The Money Supply Process

Once again, the Fed grabbed the headlines: It announced that the U.S. money supply was $3 billion lower than analysts had predicted. The announcement sent a ripple through financial markets. Commentators felt that the money supply decline would be bad news for the economy. Investors acknowledged the bad news by selling shares of stock, causing the stock market to fall. Business executives complained that interest rates would rise and that their businesses would have to cut back on spending for plants and equipment. However, some analysts predicted that the lower money supply might lead to lower inflation in the future.

At the root of such changes in financial markets is the money supply. The money supply process, which we discuss in this chapter, determines the level of the economy's medium of exchange. We identify the roles played by three participants: the central bank (the Federal Reserve System in the United States), banks, and the nonbank public. We then examine who controls the money supply. Understanding that helps policymakers, businesspeople, and investors know where to look for information about likely future changes in the money supply.

We proceed in two steps. First, we describe how the Fed controls the monetary base, that is, the total amount of currency in the hands of the nonbank public and in bank reserves. We then connect changes in the monetary base to changes in the money supply by developing a money multiplier. The money multiplier represents the amount by which the money supply changes in response to a change in the monetary base. The combined actions of banks, the nonbank public, and the Fed determine the money multiplier.

Four questions shape our analysis in this chapter. **Q:** How do the Fed's decisions affect the monetary base? **Q:** How are deposits created? **Q:** What factors determine the money multiplier? **Q:** How do the Fed, banks, and the nonbank public together influence the money supply process?

Overview

In Chapter 1 we noted that changes in the money supply influence many economic variables, including interest rates, exchange rates, inflation, and the economy's output of goods and services. These variables affect everyone's daily life. As a result, analysts known as *Fed watchers* closely follow the financial decisions of the Federal Reserve System, banks, and the nonbank public in order to predict changes in the money supply.

In this chapter, we develop tools to help you understand the **money supply process,** the actions that determine the quantity of money. First, we must define money. In Chapter 2 we stated that money functions as a medium of exchange, a unit of account, a store of value, and a means of deferred payment in the economy. Here, we define money as liquid assets used for the *medium of exchange* function. We use the Fed's narrowest measure of money, *M1*, to describe the money supply. *M1* consists of currency and checkable deposits in depository institutions. Broader measures of money include other liquid assets. In the Appendix, we describe the money supply process in terms of *M2*, the next broadest measure of money compiled by the Fed.

The process by which money is supplied in the economy has two essential parts. The first, the **monetary base,** comprises all reserves held by banks and all currency in circulation. The monetary base sometimes is called *high-powered money*, because a given amount of base allows creation of a multiple amount of money. Various factors affect how much monetary base is available, but by far the most important are the actions of the Fed.

The second part of the money supply process is the means by which the monetary base is transformed into money supply. It is called *multiple deposit expansion*, as it involves the depositing and redepositing of funds in banks. As the name implies, both banks and depositors play crucial roles here, although the decisions of the Fed are important, too. The degree to which the monetary base is ultimately magnified by deposit expansion is called the money multiplier. The end result is the money supply. In simple terms, the money supply process is

$$\text{Money supply} = (\text{Monetary base}) \times (\text{Money multiplier}).$$

To gain a deeper understanding of the money supply process, let's first look at how the Federal Reserve System affects the size of the monetary base. Then we can consider how the decisions of banks, the nonbank public, and the Fed convert the monetary base into the money supply and how their interactions influence the money supply process.

The Fed and the Monetary Base

The Federal Reserve System performs three general functions. The first two reflect the Fed's role as a banker's bank. The Fed operates a network to clear checks by settling claims among banks in commercial and financial

transactions. It also regulates the operation of banks under federal law. The Fed's third general function is to guide monetary policy by managing the nation's money supply. The Fed does not directly control the money supply; rather, it influences the behavior of banks, which in turn affects the money supply.

The Fed affects the monetary base by manipulating its *balance sheet.* A detailed look at the Fed's balance sheet isn't necessary at this point. Instead, we focus on the four entries that matter most. The Fed's principal *liabilities* are currency in circulation and reserves (deposits by banks with the Fed and cash held by banks). The Fed's principal *assets* are U.S. government securities and discount loans (loans to banks).

BALANCE SHEET OF THE FEDERAL RESERVE SYSTEM

Assets	Liabilities
U.S. government securities	Currency in circulation
Discount loans to banks	Reserves

The Fed's Liabilities

The Fed's principal liabilities reflect its role in the money supply process. If we hold other elements of the money supply process constant, increases in either currency in circulation or reserves increase the money supply. The sum of these two liabilities, together with the monetary liabilities of the U.S. Treasury (primarily coins in circulation, called *Treasury currency in circulation),* equals the monetary base. Simply stated, the monetary base is the sum of the Fed's currency in circulation and reserves (because the monetary liabilities of the Treasury are so small), or

$$\text{Monetary base} = \text{Currency in circulation} + \text{Reserves}.$$

Currency in Circulation. The dollar bills in your wallet are *Federal Reserve Notes.* They are part of the Fed's currency outstanding, which includes currency in circulation and vault cash. Specifically, **currency in circulation** is the currency held by the nonbank public, and **vault cash** is the currency held by depository financial institutions (still a liability of the Fed but counted as reserves). Hence

$$\text{Currency in circulation} = \text{Currency outstanding} - \text{Vault cash}.$$

At the end of 1992, currency in circulation equaled $320.2 billion.

Reserves. The second largest liability of the Fed is **bank reserves,** or vault cash in banks and deposits by commercial banks and savings institutions with the Fed. Financial institutions record reserve deposits as assets on their balance sheets. The Fed records them as liabilities, because the Fed must

redeem banks' requests for repayment on demand in Federal Reserve Notes. The total reserves of the banking system are the sum of banks' deposit accounts with the Fed ($25.5 billion at the end of 1992) and vault cash ($28.5 billion at the end of 1992). Thus,

Reserves = Deposits with the Fed by depository institutions + Vault cash.

Total reserves are made up of amounts that the Fed compels depository institutions to hold, called **required reserves,** and extra amounts that depository institutions elect to hold, called **excess reserves:**

Reserves = Required reserves + Excess reserves.

The Fed specifies a percentage of deposits that banks must hold as reserves, which is known as the **required reserve ratio.** For example, if the required reserve ratio is 10%, a bank would have to set aside 10% of its checkable deposits as reserves—vault cash and/or deposits with the Fed. At the end of 1992, of the $54 billion of bank reserves, less than $1 billion was excess reserves. Because the Fed doesn't pay interest on reserves, depository institutions prefer not to hold all their liquid balances as reserves. Instead, they hold some of their balances in marketable securities, on which they can earn interest.

The Fed's Assets

The two principal Fed assets are government securities and discount loans. These assets are significant because, by influencing them, the Fed can change the level of reserves and the money supply. These assets also are a source of income for the Fed because its portfolio of government securities and discount loans earns interest, and it does not pay interest on currency or reserves. In 1992, the Fed earned about $15 billion, most of which was returned to the Treasury.

Government Securities. The Fed's portfolio of government securities consists principally of holdings of U.S. Treasury obligations: Treasury bills, notes, and bonds. At the end of 1992, the Fed held about $280 billion in Treasury securities. An increase in the Fed's holdings of Treasury securities increases reserves and the money supply.

Discount Loans. By extending loans to depository institutions to help banks handle liquidity problems, the Fed can increase the level of reserves. It earns a market interest rate on the U.S. government securities that it holds as assets. However, when the Fed lends to depository institutions, the loans are called **discount loans.** In making such loans, the Fed specifies a rate known as the **discount rate.** An increase in the volume of discount loans made by the Fed increases reserves and the money supply.

▶ **CHECKPOINT** *Federal Reserve Notes essentially are IOUs of the Fed. Why do you accept them as money?* They serve as the official medium of exchange in the United States and are accepted for use in commercial and financial transactions. The IOUs that businesses or households might write are not so widely accepted in exchange. ◀

Effect of the Fed's Actions on the Monetary Base

The Fed affects the monetary base by buying and selling Treasury securities and by making discount loans to banks. The actual execution of these transactions involves some interesting institutional details, which we discuss in Chapter 20. For now, we focus on how these transactions affect the monetary base.

Open Market Operations

The most direct route by which the Fed can change the monetary base is through **open market operations**, that is, buying or selling securities, generally U.S. government securities. In an **open market purchase,** which raises the monetary base, the Fed buys government securities. To execute such a transaction (for example, to buy $1 million in government securities), the Fed draws checks totaling $1 million on the Federal Reserve Bank of New York and uses them to buy the securities through banks or from the nonbank public. Commercial banks can redeem these checks for currency, or, more likely, the banks can deposit the funds with the Fed as reserves. In either case, an open market purchase raises the monetary base, B, because the base is the sum of currency in circulation, C, and bank reserves, R. This relationship is expressed as

$$B = C + R. \tag{17.1}$$

Open Market Purchases from Depository Institutions. Suppose that the Fed buys $1 million in T-bills from Megabank and pays for them with a check for $1 million. Megabank can either deposit the funds in its account with the Fed or hold them in vault cash. Either action increases its reserves by $1 million. The banking system's T-account shows a decrease in security holdings of $1 million and an increase in reserves of the same amount:

BANKING SYSTEM

Assets		Liabilities
Securities	−$1 million	
Reserves	+$1 million	

The Fed's T-account reflects an increase in securities (an asset) and an increase in reserves (a liability) by $1 million:

FEDERAL RESERVE

Assets		Liabilities	
Securities	+$1 million	Reserves	+$1 million

The open market purchase from depository institutions increases reserves and thus the monetary base by $1 million.

Open Market Purchase from the Nonbank Public. If the Fed purchases government securities from the nonbank public, sellers have two options: (1) to hold the proceeds as checkable deposits, or (2) to hold the proceeds as currency. If the sellers deposit checks drawn on the Fed in the banking system, checkable deposits increase by $1 million. When banks deposit the Fed's checks in their account with the Fed, reserves also rise by $1 million:

NONBANK PUBLIC

Assets		Liabilities	
Securities	−$1 million		
Checkable deposits	+$1 million		

BANKING SYSTEM

Assets		Liabilities	
Reserves	+$1 million	Checkable deposits	+$1 million

As a result of the open market purchase, the Fed's portfolio of securities rises by $1 million, and bank reserves rise by the same amount:

FEDERAL RESERVE

Assets		Liabilities	
Securities	+$1 million	Reserves	+$1 million

As in the case of an open market purchase from depository institutions, this open market purchase from the nonbank public increases bank reserves by $1 million, thereby increasing the monetary base by $1 million.

If households and businesses decide to cash the Fed's checks and hold the proceeds as currency, the nonbank public decreases its holdings of securities by $1 million and increases its currency holdings by the same

amount. The Fed increases currency in circulation by $1 million to acquire the $1 million of securities in the open market purchase:

NONBANK PUBLIC

Assets		Liabilities	
Securities	−$1 million		
Currency	+$1 million		

FEDERAL RESERVE

Assets		Liabilities	
Securities	+$1 million	Currency in circulation	+$1 million

While the proceeds from the sale of securities to the Fed are held in currency, the monetary base (the sum of currency in circulation and bank reserves) increases by the amount of the open market purchase, or $1 million.

To summarize, an open market purchase increases the monetary base by the amount of the purchase in all cases. The effect of the open market purchase on bank reserves depends on whether the nonbank public chooses to hold some of the proceeds as currency.

Open Market Sale. Similarly, the Fed can reduce the monetary base by an **open market sale** of government securities. Whether the securities are purchased with currency or with checkable deposits, an open market sale decreases the monetary base by the amount of the sale.

For example, suppose the Fed sells $1 million of securities to depository institutions or the nonbank public. If payments to the Fed are entirely in the form of checkable deposits, the Fed receives in payment $1 million in checks drawn on commercial banks. In this case, bank reserves with the Fed (a Fed liability) fall by $1 million, the Fed's securities holdings (an asset for the Fed) also fall by $1 million, and the monetary base falls by $1 million:

BANKING SYSTEM

Assets		Liabilities	
Securities	+$1 million		
Reserves	−$1 million		

FEDERAL RESERVE

Assets		Liabilities	
Securities	−$1 million	Reserves	−$1 million

Thus, if payments to the Fed are entirely in the form of checkable deposits, reserves (and the monetary base) decline by the amount of the open market sale.

However, if payments to the Fed are entirely in the form of currency, the open market sale won't affect reserves:

NONBANK PUBLIC

Assets		Liabilities	
Securities	+$1 million		
Currency	−$1 million		

FEDERAL RESERVE

Assets		Liabilities	
Securities	−$1 million	Currency in circulation	−$1 million

However, the monetary base (currency in circulation plus reserves) falls by $1 million.

The effects of open market operations on reserves and the monetary base are summarized in Fig. 17.1.

Q: How do the Fed's decisions affect the monetary base?

A: In an open market purchase, the Fed buys securities by issuing Federal Reserve Notes or increasing bank reserves. The result is an increase in the monetary base. In an open market sale, the Fed sells securities and receives Federal Reserve Notes or checks drawn on banks as payment. The result is a decrease in the monetary base. Like open market operations, discount loans (borrowing from the Fed) change the monetary base by the amount of the loans.

Discount Loans

Open market operations are the predominant means by which the Fed influences the monetary base. Recall that the Fed also can make discount loans to depository institutions, which increase bank reserves and hence the monetary base.

Let's examine the balance sheets for both the banks and the Fed to see what happens if banks obtain $1 million in discount loans from the Fed. For the Fed, assets rise by $1 million from the addition to discount loans, and liabilities rise by $1 million from the addition to bank reserves. Thus the discount loan affects both sides of the Fed's balance sheet:

FEDERAL RESERVE

Assets		Liabilities	
Discount loans	+$1 million	Reserves	+$1 million

Both sides of the banking system's balance sheet are also affected. Banks acquire $1 million of assets in the form of reserves and $1 million of liabilities in the form of discount loans payable to the Fed:

BANKING SYSTEM

Assets		Liabilities	
Reserves	+$1 million	Discount loans	+$1 million

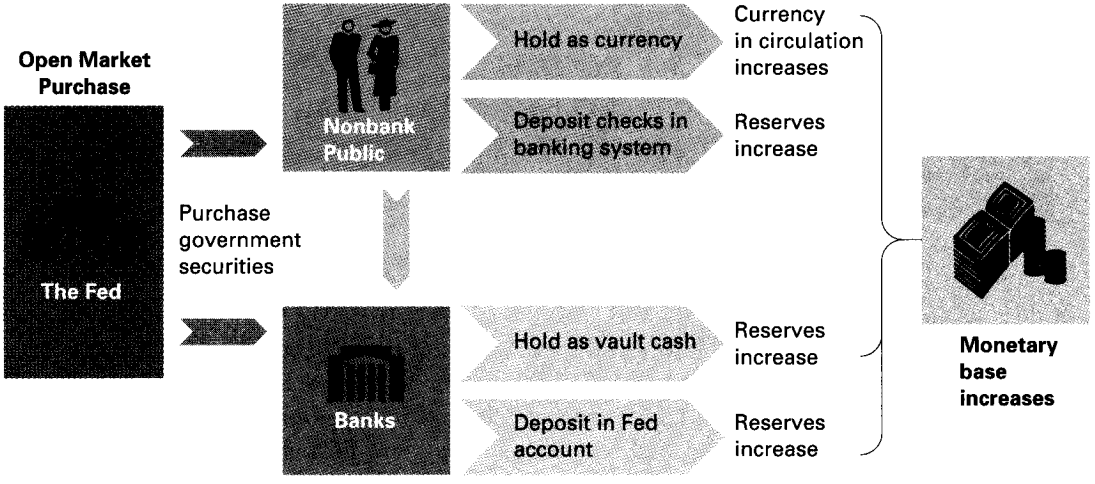


FIGURE 17.1

Effect of Open Market Operations on Reserves and the Monetary Base
One method that the Fed uses to increase the monetary base is open market purchases of securities from the nonbank public or banks. The nonbank public holds the proceeds of the sale as currency (increasing currency in circulation) or deposits the proceeds in banks. Banks may choose to hold the proceeds as vault cash or deposit the proceeds in a Fed account, increasing reserves in either case. Since increases in currency in circulation or in reserves raise the monetary base, open market purchases increase the monetary base. The process of reducing the monetary base (not shown here) works in reverse.

As a result of the Fed's making $1 million of discount loans, bank reserves and the monetary base increase by $1 million.

However, if banks repay $1 million in discount loans to the Fed, the preceding T-account transactions are reversed. Reserves fall by $1 million, as do the Fed's discount loans (assets) and the banking system's discount loans (liabilities):

FEDERAL RESERVE

Assets		Liabilities	
Discount loans	−$1 million	Reserves	−$1 million

BANKING SYSTEM

Assets		Liabilities	
Reserves	−$1 million	Discount loans	−$1 million

The effects of discount loans on reserves and the monetary base are summarized in Fig. 17.2.

Extent of Fed Control of the Monetary Base

Recall that the Fed has two ways of changing the monetary base: by open market operations and through discount loans. The Fed completely controls the volume of open market operations. It initiates purchases or sales of securities by placing orders with dealers in the government securities markets. Of course, if the Fed wants to sell a T-bill, someone must buy it, or there is no open market operation. The point is that the Fed can sell securities at whatever price it takes to accomplish its goal.

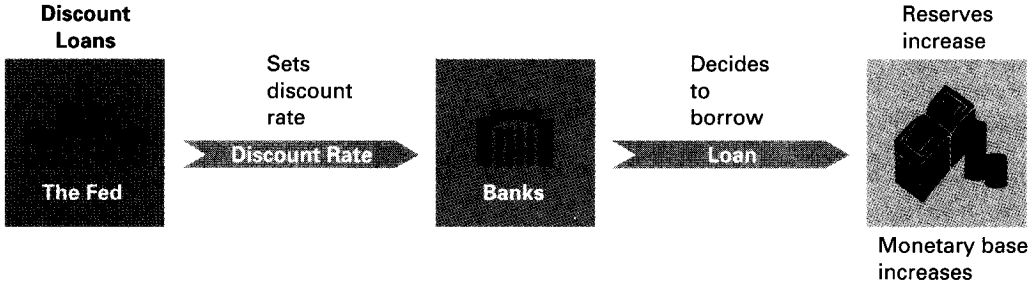


FIGURE 17.2

Effect of Discount Loans on Reserves and the Monetary Base

A second method for the Fed to increase the monetary base is through discount loans. The Fed does not control completely the volume of discount loans; it can reduce the discount rate, but banks must decide whether to borrow from the Fed. If banks choose to borrow from the Fed, reserves increase, increasing the monetary base. The process of reducing the monetary base using discount loans (not shown here) works in reverse.

However, the Fed's control over discount lending is much less complete because banks decide whether to borrow from the Fed. The Fed's limited control comes from its ability to set and change the discount rate. The fact that the Fed sets the discount rate distinguishes it from most interest rates, which are determined by market forces. An increase in the discount rate makes borrowing from the Fed more expensive for banks. If nothing else changes, banks then decrease their discount borrowing, which in turn reduces the monetary base. Hence decisions by both banks and the Fed determine the volume of discount loans.

The discount rate typically is less than other short-term market interest rates, such as the federal funds rate or the rate on three-month T-bills. (The federal funds rate is the rate that banks charge each other on overnight loans.) Thus banks have a profit opportunity in that they can borrow from the Fed at the discount rate and lend the funds at higher rates. However, the Fed discourages banks from borrowing from it too often. Instead, banks borrow more frequently in the federal funds market from other banks that have extra reserves; they are willing to pay a higher rate for doing so.

As a result of the difference in the Fed's control over open market operations and discount loans, we think of the monetary base as having two components: the *nonborrowed monetary base*, B_{non}, and *borrowed reserves*, BR, or discount loans. The monetary base B is

$$B = B_{non} + BR. \tag{17.2}$$

Although decisions by both the Fed and depository institutions determine the volume of discount loans, the Fed has greater control over the nonborrowed monetary base. We discuss the components of the monetary base and their controllability by the Fed in more detail in Chapter 18.

▶ **CHECKPOINT** *Which has more impact on the monetary base: an open market purchase of $10 million or a discount loan of $10 million? What happens to bank reserves in the short run in each case?* In each case, the mone-

tary base rises by $10 million. The effect on bank reserves of an open market operation depends on how much currency the public chooses to hold. In the case of a discount loan, reserves rise by the amount of the loan. ◀

Multiple Deposit Expansion

Having shown how the Fed can change the monetary base, we now turn to the second step in the money supply process and examine how the monetary base supports a money supply many times its size. By varying the monetary base, the Fed changes the ability of banks to make loans. And the act of making a loan is what creates money.

How a Bank Responds to an Increase in Reserves

Suppose that the Fed purchases $100,000 in T-bills from Megabank, increasing Megabank's reserves by $100,000. Megabank's T-account reflects these transactions:

MEGABANK

Assets		Liabilities	
Securities	−$100,000		
Reserves	+$100,000		

At this point, Megabank's increase in reserves represents an increase in excess reserves. The reason is that required reserves are determined as a percentage of the bank's checkable deposits. Thus this transaction doesn't change the amount of reserves that Megabank is required to hold. Megabank earns no interest on these additional reserves and will therefore try to use them to earn a return.

Suppose that Megabank loans $100,000 to Amalgamated Industries, thereby acquiring an asset on which it earns interest. Megabank extends the loan by creating a checking account for Amalgamated and depositing the loan proceeds in it. Both the asset and liability sides of Megabank's balance sheet increase by $100,000:

MEGABANK

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

By lending money to Amalgamated, Megabank creates checkable deposits, which in turn increase the money supply. Money is created because something

that becomes money, namely, funds in the hands of the borrower, is exchanged for something that is not money, namely, a loan note in the hands of the lender.

Suppose that the required reserve ratio established by the Fed is 10%. That is, 10% of Megabank's checkable deposits must be held in cash reserves either at the Fed or as vault cash. Because Megabank increased its reserves by $100,000 and its deposits by $100,000, it must hold ($100,000)(0.10) = $10,000 as reserves. It now has additional excess reserves of $100,000 − (0.10)(100,000) = $90,000. However, the bank can't lend this amount because Amalgamated will be withdrawing its loan proceeds in order to buy goods and services supplied by other businesses and individuals. When Amalgamated has withdrawn the entire proceeds of the loan, Megabank will have lost $100,000 of reserves and checkable deposits:

MEGABANK

Assets		Liabilities	
Securities	−$100,000		
Loans	+$100,000		

The recipients of Amalgamated's checks deposit the proceeds in other depository institutions, and they in turn make new loans. How much *can* banks lend from an increase in reserves? Because borrowers are likely to withdraw loan proceeds, banks cannot lend a greater amount than their total excess reserves before making a loan.

Effect of an Increase in Reserves

An increase in reserves leads to an even greater change in the volume of checkable deposits in the banking system. Banks serve as a link between the Fed and the nonbank public, taking increases in reserves from the central bank and funneling them to the nonbank public by making loans. This role of banks in the money supply process is referred to as **multiple deposit expansion.** (See Box 17.1 for a historical discussion.)

Suppose that Amalgamated uses the $100,000 it borrowed from Megabank to buy $100,000 of equipment from Toolco. Toolco deposits the $100,000 in its bank, Onebank. After this transaction, Onebank's T-account is:

ONEBANK

Assets		Liabilities	
Reserves	+$100,000	Checkable deposits	+$100,000

Onebank's reserves have increased by $100,000. If the required reserve ratio is 10%, Onebank now has additional excess reserves of $90,000. Because Onebank

BOX 17.1

Consider this...

What Are the Origins of Multiple Deposit Expansion?

Multiple deposit expansion influenced the money supply process long before the founding of the Federal Reserve System. Indeed, safekeeping of money (say, gold or silver) by means of a deposit contract can be traced to Greek or Roman times. However, the earliest banks served only as a warehouse for funds; that is, bankers did not make loans from deposits.

By the thirteenth and fourteenth centuries, deposit banking was well established in Italy and Spain, countries heavily involved in trade and commerce. Merchant bankers there loaned money to businesses and maintained reserves to cover depositors' withdrawals. In Barcelona, for example, banks typically held reserves in gold of less than 30% of deposits. This system of banking, known as *fractional reserve banking*, was a significant step toward a more sophisticated financial system.

Although religious institutions objected to charging interest on loans financed by deposits, which they called *usury*, the importance of deposit banking for commerce overcame those objections. Indeed, "a banker's social standing in thirteenth-century Florence was probably at least as good as in twentieth-century New York."[1] Deposit expansion, then and now, enables a greater volume of loans and deposits to be supported by a given level of bank reserves.

[1] Sidney Homer and Richard Sylla, *A History of Interest Rates*. New Brunswick, N.J.: Rutgers University Press, 1991, pp. 76–77.

can safely lend only this increase in excess reserves, it makes a $90,000 loan to Midtown Hardware to purchase new office equipment. Initially, Onebank's assets (loans) and liabilities (checkable deposits) rise by $90,000, but when Midtown spends the loan proceeds, Onebank's T-account becomes:

ONEBANK

Assets		Liabilities	
Reserves	+$10,000	Checkable deposits	+$100,000
Loans	+$90,000		

Midtown Hardware withdraws $90,000 to buy office equipment from Type-n-Serve. Type-n-Serve deposits the $90,000 in its bank, Twobank:

TWOBANK

Assets		Liabilities	
Reserves	+$90,000	Checkable deposits	+$90,000

Now, checkable deposits in the banking system have risen by another $90,000. In total, the volume of deposits has risen by $100,000 at Onebank and $90,000 at Twobank, for a total of $190,000.

Twobank faces the same decisions that confronted Megabank and Onebank. It wants to use the increase in reserves to expand its loans, but it can prudently lend only the increase in excess reserves. With a required reserve ratio of 10%, Twobank must add ($90,000)(0.10) = $9000 to its required reserves and can lend only $81,000. Twobank lends the $81,000 to Howard's Barber Shop for remodeling. Initially, Twobank's assets (loans) and liabilities (checkable deposits) rise by $81,000, but when Howard's spends the loan proceeds, Twobank's T-account becomes:

TWOBANK

Assets		Liabilities	
Reserves	+$9,000	Checkable deposits	+$90,000
Loans	+$81,000		

If the proceeds of the loan to Howard's Barber Shop are deposited in another bank, deposits in the banking system will have risen by another $81,000. In response to the $100,000 increase in reserves supplied by the Fed, the level of checkable deposits has increased by $100,000 + $90,000 + $81,000 = $271,000. The money supply is growing with each loan. The initial increase of the monetary base allows a multiple of that amount of money to be supplied.

The process still isn't complete. The recipient of the $81,000 check from Howard's Barber Shop will redeposit it, and checkable deposits at other banks will expand. The process continues to ripple through the system, as Table 17.1 shows. Note that new deposits continue to be created each time money is redeposited and loaned but that the increment gets smaller each time. The reason is that part of the money at each step cannot be lent; it must

TABLE 17.1 MULTIPLE DEPOSIT EXPANSION FOR THE FED'S PURCHASE OF $100,000 IN GOVERNMENT SECURITIES FROM MEGABANK AND A REQUIRED RESERVE RATIO OF 10%

Bank	Increase in deposits	Increase in loans	Increase in reserves
Onebank	$100,000	$90,000	$10,000
Twobank	90,000	81,000	9,000
Nextbank3	81,000	72,900	8,100
Nextbank4	72,900	65,610	7,290
Nextbank5	65,610	59,049	6,561
	$1,000,000	$900,000	$100,000

be held as reserves. So long as each bank lends the full amount of its excess reserves, we can calculate the amount of money created by the Fed's initial $100,000 purchase of securities. The change in deposits, ΔD, is related to the initial change in reserves, ΔR, as follows:

$$\text{Change in deposits} = \text{Loan to Amalgamated} + \text{Loan to Midtown} + \text{Loan to Howard's} + \cdots$$

or

$$\begin{aligned}\Delta D &= \Delta R + \Delta R[1 - (\overline{R/D})] + \Delta R[1 - (\overline{R/D})]^2 + \cdots \\ &= \$100,000 + \$100,000(1 - 0.10) + \$100,000(1 - 0.10)^2 + \cdots\end{aligned}$$

where

D = deposits;
R = reserves; and
$\overline{R/D}$ = the required reserve ratio.

We can restate the relationship between the change in the level of checkable deposits and the change in the level of reserves by simplifying the preceding equation. The change in checkable deposits equals the change in reserves multiplied by the **simple deposit multiplier,** which is the reciprocal of the required reserve ratio:

$$\begin{aligned}\Delta D &= \Delta R\left\{\frac{1}{1 - \left[1 - \left(\overline{R/D}\right)\right]}\right\} \\ &= \Delta R\left(\frac{1}{\overline{R/D}}\right),\end{aligned} \tag{17.3}$$

or, in our example,

$$\Delta D = 100,000\left(\frac{1}{0.10}\right) = \$1,000,000.$$

Eventually, the increase in reserves of $100,000 leads to a tenfold expansion of checkable deposits. Thus the volume of checkable deposits expands by a factor equal to the reciprocal of the required reserve ratio, in this case, 1/0.10 = 10.

If a depository institution decides to invest all or some of its excess reserves in marketable securities, deposit expansion still results in the same

relationship between the change in reserves and the change in deposits. Suppose that Onebank had decided to purchase $90,000 worth of Treasury bills instead of extending the $90,000 loan to Midtown. Onebank would write a check to the owner of the securities in the amount of $90,000, which the seller would deposit in the banking system, and so on. Thus the effect on multiple deposit expansion is the same whether banks use excess reserves to make loans or buy securities.

At first you may think that individual banks are creating money. However, an individual bank can lend only the amount of its reserves that exceeds the amount it wants (or is required) to maintain. Deposits are expanded or created when borrowers do not hold the proceeds of loans as currency. If funds are redeposited, money flows back into the banking system as reserves. If banks do not want to hold excess reserves, the multiple deposit expansion process ends only when all excess reserves have been eliminated. Multiple deposit expansion relates to the banking system as a whole, not to the action of an individual bank.

Q: How are deposits created?

A: Deposit expansion is the process by which a change in reserves leads to a greater change in the volume of checkable deposits in the banking system. When the proceeds of loans are not held as currency, money flows back into the banking system as reserves. If banks do not want to hold excess reserves, deposit expansion ends only when all excess reserves have been eliminated. Deposit expansion comes from actions in the banking system as a whole, not from the action of any individual bank.

▶ **CHECKPOINT** Let's consider an example of how the simple deposit multiplier works. *Suppose that in Nationia, bank reserves equal $10 million and the required reserve ratio is 10%. If citizens of Nationia do not hold currency, how large is the stock of checkable deposits (if banks hold no excess reserves)?*

$$D = \frac{R}{R/D}$$

$$= \frac{\$10 \text{ million}}{0.10} = \$100 \text{ million.}$$

What will happen to the level of checkable deposits if the central bank of Nationia increases the level of bank reserves by $500,000?

$$\Delta D = \Delta R\left(\frac{1}{R/D}\right)$$

$$= \frac{\$500,000}{0.10} = \$5 \text{ million.}$$

The level of checkable deposits rises by $5 million. ◀

Multiple Deposit Contraction

The Fed expands the volume of checkable deposits in the banking system by increasing reserves. Similarly, it can *contract* the volume of such

deposits in the banking system by reducing reserves. The Fed does so by selling government securities in an open market operation. This action has a ripple effect similar to deposit expansion in the banking system, but in the opposite direction. The effect is known as **multiple deposit contraction.**

Suppose that the Fed sells $100,000 in Treasury securities to Megabank, thereby reducing Megabank's reserves by $100,000. If Megabank has not maintained any excess reserves, it cannot now meet its reserve requirement. Megabank continually makes loans, and loans continually come due. Megabank can, if it has to, *call* some loans, that is, not renew them. By doing so, Megabank replenishes its reserves and can thus meet withdrawals. To raise reserves, then, Megabank could demand repayment of $100,000 of loans, but could also sell $100,000 of securities. In either case, Megabank gains the needed $100,000 of reserves. In the process, however, another bank loses reserves and checkable deposits. For example, if a depositor at Onebank buys $100,000 of securities from Megabank, Onebank's reserves and checkable deposits fall by $100,000.

When it loses $100,000 in checkable deposits to Megabank (with a required reserve ratio of 10%), Onebank's required reserves decline by $10,000. Hence it must increase its reserves by $100,000 – $10,000 = $90,000. Onebank now faces the problem that Megabank experienced. If it has no excess reserves, it will have $90,000 less reserves than it needs to satisfy the reserve requirement. As a result, Onebank must sell securities or demand repayment of loans to raise its reserves by $90,000.

ONEBANK

Assets		Liabilities	
Reserves	–$10,000	Checkable deposits	–$100,000
Securities }	–$90,000		
Loans }			

Onebank's contraction will ripple through the banking system to other banks. Suppose that the $90,000 that Onebank receives for its securities (or from loan repayments) is a check drawn on Twobank. Remember that Onebank faced a required reserves shortfall as a result of the loss of reserves to Megabank. The same problem now confronts Twobank. Twobank's required reserves are insufficient by $90,000 – (0.10)($90,000), or $81,000.

Our examination of multiple deposit expansion showed that an increase in reserves is multiplied in the banking system. Similarly, a decrease in reserves is multiplied in the banking system, resulting in multiple deposit contraction. If we assume that banks hold only required reserves, the reduction in deposits in the banking system because of the decrease in reserves is equal to the change in reserves multiplied by the reciprocal of the required

reserve ratio:

$$\Delta D = \Delta R \left(\frac{1}{R/D} \right).$$

This is the same formula we developed for multiple deposit expansion.

Extending the Basic Process

So far we have stressed the Fed's influence on the money supply through the effects of open market operations and discount lending on the monetary base and the effects of reserve requirements on multiple deposit expansion. Indeed, sometimes you will see statements in the financial media suggesting that the Fed controls the money supply. However, the Fed does not completely control the money supply. In deriving the simple deposit multiplier, we assumed that all money was held as checkable deposits and that all excess reserves are loaned out. These assumptions aren't realistic: Everyone holds some money in cash. Moreover, banks do not always lend out all of their excess reserves.

Thus decisions by the nonbank public and by banks also affect the money supply. These decisions concern currency holdings by the nonbank public and reserve holdings by banks. We explore each, focusing on ways to predict these decisions to help explain changes in the money supply.

Currency Holdings by the Nonbank Public

The decisions made by the nonbank public about how to allocate liquid assets between currency, C, and checkable deposits, D, are an important part of the money supply process. Specifically, the nonbank public decides how much currency to hold in relation to checkable deposits. Such decisions collectively result in the **currency-deposit ratio,** (C/D). Figure 17.3 shows currency-deposit ratio trends during this century. The ratio generally declined from the late nineteenth century through the mid-1960s, except during World War I, the early 1930s, and World War II. Beginning in the late 1960s, C/D began to rise steadily. Because the decision about how much currency to hold is one of portfolio allocation, we can analyze how the decision is made by examining the determinants of asset demand that we introduced in Chapter 6: wealth, expected returns, and characteristics of risk, liquidity, and information.

Wealth. One decision that the nonbank public makes is how much of its wealth to hold in the form of currency. Recall that currency is an example of a *necessity good,* which you studied in your first course in economics. The proportion of wealth held in cash doesn't increase as a person

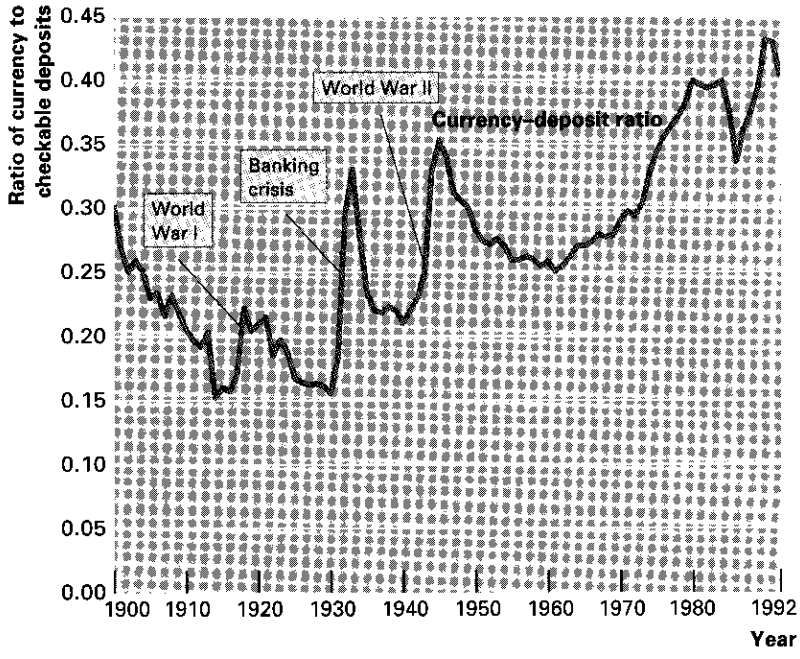


FIGURE 17.3

The Ratio of Currency to Checkable Deposits in the United States (1900–1992)
Movements in the currency-deposit ratio reflect portfolio decisions by the nonbank public. *Source*: *Federal Reserve Historical Chart Book*, 1990, and *Federal Reserve Bulletin*, various issues.

gets richer. In other words, a wealthy individual might hold more currency than a not-so-wealthy individual, but the wealthy person isn't likely to hold proportionately more. The reason is that checkable deposits are safer and more efficient than holding larger amounts of currency. Hence an individual's currency-deposit ratio declines with increases in income and wealth. Moreover, for the economy as a whole, as the economy grows and national wealth increases, the currency-deposit ratio, *C/D*, declines. This result explains the pattern in Fig. 17.1 of declining *C/D* before World War I, between the two world wars (except for the early 1930s), and after World War II until the early 1960s. These were periods of relatively steady economic growth, and therefore *C/D* decreased.

Expected Returns. A second factor that affects the nonbank public's decision regarding how much currency to hold in relation to checkable deposits is the expected returns on these assets. The demand for an asset (here currency or checkable deposits) depends on its expected return relative to expected returns on assets with similar risk, liquidity, and information characteristics. Two considerations affect the nonbank public's demand for currency. First, because holding currency yields no interest, an increase in the interest paid on checkable deposits decreases the demand for currency relative to checkable deposits, decreasing *C/D*. Second, a decrease in interest rates paid on checkable deposits increases *C/D*. Between 1933 and 1980, banking regulations prohibited banks from paying interest on checkable deposits; since 1980, regulations have allowed interest-bearing checkable deposits. As a

result, the expected return has become a more significant influence in the nonbank public's decisions about how much currency to hold relative to checkable deposits.

Risk. Our discussion of asset demand in Chapter 6 showed that savers weigh three characteristics of an investment: risk, liquidity, and information. Those characteristics apply to the nonbank public's demand for currency relative to checkable deposits. Most of the time, there is little difference in the default risk associated with holding currency and checkable deposits. During a banking panic, however, the fact that currency's (0% nominal) return has no risk may lead to a significant increase in demand for currency, which increases the currency-deposit ratio. For example, as Fig. 17.1 illustrates, in the early 1930s, the loss of public confidence in the banking system led depositors to convert checkable deposits into currency, increasing *C/D*. Since the 1930s, most bank deposits have been covered (within limits) by federal deposit insurance. Reassured that their checkable deposits are safe, savers are less likely to take risk into consideration when deciding how much currency to hold relative to checkable deposits.

Liquidity. When making portfolio allocation decisions, savers also weigh the liquidity of an asset, that is, how easily it can be converted into money. Currency is the most liquid asset possible because Federal Reserve Notes are definitive money in the United States. Checkable deposits by definition are convertible upon demand into currency. Therefore the nonbank public doesn't generally consider liquidity differences when allocating how much currency to hold relative to checkable deposits.

Information. The final factor that influences the nonbank public's demand for currency is the amount of information required to assess the value of currency versus that of checkable deposits. At first, the cost of obtaining information about currency and checkable deposits might seem to be identical. After all, no information is required to assess the value of currency, and, with federal deposit insurance and bank supervision, individual depositors need little information to assess the value of checkable deposits. Nevertheless, there is an important difference between the two assets: Currency holdings are anonymous, whereas checkable deposits aren't. In other words, when you hold your money as checkable deposits you leave a trail of information, but how much currency you hold would be very difficult for someone to discover. Currency thus carries an *anonymity premium*, meaning that it is valued higher than checkable deposits for its usefulness in illegal activities, such as drug transactions, black-market sales, and tax avoidance. This feature can help explain two patterns in Fig. 17.1. First, the increase in *C/D* during wars, such as World Wars I and II, reflects the use of currency in black-market activities and high income tax rates during the war years. Second, from the late 1960s until the present, there has been a steady increase in *C/D*. Economists point to

high marginal income tax rates during the 1960s and the apparent increase in illegal activity in the drug trade during the 1980s and early 1990s as reasons for this reversal. Analysts refer to economic activity that isn't measured in formal government statistics as the *underground economy.*

There is good reason to suspect the existence of a sizable underground economy in the United States because the amount of currency outstanding for every person in the country is more than $1000. Few individuals hold that much cash at any time, so the suggestion that large amounts of cash are circulating in the underground economy to finance illicit activities seems plausible. In fact, some experts estimate that the underground economy may account for more than 10% of total U.S. economic activity. In a $6 trillion U.S. economy, this amount would be more than $600 billion. Collecting tax revenue from underground economic activity would sharply reduce the federal budget deficit.

If the underground economy, by definition, isn't measured, how can we estimate its size? Using what we know about the determinants of currency holdings by the nonbank public, we can trace movements in *C/D* to the underground economy. For example, an increase in marginal tax rates or the imposition of rationing (as in wartime) would increase the anonymity value of currency and hence *C/D*. Conversely, legalization of drugs, prostitution, or gambling would decrease the need for currency for underground transactions, reducing *C/D*.

Concluding Remarks. Table 17.2 summarizes the principal determinants of the currency-deposit ratio. The currency-deposit ratio represents a portfolio allocation decision by the nonbank public. Currency holdings rela-

TABLE 17.2 DETERMINANTS OF THE CURRENCY-DEPOSIT RATIO

An increase in...	Effect on *C/D*...	Because...
Wealth	Falls	In general, *C/D* decreases with rising income and wealth in the economy.
Expected returns on deposits	Falls	An increase in interest rates offered on checkable deposits increases the public's demand for those deposits relative to currency and decreases *C/D*.
Riskiness of deposits	Rises	Under normal circumstances, default risk does not affect *C/D*. During banking panics, an increase in the perceived riskiness of deposits increases *C/D*.
Liquidity of deposits	None	Under normal circumstances, there is little difference in the liquidity of currency and checkable deposits and thus little or no effect on *C/D*.
Information or anonymity value of cash	Rises	An increase in the demand for anonymity, owing to black-market, tax evasion, or other illegal activities, increases *C/D*.

tive to checkable deposits are influenced by the determinants of asset demand: wealth and expected returns adjusted for risk, liquidity, and information characteristics.

▶ **CHECKPOINT** *In each of the following cases, what would you expect to happen to the currency-deposit ratio?*

(a) Interest rates on checkable deposits rise.

(b) Higher tax rates prompt increased underground activity.

(c) A tremendous wave of counterfeit bills hits the United States.

Answers:

(a) Expected return on deposits rises, so C/D falls.

(b) Increased underground activity raises demand for currency, so C/D rises.

(c) Increased risk of currency reduces demand for currency, so C/D falls. ◀

Bank Behavior: Excess Reserves and Discount Loans

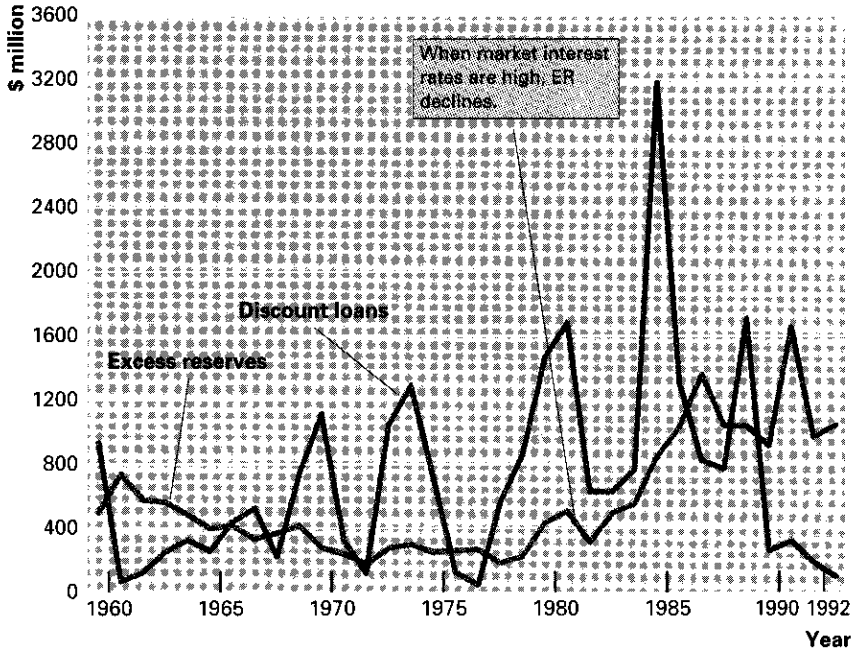
Banks influence the money supply process by their decisions about holding excess reserves and borrowing from the Fed. How do banks determine how much excess reserves to hold relative to deposits? Before we can develop ways to forecast such decisions, we need to analyze their determinants. Like those of the nonbank public, banks' portfolio allocation decisions are influenced by the determinants of asset demand.

Excess Reserves. As Fig. 17.4 shows, banks hold (generally small levels of) *excess reserves*, or reserves greater than those required by the Fed. The principal determinant of banks' decisions is the expected return from holding excess reserves. How do banks compare the expected return on holding excess reserves to the expected return on alternative uses of their funds? Because reserves deposited with the Fed pay no interest, the opportunity cost of holding excess reserves is the market interest rate—the rate that the bank could obtain by lending or investing its funds. For example, the high market interest rates of the early 1980s caused a significant decrease in excess reserves. An increase in the market interest rate, all else being equal, decreases excess reserves; a decrease in the market interest rate increases excess reserves. In other words holdings of excess reserves by banks are inversely related to the market interest rate.

The reason banks hold excess reserves despite the opportunity cost, has to do with Fed-bank relationships. The Fed stipulates certain reserve requirements, but it discourages banks from frequent borrowing at the discount rate to satisfy reserve requirements. When a bank's reserve holdings are insufficient, the Fed may impose penalties. Such penalties include a penalty rate on discount loans needed to satisfy the reserve requirement and a "stern discussion." To avoid relying on discount borrowing to satisfy reserve

FIGURE 17.4

Excess Reserves and Discount Loans
Banks hold some reserves in excess of their required reserves. Discount loans represent reserves borrowed by banks from the Fed.



requirements, banks hold small amounts of excess reserves. In addition, when banks overestimate withdrawals expected from depositors, they end up with reserves in excess of those required.

An even more important reason for banks to hold excess reserves is that they serve as a cushion against high expected deposit outflows or significant variability in deposit outflows. Without this cushion, if deposit withdrawals exceeded reserves, a bank would be forced to bear the costs in one of three ways: (1) by selling securities, (2) by calling in loans, or (3) by borrowing from the Fed or in the open market. In extreme cases, the bank could fail. Hence the benefit of excess reserves as a cushion against deposit outflows can outweigh the opportunity cost of other uses of those funds. For example, the high excess reserve holdings during the early 1930s reflected concern over future deposit withdrawals. The theory of portfolio allocation predicts that an increase in the expected level or variability of deposit outflows increases excess reserves. Conversely, a decrease in the expected level or variability of deposit outflows decreases excess reserves. Thus the level of excess reserves in the banking system is positively related to the expected level or variability of deposit outflows.

Discount Loans. Although the Fed has discount loan criteria, it doesn't control the volume of discount loans; banks must initiate discount loan transactions. Banks are more inclined to borrow from the Fed when the market interest rate that can be obtained for lending or investment activities is greater than the discount rate. Banks are less likely to borrow from the Fed

TABLE 17.3 DETERMINANTS OF EXCESS RESERVES AND DISCOUNT LOANS

An increase in...	Causes...	Because...
Market interest rates	Excess reserves to fall	Opportunity cost of holding excess reserves rises.
Average level or variability of deposit outflows	Excess reserves to rise	Banks require greater cushion against outflows.
Market interest rates relative to discount rate	Discount loans to rise	Banks' profits from discount borrowing increase.

when the spread between the market interest rate and the discount rate is small. Hence discount borrowing by banks is positively related to the market interest rate and negatively related to the discount rate.

Economists have documented that, when the spread between the rates on three-month T-bills and discount loans increases, so does the volume of discount lending. This factor is modified by the Fed's willingness to lend to banks. The Fed generally discourages routine discount borrowing, but on occasion it has strongly encouraged banks to borrow from it. For example, it did so during the October 1987 stock market crash.

Table 17.3 summarizes the determinants of banks' decisions regarding excess reserves and discount loans. Banks' portfolio allocation decisions about excess reserves and discount loans—decisions based on expected returns—influence the money supply.

Putting It All Together

The Fed influences the monetary base and the money multiplier. In addition, the nonbank public and banks make decisions that affect the monetary base and the money multiplier. We now put the pieces together to describe the complete money supply process.

Deriving the Money Multiplier

We build on our analysis of decisions by the Fed, the nonbank public, and banks to derive the money multiplier. In particular, we take into account (1) the effects of Fed decisions on the level of reserves; (2) the effects of portfolio allocation decisions by the nonbank public, assuming that the ratio of currency to checkable deposits, C/D, is constant; and (3) the effects of decisions by banks about excess reserves, ER, assuming that banks hold a constant proportion of deposits as excess reserves, ER/D.

Let's begin by considering how the Fed affects the money multiplier m by setting the required reserve ratio. Total reserves, R, equal the sum of

required reserves, RR, and excess reserves, ER:

$$R = RR + ER. \tag{17.4}$$

The Fed sets the level of required reserves by requiring banks to hold a certain percentage of checkable deposits as reserves. Thus required reserves equal the required reserve ratio, $\overline{R/D}$, multiplied by the level of checkable deposits, D:

$$RR = \left(\overline{R/D}\right)(D). \tag{17.5}$$

Total reserves then are

$$R = \left(\overline{R/D}\right)(D) + ER. \tag{17.6}$$

Recall that we started our discussion of the money supply process by noting that the money supply can be thought of as the product of the monetary base and the money multiplier. Hence we need to move from reserves to the monetary base. The monetary base, B, equals the sum of currency, C, and reserves, R, so we use Eq. (17.6) to obtain

$$\begin{aligned} B &= C + R \\ &= C + \left(\overline{R/D}\right)(D) + ER. \end{aligned} \tag{17.7}$$

Suppose, for example, that checkable deposits total \$1 billion and that currency totals \$300 million. Suppose also that the Fed requires banks to hold 10% of their checkable deposits as reserves and that banks hold no excess reserves. How large is the monetary base? It is the sum of currency (\$300 million) and reserves (the required reserve ratio, 0.10, times the level of deposits, \$1 billion):

$$B = \$300 \text{ million} + (0.10)\ (\$1 \text{ billion}) = \$400 \text{ million}.$$

We are now ready to incorporate the nonbank public's and banks' portfolio allocation decisions into the equation. If currency holdings by the nonbank public are a constant fraction of checkable deposits, then

$$C = (C/D)(D).$$

If banks' holdings of excess reserves are a constant fraction of checkable deposits, then

$$ER = (ER/D)(D).$$

Using these two expressions, we expand Eq. (17.7) to relate the monetary base to the level of checkable deposits. The monetary base is

$$\begin{aligned} B &= (C/D)(D) + (\overline{R/D})(D) + (ER/D)(D) \\ &= [(C/D) + (\overline{R/D}) + (ER/D)](D). \end{aligned} \tag{17.8}$$

If we divide both sides of Eq. (17.8) by the term in the brackets and rearrange, we can express the relationship of checkable deposits to the monetary base as

$$D = \left[\frac{1}{(C/D) + (\overline{R/D}) + (ER/D)}\right](B). \tag{17.9}$$

Returning to our example, we can verify that checkable deposits are equal to \$1 billion. The monetary base is \$400 million; banks hold no excess reserves, so $ER/D = 0$; and the required reserve ratio is 0.10. The currency-deposit ratio is \$300 million/\$1 billion, or 0.30. Hence

$$D = \left(\frac{1}{0.30 + 0.10 + 0}\right)(\$400 \text{ million}) = \$1 \text{ billion}.$$

Finally, we are ready to complete the process by moving from deposits to the money supply, M, which is equal to currency, C, plus deposits, D. Then, because $C = (C/D)(D)$,

$$M = C + D = D[1 + (C/D)].$$

Substituting for D and using Eq. (17.9) gives an expression relating the money supply, M, to the monetary base, B:

Money supply = (Money multiplier) (Monetary base)

or

$$M = \left[\frac{1 + (C/D)}{(C/D) + (\overline{R/D}) + (ER/D)}\right](B). \tag{17.10}$$

The expression in brackets in Eq. (17.10) is equal to the money multiplier, m. The money supply equals the monetary base times the money multiplier. The money multiplier conveys by how much the money supply responds to a given change in the monetary base.

For example, suppose that Nationia's monetary base is $10 billion, the required reserve ratio is 0.15, the currency-deposit ratio is 0.35, and banks hold no excess reserves. How large is the stock of checkable deposits? The total money supply? The money multiplier in this case is

$$m = \frac{1 + (C/D)}{(C/D) + (\overline{R/D})} = \frac{1.35}{0.35 + 0.15} = 2.7.$$

Q: What factors determine the money multiplier?

A: The money multiplier is determined by the required reserve ratio (set by the Fed), the currency-deposit ratio (determined by the nonbank public), and the ratio of banks' excess reserves to deposits (determined by banks). An increase in any of these factors reduces the potential for deposit expansion and the size of the money multiplier.

The money supply is equal to the money multiplier times the monetary base, so

$$\text{Money supply} = 2.7(\$10 \text{ billion}) = \$27 \text{ billion}.$$

Checkable deposits, D, are

$$D = M - C = M - (C/D)(D),$$

so

$$D = \frac{M}{1 + (C/D)} = \frac{\$27 \text{ billion}}{1.35} = \$20 \text{ billion}.$$

We now have a complete description of the money supply process:

1. The money supply equals the money multiplier times the monetary base.
2. The money multiplier depends on the required reserve ratio (determined by the Fed), the currency-deposit ratio (determined by the nonbank public), and excess reserves relative to deposits (determined by banks).
3. The monetary base comprises the nonborrowed base, determined primarily by the Fed through open market operations, and discount loans, determined jointly by the banks and the Fed.

Table 17.4 summarizes the determinants of the money supply. For an interesting historical example of the influence of all three participants in the process, see the Other times, other places box on pg. 450.

Using the Money Supply Process to Predict Money Growth

The money supply process provides a helpful way to forecast growth of the money supply. We analyze the determinants of changes in the money supply M (measured by $M1$), first by examining changes in the money multiplier, m, and then by examining changes in the monetary base, B. Recall that the monetary base, B, equals the sum of the nonborrowed base, B_{non}, and borrowed reserves, BR (discount loans). Thus we can express the money

Q: How do the Fed, banks, and the nonbank public together influence the money supply process?

A: The actions of all three participants determine the money supply. Over long periods of time, the money multiplier is relatively stable, and changes in the money supply can be generally explained by changes in the monetary base. The most important factor underlying changes in the base is the Fed's open market operations to increase or decrease the nonborrowed base.

TABLE 17.4 ELEMENTS OF THE MONEY SUPPLY PROCESS

An increase in the...	Based on the actions of...	Causes the Money Supply to...	Because...
nonborrowed base, B_{non}	the Fed (open market operations)	Rise	the monetary base rises, and more reserves are available for deposit expansion
reserve requirements, R/D	the Fed (reserve requirements)	Fall	fewer reserves can be lent out, and the money multiplier falls
discount rate	the Fed (discount policy)	Fall	discount loans become more expensive, reducing borrowed reserves and the monetary base
currency-deposit ratio, C/D	the nonbank public (portfolio decisions)	Fall	the money multiplier falls, reducing deposit expansion
excess reserves relative to deposits, ER/D	banks (portfolio decisions)	Fall	the money multiplier falls, reducing deposit expansion
expected deposit outflows	the nonbank public (transactions considerations)	Fall	excess reserves rise relative to deposits, reducing the money multiplier and deposit expansion
variability of deposit outflows	the nonbank public (transactions and portfolio considerations)	Fall	excess reserves rise relative to deposits, reducing the money multiplier and deposit expansion

supply as

$$M = m(B_{\text{non}} + BR).$$

The money multiplier, m, depends on the required reserve ratio, the currency-deposit ratio, and the ratio of excess reserves to checkable deposits.

To focus on growth rates of the money supply, we need an expression for the percentage change in M: $\%\Delta M$. The percentage change in M is approximately equal to the sum of the percentage change in the money multiplier, $\%\Delta m$, and the percentage change in the monetary base, $\%\Delta(B_{\text{non}} + BR)$:

$$\%\Delta M \cong \%\Delta m + \%\Delta(B_{\text{non}} + BR).$$

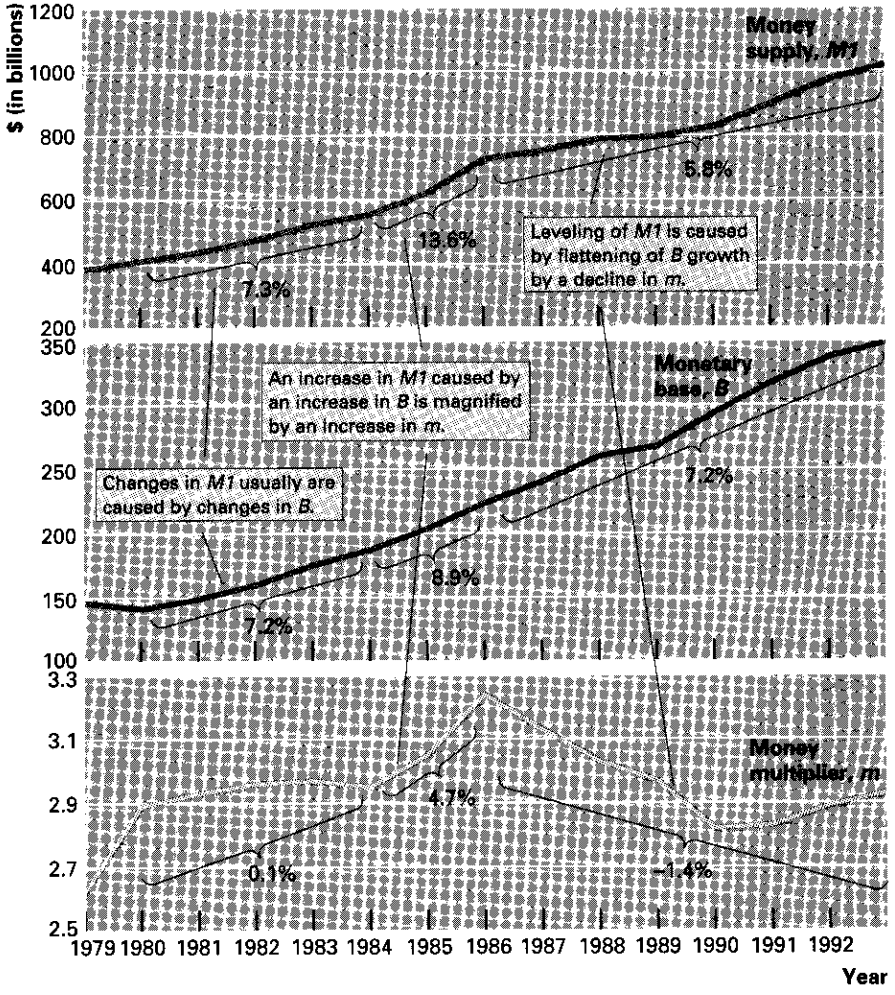
Let's begin with a simple example and assume that the money multiplier is constant. Then, $\%\Delta m = 0$, and $\%\Delta M = \%\Delta(B_{\text{non}} + BR)$. In order to predict the growth rate of the money supply, we need to predict the growth rate of the monetary base. To do so, we study Fed decisions about open market opera-

tions that affected the nonborrowed base, B_{non}, and bank and Fed decisions about discount loans, *BR*. As we noted earlier, *BR* is small relative to B_{non}, so, not surprisingly, most analysts studying the money supply process are Fed watchers, or careful observers of the Fed's actions and intentions. So long as the percentage change in the money multiplier is zero or very small, careful forecasting of changes in discount loans and especially in the nonborrowed base will produce a good prediction of the growth of the money supply.

Let's use some actual data to translate changes in the money supply into changes in the monetary base and the money multiplier. Figure 17.5 presents data on percentage changes in the money supply, the monetary base, and the money multiplier from 1979 through of 1992. During this period, the money supply grew at an average annual rate of 7.2%. Most of this growth reflected growth in the monetary base, which averaged 6.4% overall. The

FIGURE 17.5

Accounting for Changes in the Money Supply (*M1*)
Over long periods of time, fluctuations in the monetary base primarily determine changes in the money supply. Over short periods of time, fluctuations in the money multiplier magnify or dampen the effects of changes in the monetary base on the money supply.
Source: Federal Reserve Bulletin.



Other times, other places...

The Money Multiplier and Money Supply during the Early 1930s

During the depths of the Great Depression in the United States (1930–1933), the money multiplier was extremely unstable. Why did this happen? What insights can we gain from that experience for predicting the multiplier in the future?

The most severe banking crisis in U.S. history occurred in the early 1930s. It actually began in the late 1920s, as falling farm prices caused farmers to default on agricultural bank loans. Other sources of the crisis were the failure of some prominent U.S. and European financial institutions in 1930 and 1931 and abandonment of the gold standard by Britain in September 1931. By 1933, more than one-third of the commercial banks in the United States had failed or had been taken over by other banks.

The banking crisis significantly changed the money multiplier by affecting the portfolio allocation decisions of the nonbank public and banks. First, because of the perceived increase in riskiness of bank loan portfolios, wary depositors converted (or tried to convert) deposits into currency. The currency-deposit ratio, C/D, increased steadily after 1931 and dramatically in early 1933, more than doubling. Currency holdings by the public represent a leakage from the deposit creation process, so the multiplier and money supply fell while the monetary base was relatively stable.

Because of the wave of bank runs, by 1932, banks had to anticipate greater deposit outflows and increased their holdings of excess reserves. As a result, the ratio of excess reserves to deposits ER/D increased, further reducing the money multiplier.

The Fed did not aggressively increase its discount lending during the banking panic of 1931–1933, worsening the problems of the banking system and prompting the public to convert checkable deposits to currency and banks to convert loans to reserves. As a result of these portfolio allocation decisions by banks and the nonbank public, the money multiplier fell from 3.8 in March 1930 to 2.3 in March 1933. Although the monetary base *increased* by about 20% over the same period, the money supply actually *fell* by 28%.

Note: Figures are based on data from Milton Friedman and Anna J. Schwartz, *A Monetary History of the United States, 1867–1960*. Princeton, N.J.: Princeton University Press, 1963, pp. 299–419.

money multiplier increased at an average annual rate of only 0.8%. Figure 17.5 shows that virtually all the average annual rate of growth in the money supply (7.3%) from 1980 through 1984 can be explained by growth in the monetary base (7.2%); the money multiplier grew by only 0.1% per year. Virtually all the growth in the monetary base represented growth in the nonborrowed base from the Federal Reserve System's open market operations. The only significant exception during the 1980s and early 1990s came in 1984, when the Fed provided discount loans of about $5 billion to the distressed Continental Illinois Bank. Over periods of several years, the primary determinant of changes in the money supply is changes in the nonborrowed portion of the monetary base, B_{non}, which is controlled by the Federal Reserve System through open market operations.

Many forecasters in the financial community are concerned with predicting *short-term* movements in the money supply. Over short periods of time, however, the correlation between the Fed's actions to change the monetary base and actual changes in the money supply are much less precise. Short-

run disturbances in the components of the money multiplier disrupt the relationship, as the second and third periods in Fig. 17.5 indicate.

Note that, over short periods of time, the money multiplier may change significantly. For example, in 1985 and 1986, the money multiplier grew at a rate of 4.7% per year. Over the same period, the monetary base grew by 8.9% per year, and the *M1* money supply grew by 4.7% + 8.9% = 13.6% per year. To account for the change in the money multiplier, we must analyze changes in its components. The culprit turned out to be the currency-deposit ratio, *C/D*. Not shown in Fig. 17.5, *C/D* declined by about 17% over these two years, increasing the money multiplier. This effect was reversed after 1986, and since then, the declining money multiplier has reflected a steady increase in the currency-deposit ratio.

Our analysis of changes in the money supply during the 1980s and early 1990s shows that changes in the money multiplier may lead to a significant change in the money supply in a short period of time. Nonetheless, over long periods of time, the majority of changes in the money supply can be explained by changes in the monetary base. By far the most important determinant of changes in the monetary base is the Fed's actions to change the nonborrowed base through open market operations.

Key Terms and Concepts

Bank reserves
- Excess reserves
- Required reserve ratio
- Required reserves

Currency-deposit ratio

Currency in circulation

Multiple deposit contraction

Multiple deposit expansion
- Simple deposit multiplier

Discount loans

Discount rate

Money supply process
- Monetary base
- Money multiplier

Open market operations
- Open market purchase
- Open market sale

Vault cash

Summary

1. The three participants in the money supply process are the Federal Reserve System, depository institutions (banks), and the nonbank public.

2. One measure of the money supply (*M1*) is the sum of currency in the hands of the nonbank public and checkable deposits at depository institutions. Checkable deposits account for about two-thirds of the money supply.

3. The complete money supply process involves two parts. First, actions by the Fed largely determine the monetary base. Then the money multiplier measures the amount by which the money supply changes in response to a change in the monetary base.

4. The Fed influences the monetary base primarily by buying and selling government securities (open market operations). Purchases of securities by the

Fed increase the monetary base. Sales of securities by the Fed decrease the monetary base. The Fed also can change the monetary base by making discount loans to banks. An increase in discount lending increases the monetary base; a decrease in discount lending decreases the monetary base.

5. The process by which an increase in bank reserves increases the level of checkable deposits is called multiple deposit expansion. The Fed can add to reserves in the banking system by buying government securities or making discount loans. The increase in reserves allows banks to make additional loans, which lead to additional deposits in banks. As a result, the money supply increases. In the simplest case—in which currency holdings do not change and banks do not hold excess reserves—multiple deposit expansion is limited only by the Fed's reserve requirements. An increase in the level of bank reserves raises the level of checkable deposits by a multiple of the change in the reserves. This multiple, the simple deposit multiplier, is equal to the reciprocal of the required reserve ratio.

6. The money multiplier represents the link between the monetary base and the money supply. If the multiplier is constant, the change in the money supply equals the multiplier times the change in the monetary base. An increase in currency or reserve holdings relative to checkable deposits reduces the money multiplier.

7. Despite the Fed's important role in the money supply process through open market operations, discount lending, and reserve requirements, the Fed doesn't completely control the money supply. Portfolio allocation decisions by banks and the nonbank public also affect the monetary base and the money multiplier. The nonbank public decides how to allocate its holdings between checkable deposits and currency. An increase in the nonbank public's demand for currency relative to deposits increases the currency-deposit ratio, reducing the money multiplier. Banks must decide what proportion of checkable deposits to hold as reserves (above those required by regulation). Holdings of excess reserves raise the ratio of effective reserves to deposits and reduce the money multiplier. These portfolio allocation decisions by the nonbank public and banks are determined by the principal factors governing asset demand: wealth, expected returns, risk, liquidity, and information. Finally, the Fed doesn't control discount lending. The Fed sets the discount rate (the interest rate charged on discount loans), but the decision to borrow is made by banks.

8. Putting it all together, the money supply process involves important roles for the Fed, banks, and the nonbank public. We can express the money supply (represented by *M1*, the sum of currency and checkable deposits) as

$$\text{Money supply} = (\text{Money multiplier})(\text{Nonborrowed base} + \text{Discount loans}).$$

Over long periods of time, the multiplier is relatively stable, and movements in the money supply are governed principally by changes in the nonborrowed base by the Fed. Over short periods of time, the multiplier may increase or decrease significantly and may even dominate movements in the nonborrowed base.

Review Questions

1. What are the major assets and liabilities of the Federal Reserve System? Describe each briefly.

2. What are the components of the monetary base? Why is the monetary base a useful concept?

3. What is the difference between currency in circulation and currency outstanding? Which is added to reserves to get the monetary base?

4. What are excess reserves and how are they calculated? What determines the amount of required reserves?

5. If the Fed wants to increase the money supply, should it make an open market purchase or sale? Should it make more discount loans or fewer? If the Fed wants to decrease the money supply, what should it do?

6. If a bank has $10,000 in excess reserves, what is the most new lending that it should do? Why shouldn't it do more than that amount?

7. If the discount rate is usually below the federal funds rate, why don't banks borrow from the Fed at the discount rate and lend the money out at the federal funds rate to profit from the difference in the interest rates?

8. Wealth in the United States has grown steadily. If wealth were the only factor affecting currency demand, what do you expect would have happened to the currency-deposit ratio over time?

9. What happens to the simple deposit multiplier when the Fed makes more discount loans?

10. Suppose that the Fed wanted to increase the money supply (*M1*) by 10% next year. It predicts that the money multiplier will increase by 2%. How much should it increase the monetary base?

Analytical Problems

11. Suppose that Bank Five lends $100,000 to the Monkey Wrench Company. Using T-accounts, show how this transaction is recorded on the bank's balance sheet. If Monkey Wrench spends the money to buy materials from Scrap Steel, Inc., which banks at Wonder Bank, show the effect on Bank Five's balance sheet. What is the total change in Bank Five's assets and liabilities?

12. Suppose that a bank currently has assets of $24,000 in reserves and $176,000 in loans and liabilities of $200,000 in deposits. If the required reserve ratio is 10%, what are the bank's required and excess reserves? What is the bank likely to do?

    Questions 13 and 14 require use of the following bank balance sheet (amounts are in $ millions):

Assets		Liabilities	
Reserves	48	Checkable deposits	300
Loans	280	Time deposits	200
Securities	182	Net worth	10
	510		510

13. Calculate the bank's excess reserves when the required reserve ratio on checkable deposits is 14% and the required reserve ratio on time deposits is 3%. Now suppose that the required reserve ratios are changed to 16% on checkable deposits and 0% on time deposits. Again, calculate the bank's excess reserves.

14. Suppose that the bank sells $3 million in securities on the open market. Calculate the change in the bank's excess reserves when the required reserve ratio on checkable deposits is 14%.

15. In the following bank balance sheet, amounts are $ millions. The required reserve ratio is 3% on the first $30 million of checkable deposits and 12% on any checkable deposits over $30 million.

Assets		Liabilities	
Reserves	18.9	Checkable deposits	180.0
Loans	150.0		
Securities	31.1	Net worth	20.0
	200.0		200.0

a. Calculate the bank's excess reserves.

b. Suppose that the bank sells $5 million in securities to get new cash. Show the bank's balance sheet after this transaction. What are the bank's new excess reserves?

c. Suppose that the bank loans its excess reserves in (b) to a business. Show the bank's balance sheet after the loan has been made but before the business has spent the proceeds of the loan. Now what are the bank's excess reserves?

d. Suppose that the business spends the proceeds of the loan. Revise the bank's balance sheet and calculate its excess reserves.

16. If the required reserve ratio is 25%, banks hold no excess reserves, and the public holds currency equal to 25% of deposits, what is the value of the *M1* money multiplier?

17. Suppose that the statistics for the economy as a whole (in $ billions) are as follows:

Currency held by the public	100
Reserves held by banks	200
Checkable deposits held at banks	800
Time deposits held at banks	1,200
Excess reserves held by banks	40

If the required reserve ratio on checkable deposits is 20%, what is the value of the *M1* money multiplier?

18. What would the money multiplier be if banks held no excess reserves, the currency-deposit ratio was 1, and the reserve requirement for checkable deposits was 100%?

19. Analysts have noted that, at times, a substantial increase in demand for U.S. currency corresponds to a crisis in some foreign country. Is this a coincidence? Explain.

20. Suppose that First Bank discovered that its computer had been programmed incorrectly and that it suddenly was short of reserves by $100 million. What would you expect to happen to the federal funds rate, the number of discount loans made by the Fed, and the amount of excess reserves held by other banks?

21. Suppose that banks were so risk-averse that they would gladly sell securities in order to hold excess reserves. In other words, if the Fed engaged in open market purchases, banks would hold the entire amount of the increase in the monetary base in the form of excess reserves. What would be the money multiplier in such a case? Could the Fed increase the money supply if it wanted to?

Questions 22 and 23 pertain to the Appendix.

22. What would happen to *M1* and *M2* if the public decided to hold less currency and more time deposits, so that *C/D* fell by 1% and *N/D* rose by 1% (assuming that the ratio of reserves to deposits is less than 100%)?

23. Consider Bank A's balance sheet (all amounts are in $ millions):

Assets		Liabilities	
Reserves, *R*	48	Checkable deposits, *D*	300
Loans, *L*	280	Time deposits, *N*	200
Securities, *S*	182	Net worth, *NW*	10
	510		510

For the economy as a whole, the initial level of checkable deposits, *D*, is $2 trillion. Relevant ratios are

Currency-deposit ratio, *C/D*	0.2
Time deposit-checkable deposit ratio, *N/D*	1.5
Money market account-deposit ratio, *MM/D*	0.5
Excess reserve-deposit ratio, *ER/D*	0.06
Required reserve ratio, $\overline{R/D}$	0.14

a. Calculate the monetary base *B*, *M1* (= *C* + *D*), and *M2* (= *M1* + *N* + *MM*). Does Bank A have any excess reserves? Are there any excess reserves in the economy as a whole?

b. Calculate the multipliers (the respective m values) for *M1* and *M2*.

c. Suppose that the Fed changes the required reserve ratio to 16%, or 0.16. In response, banks as a whole reduce their excess reserves to zero. What happens to Bank A's balance sheet? Calculate its required reserves. What are Bank A's excess reserves? Calculate the new *M1* and *M2* multipliers.

d. Suppose that, instead of taking the actions in (c), the Fed buys $88.888 billion in securities on the open market, including $1.5 million from Bank A. What happens to Bank A's balance sheet? Calculate its required and excess reserves. Calculate the new size of the monetary base.

Data Question

24. Look up the following data in the latest issue of the *Federal Reserve Bulletin* in your library: currency holdings, C, checkable deposits, D, required reserves, RR, excess reserves, ER, and the *M1* money supply. From these data, calculate the ratios C/D, ER/D, and $\overline{R/D}$. Calculate the *M1* money multiplier using the multiplier formula. Alternatively, calculate the *M1* money multiplier using the equation $M1 = (m)(B)$. Compare these multipliers. How do they compare with the simple deposit multiplier, $1/(\overline{R/D})$?

Appendix: The Money Supply Process for *M2*

In the aftermath of financial innovation during the 1980s (much of which we discussed in Chapter 15), many analysts and policymakers became concerned that *M1* no longer adequately covered assets functioning as the medium of exchange. As a result, they focused more attention on *M2*. It is a broader monetary aggregate than *M1*, including not only currency, C, and checkable deposits, D, but also the nontransaction accounts we introduced in Chapter 13. These accounts consist of savings and small time deposits, N, and certain money market accounts, MM. Money market items in *M2* include money market deposit accounts at commercial banks, general purpose and broker/dealer money market mutual funds, overnight repurchase agreements issued by banks, and overnight Eurodollars issued to U.S. residents by foreign branches of U.S. banks. As a sum of its components, *M2* is

$$M2 = C + D + N + MM. \tag{17A.1}$$

The *M2* measure of the money supply is less sensitive than *M1* to shifts in the nonbank public's portfolio preferences. Suppose that, because of financial innovation, the nonbank public wants to switch from checkable and nontransaction deposits to money market–type accounts. In that case, D and

N would fall, and *MM* would rise by the same amount, leaving *M2* *unchanged.* However, *M1*, the sum of currency and checkable deposits, would *fall.*

If we make assumptions similar to those used in deriving the *M1* multiplier, namely, that *C/D*, *N/D*, and *MM/D* are constant, we can express *M2* as

Broader money supply = (*M2* multiplier)(Base),

or

$$M2 = \left[\frac{1 + (C/D) + (N/D) + (MM/D)}{(C/D) + (\overline{R/D}) + (ER/D)}\right](B). \qquad (17A.2)$$

The *M2* multiplier is significantly larger than the *M1* multiplier. The reason is that the terms *N/D* and *MM/D* are added to the numerator. Because the volume of both nontransaction accounts and money market–type accounts are greater than the volume of checkable deposits, *N/D* and *MM/D* are greater than 1. With no reserve requirements for these measures, *M2* money expansion from a change in the monetary base is greater than that for *M1*. Indeed, the *M2* multiplier has been more stable than the *M1* multiplier during the 1980s and early 1990s.

Components of the *M2* multiplier affect the size of the multiplier in a manner similar to that for *M1*. Increases in the required reserve ratio and the currency-deposit ratio reduce the extent of deposit expansion, thereby reducing the multiplier. However, an increase in the nonbank public's preference for nontransaction or money market–type accounts relative to checkable deposits increases the multiplier.

Fed watchers predict the growth of *M2* in much the same way as they do for *M1*. They forecast changes in the monetary base—particularly in the nonborrowed base—and in the components of the *M2* multiplier.