.federalreserve.gov/boarddocs/hh/ and find the most recent annual report of the Federal Reserve. Read the first section of the annual report, which summarizes Monetary Policy and the Economic Outlook. Write a one-page summary of this section of the report.

2. Go to http://www.federalreserve.gov/releases/h6/hist/ and find the historical report of M1 and M2. Compute the growth rate of each aggregate over each of the past three years (it will be easier to do this if you move the data into Excel, as demonstrated in Chapter 1). Does

it appear that the Fed has been increasing or decreasing the rate of growth of the money supply? Is this consistent with your understanding of the needs of the economy? Why?

3. An important aspect of the supply of money is reserve balances. Go to http://www.federalreserve.gov/Releases/h41/ and locate the most recent release. This site reports changes in factors that affect depository reserve balances.
   a. What is the current reserve balance?
   b. What is the change in reserve balances since a year ago?
   c. Based on your results in parts (a) and (b), does it appear that the money supply should be increasing or decreasing?

WEB REFERENCES

http://www.federalreserve.gov/boarddocs/rptcongress/annual04/default.htm

See the most recent Federal Reserve financial statement.

http://www.richmondfed.org/about_us/visit_us/tours/money_museum/index.cfm?WT.si_n=Search&WT.si_x=3

A virtual tour of the Federal Reserve Bank of Richmond's money museum.

http://www.federalreserve.gov/Releases/h3/

The Federal Reserve website reports data about aggregate reserves and the monetary base. This site also reports on the volume of borrowings from the Fed.

http://www.federalreserve.gov/Releases/h6/

This site reports current and historical levels of M1 and M2, as well as other data on the money supply.

WEB APPENDICES

Please visit the Companion Website at http://www.pearsonglobaleditions.com/Mishkin to read the Web appendices to Chapter 15.

Appendix 1: **The Fed's Balance Sheet and the Monetary Base**

Appendix 2: **The M2 Money Multiplier**

Appendix 3: **Explaining the Behavior of the Currency Ratio**

Appendix 4: **Application: The Great Depression Bank Panics, 1930–1933, and the Money Supply**