4

Financial Markets I

Financial markets are intimidating. They involve a maze of institutions, from banks, to money market funds, mutual funds, investment funds, and hedge funds. Trading involves bonds, stocks, and other financial claims with exotic names, such as swaps and options. The financial pages of newspapers quote interest rates on many government bonds, on many corporate bonds, on short-term bonds, on long-term bonds, and it is easy to get confused. But financial markets play an essential role in the economy. They determine the cost of funds for firms, for households, for the government, and in turn affect their spending decisions. To understand their role we must proceed in steps.

In this chapter, we focus on the role of the central bank in affecting these interest rates. To do so, we drastically simplify reality and think of the economy as having only *two* financial assets, namely money, which does not pay interest, and bonds, which do. This will allow us to understand how the interest rate on bonds is determined, and the role of the central bank (in the United States, the **Fed**, short for **Federal Reserve Bank**) in this determination.

In the next chapter, Chapter 5, we shall combine the model of the goods market we developed in the previous chapter with the model of financial markets we develop in this chapter, and have another look at equilibrium output. Having done so however, we shall return to financial markets in Chapter 6, allowing for more financial assets and more interest rates, and focusing on the role of banks and other financial institutions. This will give us a richer model, and allow us to better understand what happened in the recent crisis.

The chapter has four sections:

Section 4-1 looks at the demand for money.

Section 4-2 assumes that the central bank directly controls the supply of money and shows how the interest rate is determined by the condition that the demand for money be equal to the supply of money.

Section 4-3 introduces banks as suppliers of money, revisits the determination of the interest rate, and describes the role of the central bank in that context.

Section 4-4 looks at the constraint on monetary policy coming from the fact that the interest rate on bonds cannot be negative, a constraint that has played an important role in the crisis.

4-1 The Demand for Money

This section looks at the determinants of *the demand for money.* A warning before we start: Words such as *money* or *wealth* have specific meanings in economics, often not the same meanings as in everyday conversation. The purpose of the Focus box "Semantic Traps: Money, Income, and Wealth" is to help you avoid some of these traps. Read it carefully, and refer back to it once in a while.

Suppose, as a result of having steadily saved part of your income in the past, your financial wealth today is $50,000. You may intend to keep saving in the future and increase your wealth further, but its value today is given. Suppose also that you only have the choice between two assets, money and bonds:

Make sure you see the difference between the decision about how much to save (a decision that determines how your wealth changes over time) and the decision about how to allocate a given stock of wealth between money and bonds.

- *Money*, which you can use for transactions, pays no interest. In the real world, as we already mentioned, there are two types of money: **currency**, coins and bills, and **checkable deposits**, the bank deposits on which you can write checks or use a debit card. The distinction between the two will be important when we look at the supply of money. For the moment, however, the distinction does not matter and we can ignore it. Just think currency.
- **Bonds** pay a positive interest rate, i, but they cannot be used for transactions. In the real world, there are many types of bonds and other financial assets, each associated with a specific interest rate. For the time being, we also ignore this aspect of reality and assume that there is just one type of bond and that it pays, i, *the* rate of interest.

Assume that buying or selling bonds implies some cost; for example, a phone call to your broker and the payment of a transaction fee. How much of your $50,000 should you hold in money, and how much in bonds? On the one hand, holding all your wealth in the form of money is clearly very convenient. You won't ever need to call a broker or pay transaction fees. But it also means you will receive no interest income. On the other hand, if you hold all your wealth in the form of bonds, you will earn interest on the full amount, but you will have to call your broker frequently—whenever you need money to take the subway, pay for a cup of coffee, and so on. This is a rather inconvenient way of going through life.

You may want to pay by credit card and avoid carrying currency. But you still have to have money in your checking account when you pay the credit card company.

Therefore, it is clear that you should hold both money and bonds. But in what proportions? This will depend mainly on two variables:

- Your *level of transactions.* You will want to have enough money on hand to avoid having to sell bonds whenever you need money. Say, for example, that you typically spend $3,000 a month. In this case, you might want to have, on average, say, two months worth of spending on hand, or $6,000 in money, and the rest, $50,000 − $6,000 = $44,000, in bonds. If, instead, you typically spend $4,000 a month, you might want to have, say, $8,000 in money and only $42,000 in bonds.
- *The interest rate on bonds.* The only reason to hold any of your wealth in bonds is that they pay interest. The higher the interest rate, the more you will be willing to deal with the hassle and costs associated with buying and selling bonds. If the interest rate is very high, you might even decide to squeeze your money holdings to an average of only two weeks' worth of spending, or $1,500 (assuming your monthly spending is $3,000). This way, you will be able to keep, on average, $48,500 in bonds and earn more interest as a result.

Let's make this last point more concrete. Most of you probably do not hold bonds; my guess is that few of you have a broker. However, some of you hold bonds indirectly if you have a money market account with a financial institution. **Money market funds** (the full name is *money market mutual funds*) pool together the funds of many people. The funds are then used to buy bonds—typically government bonds. Money market

Semantic Traps: Money, Income, and Wealth

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In everyday conversation, we use "money" to denote many different things. We use it as a synonym for income: "making money." We use it as a synonym for wealth: "She has a lot of money." In economics, you must be more careful. Here is a basic guide to some terms and their precise meanings in economics.

Money is what can be used to pay for transactions. Money is currency and checkable deposits at banks. **Income** is what you earn from working plus what you receive in interest and dividends. It is a **flow**—something expressed in units of time: weekly income, monthly income, or yearly income, for example. J. Paul Getty was once asked what his income was. Getty answered: "$1,000." He meant but did not say: $1,000 per minute!

Saving is that part of after-tax income that you do not spend. It is also a flow. If you save 10% of your income, and your income is $3,000 per month, then you save $300 per month. **Savings** (plural) is sometimes used as a synonym for wealth—the value of what you have accumulated over time. To avoid confusion, I shall not use the term *savings* in this book.

Your **financial wealth**, or wealth for short, is the value of all your financial assets minus all your financial liabilities. In contrast to income or saving, which are flow variables, financial wealth is a **stock** variable. It is the value of wealth at a given moment in time.

At a given moment in time, you cannot change the total amount of your financial wealth. It can only change over time as you save or dissave, or as the value of your assets and liabilities change. But you can change the composition of your wealth; you can, for example, decide to repay part of your mortgage by writing a check against your checking account. This leads to a decrease in your liabilities (a smaller mortgage) and a corresponding decrease in your assets (a smaller checking account balance); but, at that moment, it does not change your wealth.

Financial assets that can be used directly to buy goods are called *money*. Money includes currency and checkable deposits—deposits against which you can write checks. Money is also a stock. Someone who is wealthy might have only small money holdings—say, $1,000,000 in stocks but only $500 in a checking account. It is also possible for a person to have a large income but only small money holdings—say, a monthly income of $10,000 but only $1,000 in his checking account.

Investment is a term economists reserve for the purchase of new capital goods, from machines to plants to office buildings. When you want to talk about the purchase of shares or other financial assets, you should refer them as a **financial investment**.

Learn how to be economically correct:

> Do not say "Mary is making a lot of money"; say "Mary has a high income."
>
> Do not say "Joe has a lot of money"; say "Joe is very wealthy."

funds pay an interest rate close to but slightly below the interest rate on the bonds they hold—the difference coming from the administrative costs of running the funds and from their profit margins.

When the interest rate on these funds reached 14% per year in the early 1980s (a very high interest rate by today's standards), people who had previously kept all of their wealth in their checking accounts (which paid little or no interest) realized how much interest they could earn by moving some of it into money market accounts instead. Now that interest rates are much lower, people are less careful about putting as much as they can in money market funds. Put another way, for a given level of transactions, people now keep more of their wealth in money than they did in the early 1980s.

Deriving the Demand for Money

Let's go from this discussion to an equation describing the demand for money.

Denote the amount of money people want to hold—their *demand for money*—by M^d (the superscript d stands for *demand*). The demand for money in the economy as a whole is just the sum of all the individual demands for money by the people and firms in the economy. Therefore, it depends on the overall level of transactions in the economy and on the interest rate. The overall level of transactions in the economy is hard to measure, but it is likely to be roughly proportional to nominal income (income

Revisit Chapter 2's example of an economy composed of a steel company and a car company. Calculate the total value of transactions in that economy. If the steel and the car companies doubled in size, what would happen to transactions and to GDP?

measured in dollars). If nominal income were to increase by 10%, it is reasonable to think that the dollar value of transactions in the economy would also increase by roughly 10%. So we can write the relation between the demand for money, nominal income, and the interest rate as:

$$M^d = \$Y\ L(i) \qquad (4.1)$$
$$(-)$$

where $\$Y$ denotes nominal income. Read this equation in the following way: *The demand for money M^d is equal to nominal income $\$Y$ times a decreasing function of the interest rate i, with the function denoted by $L(i)$.* The minus sign under i in $L(i)$ captures the fact that the interest rate has a negative effect on money demand: An increase in the interest rate *decreases* the demand for money, as people put more of their wealth into bonds.

Equation (4.1) summarizes what we have discussed so far:

What matters here is nominal income—income in dollars, not real income. If real income does not change but prices double, leading to a doubling of nominal income, people will need to hold twice as much money to buy the same consumption basket.

- First, the demand for money increases in proportion to nominal income. If nominal income doubles, increasing from $\$Y$ to $\$2Y$, then the demand for money also doubles, increasing from $\$Y\ L(i)$ to $\$2Y\ L(i)$.
- Second, the demand for money depends negatively on the interest rate. This is captured by the function $L(i)$ and the negative sign underneath: An increase in the interest rate decreases the demand for money.

The relation between the demand for money, nominal income, and the interest rate implied by equation (4.1) is shown in Figure 4-1. The interest rate, i, is measured on the vertical axis. Money, M, is measured on the horizontal axis.

The relation between the demand for money and the interest rate *for a given level of nominal income* $\$Y$ is represented by the M^d curve. The curve is downward sloping: The lower the interest rate (the lower i), the higher the amount of money people want to hold (the higher M).

Figure 4-1

The Demand for Money

For a given level of nominal income, a lower interest rate increases the demand for money. At a given interest rate, an increase in nominal income shifts the demand for money to the right.

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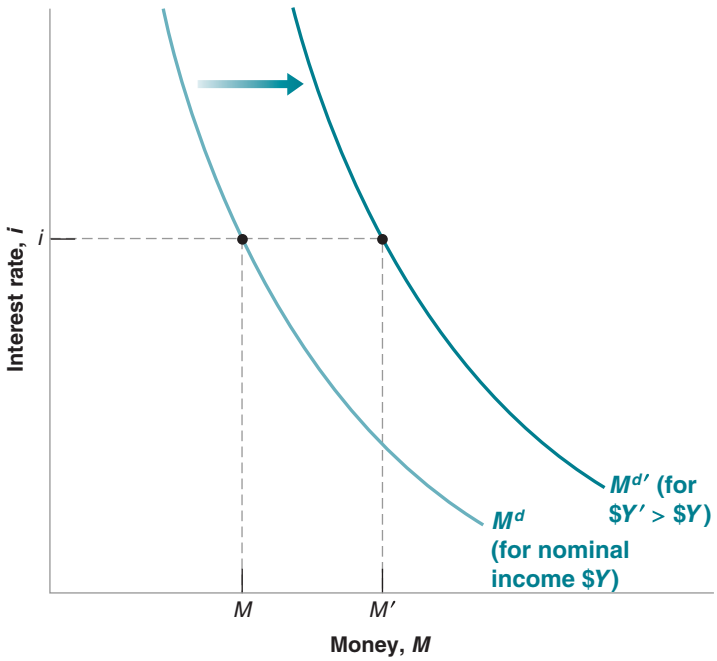

Who Holds U.S. Currency?

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According to household surveys, in 2006, the average U.S. household held $1,600 in currency (dollar bills and coins). Multiplying by the number of households in the U.S. economy at the time (about 110 million), this implies that the total amount of currency held by U.S. households was around $170 billion.

According to the Federal Reserve Board, however—which issues the dollar bills and therefore knows how much is in circulation—the amount of currency in circulation was actually a much higher $750 billion. Here lies the puzzle: If it was not held by households, where was all this currency?

Clearly some currency was held by firms rather than by households. And some was held by those involved in the underground economy or in illegal activities. When dealing with drugs, dollar bills (and, in the future, bitcoin?), not checks, are the way to settle accounts. Surveys of firms and IRS estimates of the underground economy suggest, however, that this can only account for another $80 billion at the most. This leaves $500 billion, or 66% of the total, unaccounted for. So where was it? The answer: Abroad, held by foreigners.

A few countries, Ecuador and El Salvador among them, have actually adopted the dollar as their own currency. So people in these countries use dollar bills for transactions. But these countries are just too small to explain the puzzle.

In a number of countries that have suffered from high inflation in the past, people have learned that their domestic currency may quickly become worthless and they see dollars as a safe and convenient asset. This is, for example, the case of Argentina and of Russia. Estimates by the U.S. Treasury suggest that Argentina holds more than $50 billion in dollar bills, Russia more than $80 billion—so together, close to the holdings of U.S. households.

In yet other countries, people who have emigrated to the United States bring home U.S. dollar bills; or tourists pay some transactions in dollars, and the dollar bills stay in the country. This is, for example, the case for Mexico or Thailand.

The fact that foreigners hold such a high proportion of the dollar bills in circulation has two main macroeconomic implications. First, the rest of the world, by being willing to hold U.S. currency, is making in effect an interest-free loan to the United States of $500 billion. Second, while we shall think of money demand (which includes both currency and checkable deposits) as being determined by the interest rate and the level of transactions in the country, it is clear that U.S. money demand also depends on other factors. Can you guess, for example, what would happen to U.S. money demand if the degree of civil unrest increased in the rest of the world?

For a given interest rate, an increase in nominal income increases the demand for money. In other words, an increase in nominal income shifts the demand for money to the right, from M^d to $M^{d\prime}$. For example, at interest rate i, an increase in nominal income from $\$Y$ to $\$Y'$ increases the demand for money from M to M'.

4-2 Determining the Interest Rate: I

Having looked at the demand for money, we now look at the supply of money and then at the equilibrium.

In the real world, there are two types of money: checkable deposits, which are supplied by banks, and currency, which is supplied by the central bank. In this section, we shall assume that the only money in the economy is currency, central bank money. This is clearly not realistic, but it will make the basic mechanisms most transparent. We shall reintroduce checkable deposits, and look at the role banks play in the next section.

Money Demand, Money Supply, and the Equilibrium Interest Rate

Suppose the central bank decides to supply an amount of money equal to M, so

$$M^s = M$$

The superscript s stands for *supply*. (Let's disregard, for the moment, the issue of how exactly the central bank supplies this amount of money. We shall return to it in a few paragraphs.)

◀ Throughout this section, the term *money* means central bank money, or currency.

Figure 4-2

The Determination of the Interest Rate

The interest rate must be such that the supply of money (which is independent of the interest rate) is equal to the demand for money (which does depend on the interest rate).

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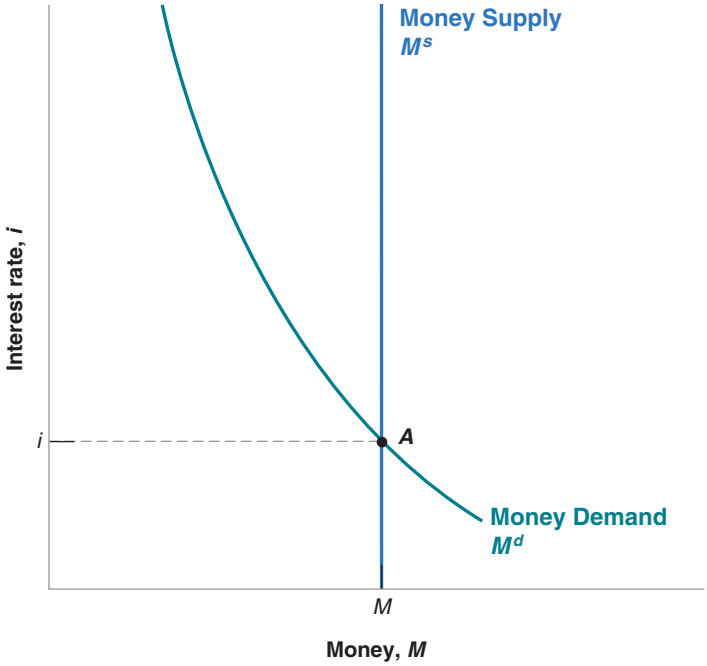

Equilibrium in financial markets requires that money supply be equal to money demand, that $M^s = M^d$. Then, using $M^s = M$, and equation (4.1) for money demand, the equilibrium condition is

$$\begin{aligned} \text{Money supply} &= \text{Money demand} \\ M &= \$Y\ L(i) \end{aligned} \tag{4.2}$$

This equation tells us that the interest rate i must be such that, given their income $\$Y$, people are willing to hold an amount of money equal to the existing money supply M.

This equilibrium condition is represented graphically in Figure 4-2. As in Figure 4-1, money is measured on the horizontal axis, and the interest rate is measured on the vertical axis. The demand for money, M^d, drawn for a given level of nominal income, $\$Y$, is downward sloping: A higher interest rate implies a lower demand for money. The supply of money is drawn as the vertical line denoted M^s: The money supply equals M and is independent of the interest rate. Equilibrium occurs at point A, and the equilibrium interest rate is given by i.

Now that we have characterized the equilibrium, we can look at how changes in nominal income or changes in the money supply by the central bank affect the equilibrium interest rate.

- Figure 4-3 shows the effects of an increase in nominal income on the interest rate.

  The figure replicates Figure 4-2, and the initial equilibrium is at point A. An increase in nominal income from $\$Y$ to Y' increases the level of transactions, which increases the demand for money at any interest rate. The money demand curve *shifts* to the right, from M^d to $M^{d'}$. The equilibrium moves from A up to A', and the equilibrium interest rate increases from i to i'.

  In words: For a given money supply, *an increase in nominal income leads to an increase in the interest rate*. The reason: At the initial interest rate, the demand for

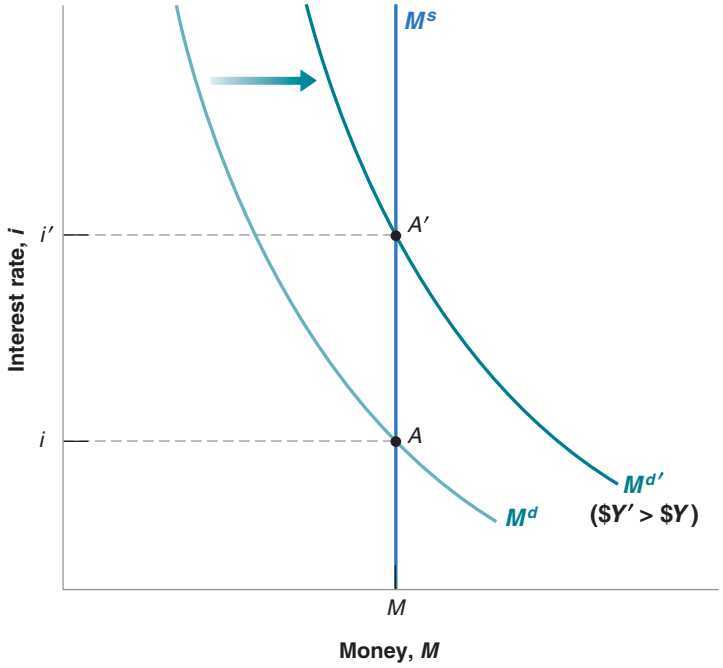

Figure 4-3

The Effects of an Increase in Nominal Income on the Interest Rate

Given the money supply, an increase in nominal income leads to an increase in the interest rate.

MyEconLab Animation

money exceeds the supply. The increase in the interest rate decreases the amount of money people want to hold and reestablishes equilibrium.

- Figure 4-4 shows the effects of an increase in the money supply on the interest rate.

The initial equilibrium is at point A, with interest rate i. An increase in the money supply, from $M^s = M$ to $M^{s'} = M'$, leads to a shift of the money supply curve to the right, from M^s to $M^{s'}$. The equilibrium moves from A down to A'; the interest rate decreases from i to i'.

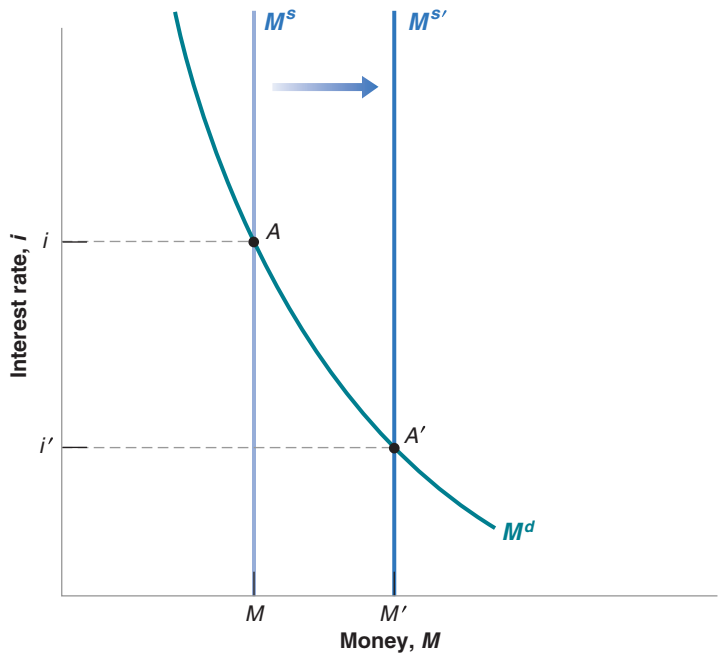

Figure 4-4

The Effects of an Increase in the Money Supply on the Interest Rate

An increase in the supply of money leads to a decrease in the interest rate.

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In words: *an increase in the supply of money by the central bank leads to a decrease in the interest rate.* The decrease in the interest rate increases the demand for money so it equals the now larger money supply.

Monetary Policy and Open Market Operations

We can get a better understanding of the results in Figures 4-3 and 4-4 by looking more closely at how the central bank actually changes the money supply, and what happens when it does so.

In modern economies, the way central banks typically change the supply of money is by buying or selling bonds in the bond market. If a central bank wants to increase the amount of money in the economy, it buys bonds and pays for them by creating money. If it wants to decrease the amount of money in the economy, it sells bonds and removes from circulation the money it receives in exchange for the bonds. These actions are called **open market operations** because they take place in the "open market" for bonds.

The balance sheet of a bank (or firm, or individual) is a list of its assets and liabilities at a point in time. The assets are the sum of what the bank owns and what is owed to the bank by others. The liabilities are what the bank owes to others. It goes without saying that Figure 4-5 gives a much simplified version of an actual central bank balance sheet, but it will do for our purposes.

The Balance Sheet of the Central Bank

To understand what open market operations do, it is useful to start with the balance sheet of the central bank, given in Figure 4-5. The assets of the central bank are the bonds it holds in its portfolio. Its liabilities are the stock of money in the economy. Open market operations lead to equal changes in assets and liabilities.

If the central bank buys, say, $1 million worth of bonds, the amount of bonds it holds is higher by $1 million, and so is the amount of money in the economy. Such an operation is called an **expansionary open market operation**, because the central bank increases (*expands*) the supply of money.

If the central bank sells $1 million worth of bonds, both the amount of bonds held by the central bank and the amount of money in the economy are lower by $1 million. Such an operation is called a **contractionary open market operation**, because the central bank decreases (*contracts*) the supply of money.

Bond Prices and Bond Yields

We have focused so far on the interest rate on bonds. In fact, what is determined in bond markets are not interest rates, but bond *prices.* The two are however directly related. Understanding the relation between the two will prove useful both here and later in this book.

Figure 4-5

The Balance Sheet of the Central Bank and the Effects of an Expansionary Open Market Operation

The assets of the central bank are the bonds it holds. The liabilities are the stock of money in the economy. An open market operation in which the central bank buys bonds and issues money increases both assets and liabilities by the same amount.

Central Bank Balance Sheet

Assets	Liabilities
Bonds	Money (currency)

The Effects of an Expansionary Open Market Operation

Assets	Liabilities
Change in bond holdings: +$1 million	Change in money stock: +$1 million

- Suppose the bonds in our economy are one-year bonds—bonds that promise a payment of a given number of dollars, say \$100, a year from now. In the United States, bonds issued by the government promising payment in a year or less are called **Treasury bills** or **T-bills**. Let the price of a bond today be $\$P_B$, where the subscript B stands for "bond." If you buy the bond today and hold it for a year, the rate of return on holding the bond for a year is $(\$100 - \$P_B)/\$P_B$. Therefore, the interest rate on the bond is given by

$$i = \frac{\$100 - \$P_B}{\$P_B}$$

The interest rate is what you get for the bond a year from now (\$100) minus what you pay for the bond today ($\$P_B$), divided by the price of the bond today, ($\$P_B$).

  If $\$P_B$ is \$99, the interest rate equals $\$1/\$99 = 0.010$, or 1.0% per year. If $\$P_B$ is \$90, the interest rate is $\$1/\$90 = 11.1\%$ per year. *The higher the price of the bond, the lower the interest rate.*
- If we are given the interest rate, we can figure out the price of the bond using the same formula. Reorganizing the formula above, the price today of a one-year bond paying \$100 a year from today is given by

$$\$P_B = \frac{100}{1 + i}$$

  The price of the bond today is equal to the final payment divided by 1 plus the interest rate. If the interest rate is positive, the price of the bond is less than the final payment. *The higher the interest rate, the lower the price today*. You may read or hear that "bond markets went up today." This means that *the prices of bonds went up*, and therefore that *interest rates went down.*

Back to Open Market Operations

We are now ready to return to the effects of an open market operation and its effect on equilibrium in the money market.

Consider first an expansionary open market operation, in which the central bank buys bonds in the bond market and pays for them by creating money. As the central bank buys bonds, the demand for bonds goes up, increasing their price. Conversely, the interest rate on bonds goes down. Note that by buying the bonds in exchange for money that it created, the central bank has increased the money supply.

Consider instead a contractionary open market operation, in which the central bank decreases the supply of money. This leads to a decrease in their price. Conversely, the interest rate goes up. Note that by selling the bonds in exchange for money previously held by households, the central bank has reduced the money supply.

This way of describing how monetary policy affects interest rates is more intuitive. By buying or selling bonds in exchange for money, the central bank affects the price of bonds, and by implication, the interest rate on bonds.

Let's summarize what we have learned in the first two sections:

- The interest rate is determined by the equality of the supply of money and the demand for money.
- By changing the supply of money, the central bank can affect the interest rate.
- The central bank changes the supply of money through open market operations, which are purchases or sales of bonds for money.
- Open market operations in which the central bank increases the money supply by buying bonds lead to an increase in the price of bonds and a decrease in the interest rate. In Figure 4-2, the purchase of bonds by the central bank shifts the money supply to the right.

- Open market operations in which the central bank decreases the money supply by selling bonds lead to a decrease in the price of bonds and an increase in the interest rate. In Figure 4-2, the purchase of bonds by the central bank shifts the money supply to the left.

Choosing Money or Choosing the Interest Rate?

Let me take up one more issue before moving on. I have described the central bank as choosing the money supply and letting the interest rate be determined at the point where money supply equals money demand. Instead, I could have described the central bank as choosing the interest rate and then adjusting the money supply so as to achieve the interest rate it has chosen.

To see this, return to Figure 4-4. Figure 4-4 showed the effect of a decision by the central bank to increase the money supply from M^s to $M^{s'}$, causing the interest rate to fall from i to i'. However, we could have described the figure in terms of the central bank decision to lower the interest rate from i to i' by increasing the money supply from M^s to $M^{s'}$.

Why is it useful to think about the central bank as choosing the interest rate? Because this is what modern central banks, including the Fed, typically do. They typically think about the interest rate they want to achieve, and then move the money supply so as to achieve it. This is why, when you listen to the news, you do not hear: "The Fed decided to decrease the money supply today." Instead you hear: "The Fed decided to increase the interest rate today." The way the Fed did it was by increasing the money supply appropriately.

Suppose nominal income increases, as in Figure 4-3, and that the central bank wants to keep the interest rate unchanged. How does it need to adjust the money supply? ▶

4-3 Determining the Interest Rate: II

We took a shortcut in Section 4-2 in assuming that all money in the economy consisted of currency supplied by the central bank. In the real world, money includes not only currency but also checkable deposits. Checkable deposits are supplied not by the central bank but by (private) banks. In this section, we reintroduce checkable deposits and examine how this changes our conclusions. Let me give you the bottom line: Even, in this more complicated case, by changing the amount of central bank money, the central bank can and does control the interest rate.

To understand what determines the interest rate in an economy with both currency and checkable deposits, we must first look at what banks do.

What Banks Do

Modern economies are characterized by the existence of many types of **financial intermediaries**—institutions that receive funds from people and firms and use these funds to buy financial assets or to make loans to other people and firms. The assets of these institutions are the financial assets they own and the loans they have made. Their liabilities are what they owe to the people and firms from whom they have received funds.

Banks are one type of financial intermediary. What makes banks special—and the reason we focus on banks here rather than on financial intermediaries in general—is that their liabilities are money: People can pay for transactions by writing checks up to the amount of their account balance. Let's look more closely at what they do.

The balance sheet of banks is shown in the bottom half of Figure 4-6, Figure 4-6b.

Banks have other types of liabilities in addition to checkable deposits, and they are engaged in more activities than just holding bonds or making loans. Ignore these complications for the moment. We consider them in Chapter 6. ▶