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: An increase in nominal income leads to an increase in the interest rate. The reason: At the initial interest rate, the demand for money exceeds the supply. An increase in the interest rate is needed to decrease the amount of money people want to hold and to reestablish 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 \( i' \).

  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.
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.

**Open market operations.** In modern economies, the way central banks 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 the central bank is 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 is not interest rates, but bond prices; in this section we show that the interest rate on a bond can then be inferred from the price of the bond. Understanding...
this relation between the interest rate and bond prices will prove useful both here and later in this book.

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 \( \frac{100 - P_B}{P_B} \). Therefore, the interest rate on the bond is given by

\[
i = \frac{100 - P_B}{P_B}
\]

If \( P_B \) is $99, the interest rate equals \( \frac{1}{99} = 0.010 \), or 1.0% per year. If \( P_B \) is $90, the interest rate is \( \frac{1}{90} = 11.1\% \) 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.

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 paying for the bonds with money, 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. It sells bonds in the bonds market. This leads to a decrease in their price, and an increase in the interest rate. Note that by selling...
The bonds in exchange for money previously held by households, the central bank has reduced the money supply. 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.

Let us take up two more issues before moving on.

**Choosing Money or Choosing the Interest Rate?**

We 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, we 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 \( M^s/2 \), causing the interest rate to fall from \( i \) to \( i/2 \). However, we could have described the figure in terms of the central bank decision to lower the interest rate from \( i \) to \( i/2 \) by increasing the money supply from \( M^s \) to \( M^s/2 \).

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 increase the money supply today.” Instead you hear: “The Fed decided to decrease the interest rate today.” The way the Fed did it was by increasing the money supply appropriately.

**Money, Bonds, and Other Assets**

We have been looking at an economy with only two assets, money and bonds. This is obviously a much simplified version of actual economies with their many financial assets and many financial markets. But, as you will see in later chapters, the basic lessons we have just learned apply very generally. The only change we will have to make is replacing “interest rate” in our conclusions with “short-term interest rate on government bonds.” You will see that the short-term interest rate is determined by the condition we just discussed—the equilibrium between money supply and money demand. The central bank can, through open market operations, change the short-term interest rate; and open market operations are indeed the basic tool used by most modern central banks, including the Fed, to affect interest rates.

There is one dimension, however, to which our model must be extended. We have assumed that all money in the economy consisted of currency, supplied by the central
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. How the presence of banks and checkable deposits changes our conclusions is the topic of the next section.

4-3 Determining the Interest Rate: II

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—financial intermediaries are 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 banks do.

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

- Banks receive funds from people and firms who either deposit funds directly or have funds sent to their checking accounts (via direct deposit of their paychecks, for example.) At any point in time, people and firms can write checks or withdraw up to the full amount of their account balances. The liabilities of the banks are therefore equal to the value of these checkable deposits.

- Banks keep as reserves some of the funds they receive. They are held partly in cash and partly in an account the banks have at the central bank, which they can draw on when they need to. Banks hold reserves for three reasons:

  - 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 these complications in Chapter 9.

  - On any given day, some depositors withdraw cash from their checking accounts while others deposit cash into their accounts. There is no reason for the inflows and outflows of cash to be equal, so the bank must keep some cash on hand.

  - Let us give you the bottom line in case you want to skip the section: Even in this more complicated case, the central bank can, by changing the amount of central bank money, control the short-term interest rate.

  - 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 these complications in Chapter 9.
In the same way, on any given day, people with accounts at the bank write checks to people with accounts at other banks, and people with accounts at other banks write checks to people with accounts at the bank. What the bank, as a result of these transactions, owes the other banks can be larger or smaller than what the other banks owe to it. For this reason also, the bank needs to keep reserves.

The first two reasons imply that the banks would want to keep some reserves even if they were not required to do so. But, in addition, banks are subject to reserve requirements, which require them to hold reserves in some proportion of their checkable deposits. In the United States, reserve requirements are set by the Fed. The actual reserve ratio—the ratio of bank reserves to bank checkable deposits—is about 10% in the United States today. Banks can use the other 90% to make loans or buy bonds.

Loans represent roughly 70% of banks’ nonreserve assets. Bonds account for the rest, 30%. The distinction between bonds and loans is unimportant for our purposes in this chapter—which is to understand how the money supply is determined. For this reason, to keep the discussion simple, we will assume in this chapter that banks do not make loans, that they hold only reserves and bonds as assets. But the distinction between loans and bonds is important for other purposes, from the possibility of “bank runs” to the role of federal deposit insurance. These topics are first explored in the Focus box, “Bank Runs, Deposit Insurance, and Wholesale Funding,” and then at more length in Chapter 9 on the crisis.

Figure 4-6a returns to the balance sheet of the central bank, in an economy in which there are banks. It is very similar to the balance sheet of the central bank we saw in Figure 4-5. The asset side is the same as before: The assets of the central bank are the bonds it holds. The liabilities of the central bank are the money it has issued, central bank money. The new feature is that not all of central bank money is held as currency by the public. Some of it is held as reserves by banks.

The Supply and the Demand for Central Bank Money

The easiest way to think about how the interest rate in this economy is determined is by thinking in terms of the supply and the demand for central bank money:

- The demand for central bank money is equal to the demand for currency by people plus the demand for reserves by banks.
- The supply of central bank money is under the direct control of the central bank.
- The equilibrium interest rate is such that the demand and the supply for central bank money are equal.

Figure 4-7 shows the structure of the demand and the supply of central bank money in more detail. (Ignore the equations for the time being. Just look at the boxes.) Start on the left side. The demand for money by people is for both checkable deposits and currency. Because banks have to hold reserves against checkable deposits, the demand for checkable deposits leads to a demand for reserves by banks. Consequently, the demand for central bank money is equal to the demand for reserves by banks plus the demand for currency. Go to the right side: The supply of central bank money is determined by the central bank. Look at the equal sign: The interest rate must be such that the demand and the supply of central bank money are equal.
Is bank money (checkable deposits) just as good as central bank money (currency)? To answer this question, we must look at what banks do with their funds, and at the distinction between making loans or holding bonds.

Making a loan to a firm or buying a government bond are more similar than they may seem. In one case, the bank lends to a firm. In the other, the bank lends to the government. This is why, for simplicity, we assumed in the text that banks held only bonds.

But, in one respect, making a loan is very different from buying a bond. Bonds, especially government bonds, are very liquid: If need be, they can be sold easily in the bond market. Loans, on the other hand, are often not liquid at all. Calling them back may be impossible. Firms have probably already used their loans to buy inventories or new machines, so they no longer have the cash on hand. Likewise, individuals likely have used their loans to purchase cars, houses, or other things. The bank could in principle sell the loans to a third party to get cash. However, selling them might be very difficult because potential buyers would know little about how the borrowers are.

This fact has one important implication: Take a healthy bank, a bank with a portfolio of good loans. Suppose rumors start that the bank is not doing well and some loans will not be repaid. Believing that the bank may fail, people with deposits at the bank will want to close their accounts and withdraw cash. If enough people do so, the bank will run out of reserves. Given that the loans cannot be called back, the bank will not be able to satisfy the demand for cash, and it will have to close.

Conclusion: Fear that a bank will close can actually cause it to close—even if all its loans are good. The financial history of the United States up to the 1930s is full of such bank runs. One bank fails for the right reason (because it has made bad loans). This causes depositors at other banks to panic and withdraw money from their banks, forcing them to close. You have probably seen *It’s a Wonderful Life*, an old movie with James Stewart that runs on TV every year around Christmas. After another bank in Stewart’s town fails, depositors at the savings and loan he manages get scared and want to withdraw their money too. Stewart successfully persuades them this is not a good idea. It’s a Wonderful Life has a happy ending. But in real life, most bank runs didn’t.

What can be done to avoid bank runs? One solution is called narrow banking. Narrow banking would restrict banks to holding liquid and safe government bonds, like T-bills. Loans would have to be made by financial intermediaries other than banks. This would eliminate bank runs, as well as the need for federal insurance. Some recent changes in U.S. regulation have gone in that direction, restricting banks that rely on deposits from engaging in some financial operations, but they stop far short of imposing narrow banking.

Another solution, and one that has been adopted by governments in most advanced countries, is deposit insurance. The United States, for example, introduced federal deposit insurance in 1934. The U.S. government now insures each account up to a ceiling, which, since 2008, is $250,000. (In response to the crisis, all accounts are currently fully insured, regardless of the amount, but this is scheduled to end in December 2012.) As a result, there is no reason for depositors to run and withdraw their money.

Federal deposit insurance leads, however, to problems of its own: Depositors, who do not have to worry about their deposits, no longer look at the activities of the banks in which they have their accounts. Banks may then misbehave, by making loans they wouldn’t have made in the absence of deposit insurance. And, as the crisis has unfortunately shown, deposit insurance is no longer enough. The reason is that banks have increasingly relied on other sources of funds, often borrowing overnight from other financial institutions and investors, a method of financing known as wholesale funding. Wholesale funding, just before the crisis, accounted for close to 30% of total funding for U.S. banks. These funds were not insured, and when, in late 2008, doubts increased about the quality of the assets held by banks, there was in effect a run on many banks, this time not from the traditional depositors but from wholesale funders. To avoid more bank collapses, the Fed had no choice than to provide funds to banks on a very large scale.

Since then, banks have reduced their reliance on wholesale funding, which is down to roughly 25% in the United States. In parallel, regulation is being considered that would force banks to hold enough liquid assets to be able to withstand a large decrease in their wholesale funding. This is one of the challenges facing bank regulators today.

### FOCUS

Be careful to distinguish among:
- Demand for money (demand for currency and checkable deposits)
- Demand for bank money (demand for checkable deposits)
- Demand for central bank money (demand for currency by people and demand for reserves by banks)

We now go through each of the boxes in Figure 4-7 and ask:

- What determines the demand for checkable deposits and the demand for currency?
- What determines the demand for reserves by banks?
- What determines the demand for central bank money?
- How does the condition that the demand for and the supply of central bank money be equal determine the interest rate?
The Demand for Money

When people can hold both currency and checkable deposits, the demand for money involves two decisions. First, people must decide how much money to hold. Second, they must decide how much of this money to hold in currency and how much to hold in checkable deposits.

It is reasonable to assume that the overall demand for money (currency plus checkable deposits) is given by the same factors as before. People will hold more money the higher the level of transactions and the lower the interest rate on bonds. So we can assume that overall money demand is given by the same equation as before (equation (4.1)):

\[ M^d = \$Y L(i) \]  

That brings us to the second decision. How do people decide how much to hold in currency, and how much in checkable deposits? Currency is more convenient for small transactions (it is also more convenient for illegal transactions.) Checks are more convenient for large transactions. Holding money in your checking account is safer than holding cash.

Let’s assume people hold a fixed proportion of their money in currency—call this proportion \( c \)—and, by implication, hold a fixed proportion \( 1 - c \) in checkable deposits. Call the demand for currency \( CU^d \) (\( CU \) for currency, and \( d \) for demand). Call the demand for checkable deposits \( D^d \) (\( D \) for deposits, and \( d \) for demand). The two demands are given by

\[ CU^d = cM^d \]  \hspace{1cm} \[ D^d = (1 - c)M^d \]
Equation (4.4) shows the first component of the demand for central bank money—the demand for currency by the public. Equation (4.5) shows the demand for checkable deposits.

We now have a description of the first box, “Demand for Money,” on the left side of Figure 4-7: Equation (4.3) shows the overall demand for money. Equations (4.4) and (4.5) show the demand for checkable deposits and the demand for currency, respectively.

The demand for checkable deposits leads to a demand by banks for reserves, the second component of the demand for central bank money. To see how, let’s turn to the behavior of banks.

**The Demand for Reserves**

The larger the amount of checkable deposits, the larger the amount of reserves the banks must hold, both for precautionary and for regulatory reasons. Let \( \theta \) (the Greek lowercase letter theta) be the reserve ratio, the amount of reserves banks hold per dollar of checkable deposits. Let \( R \) denote the reserves of banks. Let \( D \) denote the dollar amount of checkable deposits. Then, by the definition of \( \theta \), the following relation holds between \( R \) and \( D \):

\[
R = \theta D \quad (4.6)
\]

We saw earlier that, in the United States today, the reserve ratio is roughly equal to 10%. Thus, \( \theta \) is roughly equal to 0.1.

If people want to hold \( D^d \) in deposits, then, from equation (4.6), banks must hold \( \theta D^d \) in reserves. Combining equations (4.5) and (4.6), the second component of the demand for central bank money—the demand for reserves by banks—is given by

\[
R^d = \theta (1 - c) M^d \quad (4.7)
\]

We now have the equation corresponding to the second box, “Demand for Reserves by Banks,” on the left side of Figure 4-7.

**The Demand for Central Bank Money**

Call \( H^d \) the demand for central bank money. This demand is equal to the sum of the demand for currency and the demand for reserves:

\[
H^d = CU^d + R^d \quad (4.8)
\]

Replace \( CU^d \) and \( R^d \) by their expressions from equations (4.4) and (4.7) to get

\[
H^d = cM^d + \theta (1 - c) M^d = [c + \theta (1 - c)] M^d
\]

Finally, replace the overall demand for money, \( M^d \), by its expression from equation (4.3) to get:

\[
H^d = [c + \theta (1 - c)] Y L(i) \quad (4.9)
\]

This gives us the equation corresponding to the third box, “Demand for Central Bank Money,” on the left side of Figure 4-7.

**The Determination of the Interest Rate**

We are now ready to characterize the equilibrium. Let \( H \) be the supply of central bank money; \( H \) is directly controlled by the central bank; just like in the previous section, the central bank can change the amount of \( H \) through open market operations. The equilibrium condition is that the supply of central bank money be equal to the demand for central bank money:

\[
H = H^d \quad (4.10)
\]
Or, using equation (4.9):

\[ H = [c + \theta(1 - c)] Y L(i) \]  

(4.11)

The supply of central bank money (the left side of equation (4.11)) is equal to the demand for central bank money (the right side of equation (4.11)), which is equal to the term in brackets times the overall demand for money.

Look at the term in brackets more closely:

Suppose that people held only currency, so \( c = 1 \). Then, the term in brackets would be equal to 1, and the equation would be exactly the same as equation (4.2) in Section 4-2 (with the letter \( H \) replacing the letter \( M \) on the left side, but \( H \) and \( M \) both stand for the supply of central bank money). In this case, people would hold only currency, and banks would play no role in the supply of money. We would be back to the case we looked at in Section 4-2.

Assume instead that people did not hold currency at all, but held only checkable deposits, so \( c = 0 \). Then, the term in brackets would be equal to \( \theta \). Suppose, for example, that \( \theta = 0.1 \), so that the term in brackets was equal to 0.1. Then the demand for central bank money would be equal to one-tenth of the overall demand for money. This is easy to understand: People would hold only checkable deposits. For every dollar they wanted to hold, banks would need to have 10 cents in reserves. In other words, the demand for reserves would be one-tenth of the overall demand for money.

Leaving aside these two extreme cases, note that, as long as people hold some checkable deposits (so that \( c < 1 \)), the term in brackets is less than 1: This means the demand for central bank money is less than the overall demand for money. This is due to the fact that the demand for reserves by banks is only a fraction of the demand for checkable deposits.

We can represent the equilibrium condition, equation (4.11), graphically, and we do this in Figure 4-8. The figure looks the same as Figure 4-2, but with central bank money rather than money on the horizontal axis. The interest rate is measured on the vertical axis. The demand for central bank money, \( CU^d + R^d \), is drawn for a given level of

**Figure 4-8**

*Equilibrium in the Market for Central Bank Money and the Determination of the Interest Rate*

The equilibrium interest rate is such that the supply of central bank money is equal to the demand for central bank money.
nominal income. A higher interest rate implies a lower demand for central bank money for two reasons: (1) The demand for currency by people goes down; (2) the demand for checkable deposits by people also goes down. This leads to a lower demand for reserves by banks. The supply of money is fixed and is represented by a vertical line at $H$. Equilibrium is at point $A$, with interest rate $i$.

The effects of either changes in nominal income or changes in the supply of central bank money are qualitatively the same as in the previous section. In particular, an increase in the supply of central bank money leads to a shift in the vertical supply line to the right. This leads to a lower interest rate. As before, an increase in central bank money leads to a decrease in the interest rate. Conversely, a decrease in central bank money leads to an increase in the interest rate.

### 4-4 Two Alternative Ways of Looking at the Equilibrium*

In Section 4-3, we looked at the equilibrium through the condition that the supply and the demand of central bank money be equal. There are two other ways of looking at the equilibrium. While they are all equivalent, each provides a different way of thinking about the equilibrium, and going through each one will strengthen your understanding of how monetary policy affects the interest rate.

#### The Federal Funds Market and the Federal Funds Rate

Instead of thinking in terms of the supply and the demand for central bank money, we can think in terms of the supply and the demand for bank reserves:

The supply of reserves is equal to the supply of central bank money $H$, minus the demand for currency by the public, $CU_d$. The demand for reserves by banks is $R_d$. So the equilibrium condition that the supply and the demand for bank reserves be equal is given by:

$$H - CU_d = R_d$$

Notice that, if we move $CU_d$ from the left side to the right side of the equation and use the fact that the demand for central bank money $H^d$ is given by $H^d = CU_d + R^d$, then this equation becomes $H = H^d$. In other words, looking at the equilibrium in terms of the supply and the demand for reserves is equivalent to looking at the equilibrium in terms of the supply and the demand for central bank money—\`the approach we followed in Section 4-3.

Nevertheless, this alternative way of looking at the equilibrium is attractive because, in the United States, there is indeed an actual market for bank reserves, where the interest rate adjusts to balance the supply and demand for reserves. This market is called the federal funds market. Banks that have excess reserves at the end of the day lend them to banks that have insufficient reserves. In equilibrium, the total demand for reserves by all banks taken together, $R^d$, must be equal to the supply of reserves to the market, $H - CU_d$—the equilibrium condition stated above.

The interest rate determined in this market is called the federal funds rate. Because the Fed can in effect choose the federal funds rate it wants by changing the supply of central bank money, $H$, the federal funds rate is typically thought of as the main indicator of U.S. monetary policy. This is why so much attention is focused on it, and why changes in the federal funds rate typically make front page news.

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*This section is optional*
The Supply of Money, the Demand for Money, and the Money Multiplier

We have seen how we can think of the equilibrium in terms of the equality of the supply and demand of central bank money, or in terms of the equality of the supply and demand of reserves. There is yet another way of thinking about the equilibrium which is sometimes very useful. We can think about the equilibrium in terms of the equality of the overall supply and the overall demand for money (currency and checkable deposits).

To derive an equilibrium condition in terms of the overall supply and the overall demand for money, start with the equilibrium condition (4.11) (which states that the supply of central bank money must equal the demand for central bank money) and divide both sides by \( \frac{1}{c + \theta(1 - c)} \):}

\[
H = \frac{1}{[c + \theta(1 - c)]} \frac{Y}{I(i)}
\]

**Supply of money = Demand for money**

The right side of equation (4.12) is the overall demand for money (currency plus checkable deposits). The left side is the overall supply of money (currency plus checkable deposits). Basically the equation says that, in equilibrium, the overall supply and the overall demand of money must be equal.

- If you compare equation (4.12) with equation (4.2), the equation characterizing the equilibrium in an economy without banks, you will see that the only difference is that the overall supply of money is not equal just to central bank money but to central bank money times a constant term \( 1/(c + \theta(1 - c)) \).
  Notice also that, because \( (c + \theta(1 - c)) \) is less than one, its inverse—the constant term on the left of the equation—is greater than one. For this reason, this constant term is called the **money multiplier**. The overall supply of money is therefore equal to central bank money times the money multiplier. If the money multiplier is 4, for example, then the overall supply of money is equal to 4 times the supply of central bank money.

- To reflect the fact that the overall supply of money depends in the end on the amount of central bank money, central bank money is sometimes called **high-powered money** (this is where the letter \( H \) we used to denote central bank money comes from), or the **monetary base**. The term high-powered reflects the fact that increases in \( H \) lead to more than one-for-one increases in the overall money supply, and are therefore “high-powered.” In the same way, the term monetary base reflects the fact that the overall money supply depends ultimately on a “base”—the amount of central bank money in the economy.

The presence of a multiplier in equation (4.12) implies that a given change in central bank money has a larger effect on the money supply—and in turn a larger effect on the interest rate—in an economy with banks than in an economy without banks. To understand why, it is useful to return to the description of open market operations, this time in an economy with banks.

**Understanding the Money Multiplier**

To make the arithmetic easier, let’s consider a special case where people hold only checkable deposits, so \( c = 0 \). In this case, the multiplier is \( 1/\theta \). In other words, an increase of a dollar of high powered money leads to an increase of \( 1/\theta \) dollars in the money supply. Assume further that \( \theta = 0.1 \), so that the multiplier equals \( 1/0.1 = 10 \).
The purpose of what follows is to help you understand where this multiplier comes from, and, more generally, to help you understand how the initial increase in central bank money leads to a ten-fold increase in the overall money supply.

Suppose the Fed buys $100 worth of bonds in an open market operation. It pays the seller—call him seller 1—$100. To pay the seller, the Fed creates $100 in central bank money. The increase in central bank money is $100. When we looked earlier at the effects of an open market operation in an economy in which there were no banks, this was the end of the story. Here, it is just the beginning:

- Seller 1 (who, we have assumed, does not want to hold any currency) deposits the $100 in a checking account at his bank—call it bank A. This leads to an increase in checkable deposits of $100.
- Bank A keeps $100 times 0.1 = $10 in reserves and buys bonds with the rest, $100 times 0.9 = $90. It pays $90 to the seller of those bonds—call her seller 2.
- Seller 2 deposits $90 in a checking account in her bank—call it bank B. This leads to an increase in checkable deposits of $90.
- Bank B keeps $90 times 0.1 = $9 in reserves and buys bonds with the rest, $90 times 0.9 = $81. It pays $81 to the seller of those bonds, call him seller 3.
- Seller 3 deposits $81 in a checking account in his bank, call it bank C.
- And so on.

By now, the chain of events should be clear. What is the eventual increase in the money supply? The increase in checkable deposits is $100 when seller 1 deposits the proceeds of his sale of bonds in bank A, plus $90 when seller 2 deposits the proceeds of her sale of bonds in bank B, plus $81 when seller 3 does the same, and so on. Let’s write the sum as:

$$100(1 + 0.9 + 0.9^2 + \ldots)$$

The series in parentheses is a geometric series, so its sum is equal to $1/(1 - 0.9) = 10$ (see Appendix 2 at the end of this book for a refresher on geometric series). The money supply increases by $1,000—10 times the initial increase in central bank money.

This derivation gives us another way of thinking about the money multiplier: We can think of the ultimate increase in the money supply as the result of successive rounds of purchases of bonds—the first started by the Fed in its open market operation, the following rounds by banks. Each successive round leads to an increase in the money supply, and eventually the increase in the money supply is equal to 10 times the initial increase in the central bank money. Note the parallel between our interpretation of the money multiplier as the result of successive purchases of bonds and the interpretation of the goods market multiplier (Chapter 3) as the result of successive rounds of spending. Multipliers can often be interpreted as the result of successive rounds of decisions and derived as the sum of a geometric series. This interpretation often gives a better understanding of how the process works.

---

**Summary**

- The demand for money depends positively on the level of transactions in the economy and negatively on the interest rate.
- The interest rate is determined by the equilibrium condition that the supply of money be equal to the demand for money.
- For a given supply of money, an increase in income leads to an increase in the demand for money and an increase in the interest rate. An increase in the supply of money for a given income leads to a decrease in the interest rate.
The way the central bank changes the supply of money is through open market operations.

Expansionary 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.

Contractionary 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.

When money includes both currency and checkable deposits, we can think of the interest rate as being determined by the condition that the supply of central bank money be equal to the demand for central bank money.

**Key Terms**

Federal Reserve Bank (Fed), 63  
currency, 64  
checkable deposits, 64  
M1, 64  
bonds, 64  
money market funds, 65  
money, 65  
income, 65  
flow, 65  
saving, 65  
savings, 65  
financial wealth, wealth, 65  
stock, 65  
investment, 65  
financial investment, 65  
LM relation, 68  
liquidity, 68  
open market operation, 70  
expansionary, and contractionary, open market operation, 70  
Treasury bill (T-bill), 71  
financial intermediaries, 73  
(bank) reserves, 73  
reserve ratio, 74  
central bank money, 74  
bank run, 75  
narrow banking, 75  
federal deposit insurance, 75  
wholesale funding, 75  
federal funds market, federal funds rate, 79  
money multiplier, 80  
high-powered money, 80  
monetary base, 80

**Questions and Problems**

**QUICK CHECK**

All Quick Check questions and problems are available on MyEconLab.

1. Using the information in this chapter, label each of the following statements true, false, or uncertain. Explain briefly.
   a. Income and financial wealth are both examples of stock variables.
   b. The term investment, as used by economists, refers to the purchase of bonds and shares of stock.
   c. The demand for money does not depend on the interest rate because only bonds earn interest.
   d. About two-thirds of U.S. currency is held outside the United States.
   e. The central bank can increase the supply of money by selling bonds in the market for bonds.
   f. The Federal Reserve can determine the money supply, but it cannot determine interest rates—not even the federal funds rate—because interest rates are determined in the private sector.
   g. Bond prices and interest rates always move in opposite directions.
   h. Since the Great Depression, the United States has relied on federal deposit insurance to help solve the problem of bank runs.

2. Suppose that a person’s yearly income is $60,000. Also suppose that this person’s money demand function is given by

   \[ M^d = Y (0.35 - i) \]

   a. What is this person’s demand for money when the interest rate is 5%? 10%?
   b. Explain how the interest rate affects money demand.
   c. Suppose that the interest rate is 10%. In percentage terms, what happens to this person’s demand for money if her yearly income is reduced by 50%?
4. Suppose that money demand is given by

\[ Md = Y(0.25 - i) \]

where $Y$ is $100. Also, suppose that the supply of money is $20.

a. What is the equilibrium interest rate?

b. If the Federal Reserve Bank wants to increase $i$ by 10 percentage points (e.g., from 2% to 12%), at what level should it set the supply of money?

d. Suppose that the interest rate is $5\%$. In percentage terms, how does this effect depend on the interest rate?

e. Summarize the effect of income on money demand. In percentage terms, how does this effect depend on the interest rate?

3. Consider a bond that promises to pay $100 in one year.

a. What is the interest rate on the bond if its price today is $75? $85? $95?

b. What is the relation between the price of the bond and the interest rate?

c. If the interest rate is 8\%, what is the price of the bond today?

d. Suppose that the interest rate is 5\%. In percentage terms, how does this effect depend on the interest rate?

e. Consider the statement “When people earn more money, they obviously will hold more bonds.” What is wrong with this statement?

4. Suppose that money demand is given by

\[ Md = Y(0.25 - i) \]

where $Y$ is $100. Also, suppose that the supply of money is $20.

a. What is the equilibrium interest rate?

b. If the Federal Reserve Bank wants to increase $i$ by 10 percentage points (e.g., from 2% to 12%), at what level should it set the supply of money?

c. What are the effects of an increase in wealth on the demand for money and the demand for bonds? Explain in words.

d. Consider the statement “When people earn more money, they obviously will hold more bonds.” What is wrong with this statement?

6. The demand for bonds

In this chapter, you learned that an increase in the interest rate makes bonds more attractive, so it leads people to hold more of their wealth in bonds as opposed to money. However, you also learned that an increase in the interest rate reduces the price of bonds.

How can an increase in the interest rate make bonds more attractive and reduce their price?

7. ATMs and credit cards

This problem examines the effect of the introduction of ATMs and credit cards on money demand. For simplicity, let’s examine a person’s demand for money over a period of four days.

Suppose that before ATMs and credit cards, this person goes to the bank once at the beginning of each four-day period and withdraws from her savings account all the money she needs for four days. Assume that she needs $4 per day.

a. How much does this person withdraw each time she goes to the bank? Compute this person’s money holdings for days 1 through 4 (in the morning, before she needs any of the money she withdraws).

b. What is the amount of money this person holds, on average?

c. Recompute your answer to part (a).

d. Recompute your answer to part (b).

e. Recompute your answer to part (a).

Finally, with the advent of credit cards, this person pays for all her purchases using her card. She withdraws no money until the fourth day, when she withdraws the whole amount necessary to pay for her credit card purchases over the previous four days.

f. Recompute your answer to part (a).

g. Based on your previous answers, what do you think has been the effect of ATMs and credit cards on money demand?

8. The money multiplier

The money multiplier is described in Section 4-4. Assume the following:

i. The public holds no currency.

ii. The ratio of reserves to deposits is 0.1.

iii. The demand for money is given by

\[ Md = Y(0.8 - 4i) \]

Initially, the monetary base is $100 billion, and nominal income is $5 trillion.

a. What is the demand for central bank money?

b. Find the equilibrium interest rate by setting the demand for central bank money equal to the supply of central bank money.

c. What is the overall supply of money? Is it equal to the overall demand for money at the interest rate you found in part (b)?

d. What is the impact on the interest rate if central bank money is increased to $300 billion?

e. If the overall money supply increases to $3,000 billion, what will be the impact on $i$? [Hint: Use what you discovered in part (c).]

9. Bank runs and the money multiplier preferring to hold on to their cash.

During the Great Depression, the U.S. economy experienced many bank runs, to the point where people became unwilling to keep their money in banks, preferring to hold on to their cash.

How would you expect such a shift away from checkable deposits toward currency to affect the size of the money multiplier?

EXPLORE FURTHER

10. Current monetary policy

Go to the Web site for the Federal Reserve Board of Governors (www.federalreserve.gov) and download the most recent monetary policy press release of the Federal Open Market Committee (FOMC). Make sure you get the most recent FOMC press release and not simply the most recent Fed press release.

a. What is the current stance of monetary policy? (Note that policy will be described in terms of increasing or...
decreasing the federal funds rate as opposed to increasing or decreasing the money supply.)

b. If the federal funds rate has changed recently, what does the change imply about the bond holdings of the Federal Reserve? Has the Fed been increasing or decreasing its bond holdings?

Finally you can visit the Fed’s website and find various statements explaining the Fed’s current policy on interest rates. These statements set the stage for the analysis in Chapter 5. Some parts of these statements should make more complete sense at the end Chapter 5.

Further Readings

* While we shall return to many aspects of the financial system throughout the book, you may want to dig deeper and read a textbook on money and banking. Here are four of them: *Money, Banking, and Financial Markets*, by Laurence Ball (Worth, 2010); *Money, Banking, and Financial Markets*, by Stephen Cecchetti and Kermit Schoenholtz (McGraw-Hill/Irwin, 2010); *Money, the Financial System and the Economy*, by R. Glenn Hubbard (Addison-Wesley, 2007); *The Economics of Money, Banking, and the Financial System*, by Frederic Mishkin, (Pearson, 9th edition, 2010).

* The Fed maintains a useful Web site, which contains not only data on financial markets but also information on what the Fed does, on recent testimonies by the Fed Chairman, and so on (http://www.federalreserve.gov).
In Chapter 3, we looked at the goods market. In Chapter 4, we looked at financial markets. We now look at goods and financial markets together. By the end of this chapter you will have a framework to think about how output and the interest rate are determined in the short run.

In developing this framework, we follow a path first traced by two economists, John Hicks and Alvin Hansen, in the late 1930s and the early 1940s. When the economist John Maynard Keynes published his *General Theory* in 1936, there was much agreement that his book was both fundamental and nearly impenetrable. (Try to read it, and you will agree.) There were (and still are) many debates about what Keynes “really meant.” In 1937, John Hicks summarized what he saw as one of Keynes’s main contributions: the joint description of goods and financial markets. His analysis was later extended by Alvin Hansen. Hicks and Hansen called their formalization the *IS–LM* model.

Macroeconomics has made substantial progress since the early 1940s. This is why the *IS–LM* model is treated in this and the next chapter rather than in Chapter 26 of this book. (If you had taken this course 40 years ago, you would be nearly done!) But to most economists, the *IS–LM* model still represents an essential building block—one that, despite its simplicity, captures much of what happens in the economy in the *short run*. This is why the *IS–LM* model is still taught and used today.

This chapter develops the basic version of the *IS–LM* model. It has five sections:

**Section 5-1** looks at equilibrium in the goods market and derives the *IS* relation.

**Section 5-2** looks at equilibrium in financial markets and derives the *LM* relation.

**Sections 5-3 and 5-4** put the *IS* and the *LM* relations together and use the resulting *IS–LM* model to study the effects of fiscal and monetary policy—first separately, then together.

**Section 5-5** introduces dynamics and explores how the *IS–LM* model captures what happens in the economy in the short run.
Let’s first summarize what we learned in Chapter 3:

- We characterized equilibrium in the goods market as the condition that production, $Y$, be equal to the demand for goods, $Z$. We called this condition the IS relation.
- We defined demand as the sum of consumption, investment, and government spending. We assumed that consumption was a function of disposable income (income minus taxes), and took investment spending, government spending, and taxes as given:

\[ Z = C(Y - T) + I + G \]

(In Chapter 3, we assumed, to simplify the algebra, that the relation between consumption, $C$, and disposable income, $Y - T$, was linear. Here, we shall not make this assumption but use the more general form $C = C(Y - T)$ instead).
- The equilibrium condition was thus given by

\[ Y = C(Y - T) + I + G \]

- Using this equilibrium condition, we then looked at the factors that moved equilibrium output. We looked in particular at the effects of changes in government spending and of shifts in consumption demand.

The main simplification of this first model was that the interest rate did not affect the demand for goods. Our first task in this chapter is to abandon this simplification and introduce the interest rate in our model of equilibrium in the goods market. For the time being, we focus only on the effect of the interest rate on investment and leave a discussion of its effects on the other components of demand until later.

### Investment, Sales, and the Interest Rate

In Chapter 3, investment was assumed to be constant. This was for simplicity. Investment is in fact far from constant and depends primarily on two factors:

- The level of sales. Consider a firm facing an increase in sales and needing to increase production. To do so, it may need to buy additional machines or build an additional plant. In other words, it needs to invest. A firm facing low sales will feel no such need and will spend little, if anything, on investment.
- The interest rate. Consider a firm deciding whether or not to buy a new machine. Suppose that to buy the new machine, the firm must borrow. The higher the interest rate, the less attractive it is to borrow and buy the machine. (For the moment, and to keep things simple, we make two simplifications. First, we assume that all firms can borrow at the same interest rate—namely, the interest rate on bonds as determined in Chapter 4. In fact, many firms borrow from banks, possibly at a different rate. We return to this in Chapter 9. We also leave aside the distinction between the nominal interest rate—the interest rate in terms of dollars—and the real interest rate—the interest rate in terms of goods. The distinction is important, however, and we return to it in Chapter 14).

At a high enough interest rate, the additional profits from using the new machine will not cover interest payments, and the new machine will not be worth buying.

To capture these two effects, we write the investment relation as follows:

\[ I = I(Y, i) \]

(5.1)

The argument still holds if the firm uses its own funds: The higher the interest rate, the more attractive it is to lend the funds rather than to use them to buy the new machine.
Equation (5.1) states that investment $I$ depends on production $Y$ and the interest rate $i$. (We continue to assume that inventory investment is equal to zero, so sales and production are always equal. As a result, $Y$ denotes sales, and it also denotes production.) The positive sign under $Y$ indicates that an increase in production (equivalently, an increase in sales) leads to an increase in investment. The negative sign under the interest rate $i$ indicates that an increase in the interest rate leads to a decrease in investment.

### Determining Output

Taking into account the investment relation (5.1), the condition for equilibrium in the goods market becomes

$$Y = C(Y - T) + I(Y, i) + G$$

(5.2)

Production (the left side of the equation) must be equal to the demand for goods (the right side). Equation (5.2) is our expanded IS relation. We can now look at what happens to output when the interest rate changes.

Start with Figure 5-1. Measure the demand for goods on the vertical axis. Measure output on the horizontal axis. For a given value of the interest rate $i$, demand is an increasing function of output, for two reasons:

- An increase in output leads to an increase in income and thus to an increase in disposable income. The increase in disposable income leads to an increase in consumption. We studied this relation in Chapter 3.
- An increase in output also leads to an increase in investment. This is the relation between investment and production that we have introduced in this chapter.

In short, an increase in output leads, through its effects on both consumption and investment, to an increase in the demand for goods. This relation between demand and output, for a given interest rate, is represented by the upward-sloping curve $ZZ$.

Note two characteristics of $ZZ$ in Figure 5-1:

- Since we have not assumed that the consumption and investment relations in equation (5.2) are linear, $ZZ$ is in general a curve rather than a line. Thus, we have drawn it as a curve in Figure 5-1. All the arguments that follow would apply if we

---

**Figure 5-1**

**Equilibrium in the Goods Market**

The demand for goods is an increasing function of output. Equilibrium requires that the demand for goods be equal to output.
assumed that the consumption and investment relations were linear and that $ZZ$ were a straight line.

We have drawn $ZZ$ so that it is flatter than the 45-degree line. Put another way, we have assumed that an increase in output leads to a less than one-for-one increase in demand.

In Chapter 3, where investment was constant, this restriction naturally followed from the assumption that consumers spend only part of their additional income on consumption. But now that we allow investment to respond to production, this restriction may no longer hold. When output increases, the sum of the increase in consumption and the increase in investment could exceed the initial increase in output. Although this is a theoretical possibility, the empirical evidence suggests that it is not the case in reality. That’s why we will assume the response of demand to output is less than one-for-one and draw $ZZ$ flatter than the 45-degree line.

Make sure you understand why the two statements mean the same thing.
Equilibrium in the goods market is reached at the point where the demand for goods equals output; that is, at point \( A \), the intersection of \( ZZ \) and the 45-degree line. The equilibrium level of output is given by \( Y \).

So far, what we have done is extend, in straightforward fashion, the analysis of Chapter 3. But we are now ready to derive the IS curve.

**Deriving the IS Curve**

We have drawn the demand relation, \( ZZ \), in Figure 5-1 for a given value of the interest rate. Let’s now derive in Figure 5-2 what happens if the interest rate changes.

Suppose that, in Figure 5-2(a), the demand curve is given by \( ZZ \), and the initial equilibrium is at point \( A \). Suppose now that the interest rate increases from its initial value \( i \) to a new higher value \( i' \). At any level of output, the higher interest rate leads to lower investment and lower demand. The demand curve \( ZZ \) shifts down to \( ZZ' \): At a given level of output, demand is lower. The new equilibrium is at the intersection of the lower demand curve \( ZZ' \) and the 45-degree line, at point \( A' \). The equilibrium level of output is now equal to \( Y' \).

In words: The increase in the interest rate decreases investment. The decrease in investment leads to a decrease in output, which further decreases consumption and investment, through the multiplier effect.

Using Figure 5-2(a), we can find the equilibrium value of output associated with any value of the interest rate. The resulting relation between equilibrium output and the interest rate is drawn in Figure 5-2(b).

Figure 5-2(b) plots equilibrium output \( Y \) on the horizontal axis against the interest rate on the vertical axis. Point \( A \) in Figure 5-2(b) corresponds to point \( A \) in Figure 5-2(a), and point \( A' \) in Figure 5-3(b) corresponds to \( A' \) in Figure 5-2(a). The higher interest rate is associated with a lower level of output.

This relation between the interest rate and output is represented by the downward-sloping curve in Figure 5-2(b). This curve is called the IS curve.

**Shifts of the IS Curve**

We have drawn the IS curve in Figure 5-2 taking as given the values of taxes, \( T \), and government spending, \( G \). Changes in either \( T \) or \( G \) will shift the IS curve.

To see how, consider Figure 5-3. The IS curve gives the equilibrium level of output as a function of the interest rate. It is drawn for given values of taxes and spending. Now
consider an increase in taxes, from \( T \) to \( T' \). At a given interest rate, say \( i \), disposable income decreases, leading to a decrease in consumption, leading in turn to a decrease in the demand for goods and a decrease in equilibrium output. The equilibrium level of output decreases from \( Y \) to \( Y' \). Put another way, the IS curve shifts to the left: At a given interest rate, the equilibrium level of output is lower than it was before the increase in taxes.

More generally, any factor that, for a given interest rate, decreases the equilibrium level of output causes the IS curve to shift to the left. We have looked at an increase in taxes. But the same would hold for a decrease in government spending, or a decrease in consumer confidence (which decreases consumption given disposable income).

Symmetrically, any factor that, for a given interest rate, increases the equilibrium level of output—a decrease in taxes, an increase in government spending, an increase in consumer confidence—causes the IS curve to shift to the right.

Let’s summarize:

- Equilibrium in the goods market implies that an increase in the interest rate leads to a decrease in output. This relation is represented by the downward-sloping IS curve.
- Changes in factors that decrease the demand for goods given the interest rate shift the IS curve to the left. Changes in factors that increase the demand for goods given the interest rate shift the IS curve to the right.

5-2 Financial Markets and the \( LM \) Relation

Let’s now turn to financial markets. We saw in Chapter 4 that the interest rate is determined by the equality of the supply of and the demand for money:

\[
M = \$ Y \, L(i)
\]

The variable \( M \) on the left side is the nominal money stock. We will ignore here the details of the money-supply process that we saw in Sections 4-3 and 4-4, and simply think of the central bank as controlling \( M \) directly.

The right side gives the demand for money, which is a function of nominal income, \( \$ Y \), and of the nominal interest rate, \( i \). As we saw in Section 4-1, an increase in nominal income increases the demand for money; an increase in the interest rate decreases the demand for money. Equilibrium requires that money supply (the left side of the equation) be equal to money demand (the right side of the equation).

Real Money, Real Income, and the Interest Rate

The equation \( M = \$ Y \, L(i) \) gives a relation among money, nominal income, and the interest rate. It will be more convenient here to rewrite it as a relation among real money (that is, money in terms of goods), real income (that is, income in terms of goods), and the interest rate.

Recall that nominal income divided by the price level equals real income, \( Y \). Dividing both sides of the equation by the price level \( P \) gives

\[
\frac{M}{P} = Y \, L(i)
\]

Hence, we can restate our equilibrium condition as the condition that the real money supply—that is, the money stock in terms of goods, not dollars—be equal to the real money demand, which depends on real income, \( Y \), and the interest rate, \( i \).
The notion of a “real” demand for money may feel a bit abstract, so an example will help. Think not of your demand for money in general but just of your demand for coins. Suppose you like to have coins in your pocket to buy two cups of coffee during the day. If a cup costs $1.20, you will want to keep about $2.40 in coins: This is your nominal demand for coins. Equivalently, you want to keep enough coins in your pocket to buy two cups of coffee. This is your demand for coins in terms of goods—here in terms of cups of coffee.

From now on, we shall refer to equation (5.3) as the \( LM \) relation. The advantage of writing things this way is that real income, \( Y \), appears on the right side of the equation instead of nominal income, \( \$Y \). And real income (equivalently real output) is the variable we focus on when looking at equilibrium in the goods market. To make the reading lighter, we will refer to the left and right sides of equation (5.3) simply as “money supply” and “money demand” rather than the more accurate but heavier “real money supply” and “real money demand.” Similarly, we will refer to income rather than “real income.”

**Deriving the \( LM \) Curve**

To see the relation between output and the interest rate implied by equation (5.3), let’s use Figure 5-4. Look first at Figure 5-4(a). Let the interest rate be measured on the vertical axis and (real) money be measured on the horizontal axis. (Real) money supply is given by the vertical line at \( M/P \) and is denoted \( M^s \). For a given level of (real) income, \( Y \), (real) money demand is a decreasing function of the interest rate. It is drawn as the downward-sloping curve denoted \( M^d \). Except for the fact that we measure real rather than nominal money on the horizontal axis, the figure is similar to Figure 4-3 in Chapter 4. The equilibrium is at point \( A \), where money supply is equal to money demand, and the interest rate is equal to \( i \).

Now consider an increase in income from \( Y \) to \( Y' \), which leads people to increase their demand for money at any given interest rate. Money demand shifts to the right, to \( M'^{d} \). The new equilibrium is at \( A' \), with a higher interest rate, \( i' \). Why does an increase in income lead to an increase in the interest rate? When income increases, money demand increases; but the money supply is given. Thus, the interest rate must go up until the two opposite effects on the demand for money—the increase in income that leads people to want to hold more money and the increase in the interest rate that leads...
people to want to hold less money—cancel each other. At that point, the demand for money is equal to the unchanged money supply, and financial markets are again in equilibrium.

Using Figure 5-4(a), we can find the value of the interest rate associated with any value of income for a given money stock. The relation is derived in Figure 5-4(b).

Figure 5-4(b) plots the equilibrium interest rate $i$ on the vertical axis against income on the horizontal axis. Point $A$ in Figure 5-4(b) corresponds to point $A$ in Figure 5-4(a), and point $A'$ in Figure 5-4(b) corresponds to point $A'$ in Figure 5-4(a). More generally, equilibrium in financial markets implies that the higher the level of output, the higher the demand for money, and therefore the higher the equilibrium interest rate.

This relation between output and the interest rate is represented by the upward-sloping curve in Figure 5-4(b). This curve is called the $LM$ curve. Economists sometimes characterize this relation by saying, “higher economic activity puts pressure on interest rates.” Make sure you understand the steps behind this statement.

### Shifts of the $LM$ Curve

We have derived the $LM$ curve in Figure 5-4, taking both the nominal money stock, $M$, and the price level, $P$—and, by implication, their ratio, the real money stock, $M/P$—as given. Changes in $M/P$, whether they come from changes in the nominal money stock, $M$, or from changes in the price level, $P$, will shift the $LM$ curve.

To see how, let us look at Figure 5-5 and consider an increase in the nominal money supply, from $M$ to $M'$. Given the fixed price level, the real money supply increases from $M/P$ to $M'/P$. Then, at any level of income, say $Y$, the interest rate consistent with equilibrium in financial markets is lower, going down from $i$ to, say, $i'$. The $LM$ curve shifts down, from $LM$ to $LM'$. By the same reasoning, at any level of income, a decrease in the money supply leads to an increase in the interest rate. It causes the $LM$ curve to shift up.

Let’s summarize:

- Equilibrium in financial markets implies that, for a given real money supply, an increase in the level of income, which increases the demand for money, leads to an increase in the interest rate. This relation is represented by the upward-sloping $LM$ curve.
- An increase in the money supply shifts the $LM$ curve down; a decrease in the money supply shifts the $LM$ curve up.

---

**Figure 5-5**

**Shifts of the $LM$ Curve**

An increase in money causes the $LM$ curve to shift down.
5-3 Putting the IS and the LM Relations Together

The IS relation follows from the condition that the supply of goods must be equal to the demand for goods. It tells us how the interest rate affects output. The LM relation follows from the condition that the supply of money must be equal to the demand for money. It tells us how output in turn affects the interest rate. We now put the IS and LM relations together. At any point in time, the supply of goods must be equal to the demand for goods, and the supply of money must be equal to the demand for money. Both the IS and LM relations must hold. Together, they determine both output and the interest rate.

\[ IS \text{ relation: } \quad Y = C(Y - T) + I(Y, i) + G \]

\[ LM \text{ relation: } \quad \frac{M}{P} = YL(i) \]

Figure 5-6 plots both the IS curve and the LM curve on one graph. Output—equivalently, production or income—is measured on the horizontal axis. The interest rate is measured on the vertical axis.

Any point on the downward-sloping IS curve corresponds to equilibrium in the goods market. Any point on the upward-sloping LM curve corresponds to equilibrium in financial markets. Only at point A are both equilibrium conditions satisfied. That means point A, with the associated level of output \( Y \) and interest rate \( i \), is the overall equilibrium—the point at which there is equilibrium in both the goods market and the financial markets.

The IS and LM relations that underlie Figure 5-6 contain a lot of information about consumption, investment, money demand, and equilibrium conditions. But you may ask: So what if the equilibrium is at point A? How does this fact translate into anything directly useful about the world? Don’t despair: Figure 5-6 holds the answer to many questions in macroeconomics. Used properly, it allows us to study what happens to output and the interest rate when the central bank decides to increase the money stock, or when the government decides to increase taxes, or when consumers become more pessimistic about the future, and so on.

Let’s now see what the IS–LM model can do.

**Figure 5-6**

The IS–LM Model

Equilibrium in the goods market implies that an increase in the interest rate leads to a decrease in output. This is represented by the IS curve. Equilibrium in financial markets implies that an increase in output leads to an increase in the interest rate. This is represented by the LM curve. Only at point A, which is on both curves, are both goods and financial markets in equilibrium.
Fiscal Policy, Activity, and the Interest Rate

Suppose the government decides to reduce the budget deficit and does so by increasing taxes while keeping government spending unchanged. Such a change in fiscal policy is often called a **fiscal contraction** or a **fiscal consolidation**. (An increase in the deficit, either due to an increase in government spending or to a decrease in taxes, is called a **fiscal expansion**.) What are the effects of this fiscal contraction on output, on its composition, and on the interest rate?

When you answer this or any question about the effects of changes in policy, always go through the following three steps:

1. Ask how the change affects equilibrium in the goods market and how it affects equilibrium in the financial markets. Put another way: How does it shift the IS and/or the LM curves?

2. Characterize the effects of these shifts on the intersection of the IS and the LM curves. What does this do to equilibrium output and the equilibrium interest rate?

3. Describe the effects in words.

With time and experience, you will often be able to go directly to step 3. By then you will be ready to give an instant commentary on the economic events of the day. But until you get to that level of expertise, go step by step.

■ Start with step 1. The first question is how the increase in taxes affects equilibrium in the goods market—that is, how it affects the IS curve.

Let’s draw, in Figure 5-7(a), the IS curve corresponding to equilibrium in the goods market before the increase in taxes. Now take an arbitrary point, B, on this IS curve. By construction of the IS curve, output \( Y_B \) and the corresponding interest rate \( i_B \) are such that the supply of goods is equal to the demand for goods.

At the interest rate \( i_B \), ask what happens to output if taxes increase from \( T \) to \( T' \). We saw the answer in Section 5-1. Because people have less disposable income, the increase in taxes decreases consumption, and through the multiplier, decreases output. At interest rate \( i_B \) output decreases from \( Y_B \) to \( Y_C \). More generally, at *any* interest rate, higher taxes lead to lower output. Consequently, the IS curve shifts to the left, from IS to IS'.

Next, let’s see if anything happens to the LM curve. Figure 5-7(b) draws the LM curve corresponding to equilibrium in the financial markets before the increase in taxes. Take an arbitrary point, F, on this LM curve. By construction of the LM curve, the interest rate \( i_F \) and income \( Y_F \) are such that the supply of money is equal to the demand for money.

What happens to the LM curve when taxes are increased? The answer: Nothing. At the given level of income \( Y_F \) the interest rate at which the supply of money is equal to the demand for money is the same as before, namely \( i_F \). In other words, because taxes do not appear in the LM relation, they do not affect the equilibrium condition. They do not affect the LM curve.

Note the general principle here: A curve shifts in response to a change in an exogenous variable only if this variable appears directly in the equation represented by that curve. Taxes enter in equation (5.2), so, when they change, the IS curve shifts. But taxes do not enter in equation (5.3), so the LM curve does not shift.

■ Now consider step 2, the determination of the equilibrium.

Let the initial equilibrium in Figure 5-7(c) be at point A, at the intersection between the initial IS curve and the LM curve. The IS curve is the same as the IS curve in Figure 5-7(a), and the LM curve is the same as the LM curve in Figure 5-7(b).
The Effects of an Increase in Taxes

An increase in taxes shifts the IS curve to the left and leads to a decrease in the equilibrium level of output and the equilibrium interest rate.
The increase in taxes shifts the IS curve. The LM curve does not shift. The economy moves along the LM curve.

If the interest rate did not decline, the economy would go from point A to point D in Figure 5-7(c), and output would be directly below point D. Because of the decline in the interest rate—which stimulates investment—the decline in activity is only to point A’.

After the increase in taxes, the IS curve shifts to the left—from IS to IS’. The new equilibrium is at the intersection of the new IS curve and the unchanged LM curve, or point A’. Output decreases from Y to Y”. The interest rate decreases from i to i’. Thus, as the IS curve shifts, the economy moves along the LM curve, from A to A’. The reason these words are italicized is that it is important always to distinguish between the shift of a curve (here the shift of the IS curve) and the movement along a curve (here the movement along the LM curve). Many mistakes come from not distinguishing between the two.

- Step 3 is to tell the story in words:

The increase in taxes leads to lower disposable income, which causes people to decrease their consumption. This decrease in demand leads, in turn, to a decrease in output and income. At the same time, the decrease in income reduces the demand for money, leading to a decrease in the interest rate. The decline in the interest rate reduces but does not completely offset the effect of higher taxes on the demand for goods.

What happens to the components of demand? By assumption, government spending remains unchanged (we have assumed that the reduction in the budget deficit takes place through an increase in taxes). Consumption surely goes down: Taxes go up and income goes down, so disposable income goes down on both counts. The last question is, what happens to investment? On the one hand, lower output means lower sales and lower investment. On the other, a lower interest rate leads to higher investment. Without knowing more about the exact form of the investment relation, equation (5.1), we cannot tell which effect dominates: If investment depended only on the interest rate, then investment would surely increase; if investment depended only on sales, then investment would surely decrease. In general, investment depends on both the interest rate and on sales, so we cannot tell. (The case where investment falls as the deficit rises is sometimes called the crowding out of investment by the deficit. If investment instead rises when the deficit rises, there is crowding in of investment by the deficit.) Contrary to what is often stated by politicians, a reduction in the budget deficit does not necessarily lead to an increase in investment. The Focus box, “Deficit Reduction: Good or Bad for Investment?” discusses this in more detail.

We shall return to the relation between fiscal policy and investment many times in this book and we shall qualify this first answer in many ways. But the result that, in the short run, a reduction of the budget deficit may or may not decrease investment, will remain.

**Monetary Policy, Activity, and the Interest Rate**

An increase in the money supply is called a monetary expansion. A decrease in the money supply is called a monetary contraction or monetary tightening.

Let’s take the case of a monetary expansion. Suppose that the central bank increases nominal money, M, through an open market operation. Given our assumption that the price level is fixed in the short run, this increase in nominal money leads to a one-for-one increase in real money, M/P. Let us denote the initial real money supply by M/P, the new higher one by M’/P, and trace in Figure 5-8 the effects of the money supply increase on output and the interest rate.

- Again, step 1 is to see whether and how the IS and the LM curves shift.

Let’s look at the IS curve first. The money supply does not directly affect either the supply of or the demand for goods. In other words, M does not appear in the IS relation. Thus, a change in M does not shift the IS curve.
Deficit Reduction: Good or Bad for Investment?

You may have heard this argument in some form before: “Private saving goes either toward financing the budget deficit or financing investment. It does not take a genius to conclude that reducing the budget deficit leaves more saving available for investment, so investment increases.”

This argument sounds simple and convincing. How do we reconcile it with what we just saw, namely that a deficit reduction may decrease rather than increase investment? To make progress, first go back to Chapter 3, equation (3.10). There we learned that we can also think of the goods-market equilibrium condition as

\[ I = S + (T - G) \]

In equilibrium, investment is indeed equal to private saving plus public saving. If public saving is positive, the government is said to be running a budget surplus; if public saving is negative, the government is said to be running a budget deficit. So it is true that given private saving, if the government reduces its deficit—either by increasing taxes or reducing government spending so that \( T - G \) goes up—investment must go up: Given \( S \), \( T - G \) going up implies that \( I \) goes up.

The crucial part of this statement, however, is “given private saving.” The point is that a fiscal contraction affects private saving as well: The contraction leads to lower output and therefore to lower income. As consumption goes down by less than income, private saving also goes down. And it may go down by more than the reduction in the budget deficit, leading to a decrease rather than an increase in investment. In terms of the equation above: If \( S \) decreases by more than \( T - G \) increases, then \( I \) will decrease, not increase.

To sum up, a fiscal contraction may decrease investment. Or, looking at the reverse policy, a fiscal expansion—a decrease in taxes or an increase in spending—may actually increase investment.

Money enters the \( LM \) relation, however, so the \( LM \) curve shifts when the money supply changes. As we saw in Section 5-2, an increase in the money supply shifts the \( LM \) curve down, from \( LM \) to \( LM' \): At a given level of income, an increase in money leads to a decrease in the interest rate.

Step 2 is to see how these shifts affect the equilibrium. The monetary expansion shifts the \( LM \) curve. It does not shift the \( IS \) curve. The economy moves along the \( IS \) curve.

![Figure 5-8](image-url)

**The Effects of a Monetary Expansion**

A monetary expansion leads to higher output and a lower interest rate.
The increase in \( M \) shifts the \( LM \) curve down. It does not shift the \( IS \) curve. The economy moves along the \( IS \) curve.

The increase in money leads to a lower interest rate. The lower interest rate leads to an increase in investment and, in turn, to an increase in demand and output.

In contrast to the case of fiscal contraction, we can tell exactly what happens to the different components of demand after a monetary expansion: Because income is higher and taxes are unchanged, disposable income goes up, and so does consumption. Because sales are higher and the interest rate is lower, investment also unambiguously goes up. So a monetary expansion is more investment friendly than a fiscal expansion.

Let’s summarize:

- You should remember the three-step approach (characterize the shifts, show the effect on the equilibrium, tell the story in words) we have developed in this section to look at the effects of changes in policy on activity and the interest rate. We shall use it throughout the book.
- Table 5-1 summarizes what we have learned about the effects of fiscal and monetary policy. Use the same method to look at changes other than changes in policy. For example, trace the effects of a decrease in consumer confidence through its effect on consumption demand, or, say, the introduction of more convenient credit cards through their effect on the demand for money.

### 5-4 Using a Policy Mix

We have looked so far at fiscal policy and monetary policy in isolation. Our purpose was to show how each worked. In practice, the two are often used together. The combination of monetary and fiscal policy is known as the **monetary–fiscal policy mix**, or simply the **policy mix**.

Sometimes, the right mix is to use fiscal and monetary policy in the same direction. This was the case for example during the recession of 2001 in the United States, where both monetary and fiscal policy were used to fight the recession. The story of the recession and the role of monetary and fiscal policy are described in the Focus box “The U.S. Recession of 2001.”
In 1992, the U.S. economy embarked on a long expansion. For the rest of the decade, GDP growth was positive and high. In 2000, however, the expansion came to an end. From the third quarter of 2000 to the fourth quarter of 2001, GDP growth was either positive and close to zero or negative. Based on data available at the time, it was thought that growth was negative through the first three quarters of 2001. Based on revised data, shown in Figure 1, which gives the growth rate for each quarter from 1999–1 to 2002–4, measured at annual rate, it appears that growth was actually small but positive in the second quarter. (These data revisions happen often, so that what we see when we look back is not always what national income statisticians perceived at the time.) The National Bureau of Economic Research (known as the NBER for short), a nonprofit organization that has traditionally dated U.S. recessions and expansions, concluded that the U.S. economy had indeed had a recession in 2001, starting in March 2001 and ending in December 2001; this period is represented by the shaded area in the figure.

What triggered the recession was a sharp decline in investment demand. Nonresidential investment—the demand for plant and equipment by firms—decreased by 4.5% in 2001. The cause was the end of what Alan Greenspan, the chairman of the Fed at the time, had dubbed a period of “irrational exuberance”: During the second part of the 1990s, firms had been extremely optimistic about the future, and the rate of investment had been very high—the average yearly growth rate of investment from 1995 to 2000 exceeded 10%. In 2001, however, it became clear to firms that they had been overly optimistic and had invested too much. This led them to cut back on investment, leading to a decrease in demand and, through the multiplier, a decrease in GDP.

The recession could have been much worse. But it was met by a strong macroeconomic policy response, which certainly limited the depth and the length of the recession.

Take monetary policy first. Starting in early 2001, the Fed, feeling that the economy was slowing down, started increasing the money supply and decreasing the federal funds rate aggressively. (Figure 2 shows the behavior of the federal funds rate, from 1991–1 to 2002–4.) It continued to do so throughout the year. The funds rate, which stood at 6.5% in January, stood at less than 2% at the end of the year.

Turn to fiscal policy. During the 2000 Presidential campaign, then candidate George Bush had run on a of lower taxes. The argument was that the federal budget was in surplus, and so there was room to reduce tax rates while keeping the budget in balance. When President Bush took office in 2001 and it became clear that the economy was slowing down, he had an additional rationale to cut tax rates, namely the use of lower taxes to increase demand and fight the recession. Both the 2001 and the 2002 budgets included substantial reductions in tax rates. On the spending side, the events of September 11, 2001 led to an increase in spending, mostly on defense and homeland security.

Figure 3 shows the evolution of federal government revenues and spending during 1999–1 to 2002–4, both
expressed as ratios to GDP. Note the dramatic decrease in revenues starting in the third quarter of 2001. Even without decreases in tax rates, revenues would have gone down during the recession: Lower output and lower income mechanically imply lower tax revenues. But, because of the tax cuts, the decrease in revenues in 2001 and 2002 was much larger than can be explained by the recession. Note also the smaller but steady increase in spending starting around the same time. As a result, the budget surplus—the difference between revenues and spending—went from positive up until 2000, to negative in 2001 and, much more so, in 2002.

The effects of the initial decrease in investment demand and the monetary and fiscal responses can be represented using the IS-LM model. In Figure 4, assume that the equilibrium at the end of 2000 is represented by
point A, at the intersection of the initial IS and the initial LM curves. What happened in 2001 was the following:

- The decrease in investment demand led to a sharp shift of the IS curve to the left, from IS to IS". Absent policy reactions, the economy would have been at point A", with output Y".
- The increase in the money supply led to a downward shift of the LM curve, from LM to LM'.
- The decrease in tax rates and the increase in spending both led to a shift of the IS curve to the right, from IS" to IS'.

As a result of the decrease in investment demand and of the two policy responses, the economy in 2001 ended up at point A', with a decrease in output, and a much lower interest rate. The output level associated with A' was lower than the output level associated with A—there was a recession—but it was much higher than the output level associated with A", the level that would have prevailed in the absence of policy responses.

Let us end by taking up four questions you might be asking yourself at this point:

- Why weren’t monetary and fiscal policy used to avoid rather than just to limit the size of the recession?

The reason is that changes in policy affect demand and output only over time (more on this in Section 5-5). Thus, by the time it became clear that the U.S. economy was entering a recession, it was already too late to use policy to avoid it. What the policy did was to reduce both the depth and the length of the recession.

- Weren’t the events of September 11, 2001 also a cause of the recession?

The answer, in short, is no. As we have seen, the recession started long before September 11, and ended soon after. Indeed, GDP growth was positive in the last quarter of 2001. One might have expected—and, indeed, most economists expected—the events of September 11 to have large adverse effects on output, leading, in particular, consumers and firms to delay spending decisions until the outlook was clearer. In fact, the drop in spending was short and limited. Decreases in the federal funds rate after September 11—and large discounts by automobile producers in the last quarter of 2001—are believed to have been crucial in maintaining consumer confidence and consumer spending during that period.

- Was the monetary–fiscal mix used to fight the recession a textbook example of how policy should be conducted?

On this, economists differ. Most economists give high marks to the Fed for strongly decreasing interest rates as soon as the economy slowed down. But most economists are worried that the tax cuts introduced in 2001 and 2002 led to large and persistent budget deficits. They argue that the tax cuts should have been temporary, helping the U.S. economy get out of the recession but stopping thereafter. While the current crisis is mostly responsible for the large deficits we have today, the tax cuts have made the situation worse. As we saw in Chapter 1, reducing the budget deficit is perhaps the main item on the U.S. policy agenda.

- Why were monetary and fiscal policy unable to avoid the current crisis and the large decrease in U.S. output in 2009?

The answer, in short, is twofold. The shocks were much larger, and much harder to react to. And the room for policy responses was more limited. We shall return to these two aspects in Chapter 9.
Sometimes, the right mix is to use the two policies in opposite directions, for example, combining a fiscal contraction with a monetary expansion. This was the case in the early 1990s in the United States. When Bill Clinton was elected President in 1992, one of his priorities was to reduce the budget deficit using a combination of cuts in spending and increases in taxes. Clinton was worried, however, that, by itself, such a fiscal contraction would lead to a decrease in demand and trigger another recession. The right strategy was to combine a fiscal contraction (so as to get rid of the deficit) with a monetary expansion (to make sure that demand and output remained high). This was the strategy adopted and carried out by Bill Clinton (who was in charge of fiscal policy) and Alan Greenspan (who was in charge of monetary policy). The result of this strategy—and a bit of economic luck—was a steady reduction of the budget deficit (which turned into a budget surplus at the end of the 1990s) and a steady increase in output throughout the rest of the decade.

5-5 How Does the IS-LM Model Fit the Facts?

We have so far ignored dynamics. For example, when looking at the effects of an increase in taxes in Figure 5-7—or the effects of a monetary expansion in Figure 5-8—we made it look as if the economy moved instantaneously from $A$ to $A'$, as if output went instantaneously from $Y$ to $Y'$. This is clearly not realistic: The adjustment of output clearly takes time. To capture this time dimension, we need to reintroduce dynamics. Introducing dynamics formally would be difficult. But, as we did in Chapter 3, we can describe the basic mechanisms in words. Some of the mechanisms will be familiar from Chapter 3, some are new:

- Consumers are likely to take some time to adjust their consumption following a change in disposable income.
- Firms are likely to take some time to adjust investment spending following a change in their sales.
- Firms are likely to take some time to adjust investment spending following a change in the interest rate.
- Firms are likely to take some time to adjust production following a change in their sales.

So, in response to an increase in taxes, it takes some time for consumption spending to respond to the decrease in disposable income, some more time for production to decrease in response to the decrease in consumption spending, yet more time for investment to decrease in response to lower sales, for consumption to decrease in response to the decrease in income, and so on.

In response to a monetary expansion, it takes some time for investment spending to respond to the decrease in the interest rate, some more time for production to increase in response to the increase in demand, yet more time for consumption and investment to increase in response to the induced change in output, and so on.

Describing precisely the adjustment process implied by all these sources of dynamics is obviously complicated. But the basic implication is straightforward: Time is needed for output to adjust to changes in fiscal and monetary policy. How much time? This question can only be answered by looking at the data and using econometrics. Figure 5-9 shows the results of such an econometric study, which uses data from the United States from 1960 to 1990.

The study looks at the effects of a decision by the Fed to increase the federal funds rate by 1%. It traces the typical effects of such an increase on a number of macroeconomic variables.
Each panel in Figure 5-9 represents the effects of the change in the interest rate on a given variable. Each panel plots three lines. The solid line in the center of a band gives the best estimate of the effect of the change in the interest rate on the variable we look at in the panel. The two dashed lines and the tinted space between the dashed lines represents a confidence band, a band within which the true value of the effect lies with 60% probability.

Panel 5-9(a) shows the effects of an increase in the federal funds rate of 1% on retail sales over time. The percentage change in retail sales is plotted on the vertical axis; time, measured in quarters, is on the horizontal axis. Focusing on the best estimate—the solid line—we see that the increase in the federal funds rate of 1% leads to a decline in retail sales. The largest decrease in retail sales, −0.9%, is achieved after five quarters.

There is no such thing in econometrics as learning the exact value of a coefficient or the exact effect of one variable on another. Rather, what econometrics does is to provide us a best estimate—here, the thick line—and a measure of confidence we can have in the estimate—here, the confidence band.
Figure 5-9(b) shows how lower sales lead to lower output. In response to the decrease in sales, firms cut production, but by less than the decrease in sales. Put another way, firms accumulate inventories for some time. The adjustment of production is smoother and slower than the adjustment of sales. The largest decrease, \(-0.7\%\), is reached after eight quarters. In other words, monetary policy works, but it works with long lags. It takes nearly two years for monetary policy to have its full effect on production.

Panel 5-9(c) shows how lower output leads to lower employment: As firms cut production, they also cut employment. As with output, the decline in employment is slow and steady, reaching \(-0.5\%\) after eight quarters. The decline in employment is reflected in an increase in the unemployment rate, shown in Panel 5-9(d).

Panel 5-9(e) looks at the behavior of the price level. Remember, one of the assumptions of the IS–LM model is that the price level is given, and so it does not change in response to changes in demand. Panel 5-9(b) shows that this assumption is not a bad approximation of reality in the short run. The price level is nearly unchanged for the first six quarters or so. Only after the first six quarters does the price level appear to decline. This gives us a strong hint as to why the IS–LM model becomes less reliable as we look at the medium run: In the medium run, we can no longer assume that the price level is given, and movements in the price level become important.

Figure 5-9 provides two important lessons. First, it gives us a sense of the dynamic adjustment of output and other variables to monetary policy.

Second, and more fundamentally, it shows that what we observe in the economy is consistent with the implications of the IS–LM model. This does not prove that the IS–LM model is the right model. It may be that what we observe in the economy is the result of a completely different mechanism, and the fact that the IS–LM model fits well is a coincidence. But this seems unlikely. The IS–LM model looks like a solid basis on which to build when looking at movements in activity in the short-run. Later on, we shall extend the model to look at the role of expectations (Chapters 14 to 17) and the implications of openness in goods and financial markets (Chapters 18 to 21). But we must first understand what determines output in the medium run. This is the topic of the next four chapters.

Summary

- The IS–LM model characterizes the implications of equilibrium in both the goods and the financial markets.
- The IS relation and the IS curve show the combinations of the interest rate and the level of output that are consistent with equilibrium in the goods market. An increase in the interest rate leads to a decline in output. Consequently, the IS curve is downward sloping.
- The LM relation and the LM curve show the combinations of the interest rate and the level of output consistent with equilibrium in financial markets. Given the real money supply, an increase in output leads to an increase in the interest rate. Consequently, the LM curve is upward sloping.
- A fiscal expansion shifts the IS curve to the right, leading to an increase in output and an increase in the interest rate. A fiscal contraction shifts the IS curve to the left, leading to a decrease in output and a decrease in the interest rate.
- A monetary expansion shifts the LM curve down, leading to an increase in output and a decrease in the interest rate. A monetary contraction shifts the LM curve up, leading to a decrease in output and an increase in the interest rate.
- The combination of monetary and fiscal policies is known as the monetary–fiscal policy mix, or simply the policy mix. Sometimes monetary and fiscal policy are used in the same direction. This was the case during the 2001 U.S. recession. Sometimes, they are used in opposite directions. Fiscal...
contraction and monetary expansion can, for example, achieve a decrease in the budget deficit while avoiding a decrease in output.

The IS–LM model appears to describe well the behavior of the economy in the short run. In particular, the effects of monetary policy appear to be similar to those implied by the IS–LM model once dynamics are introduced in the model. An increase in the interest rate due to a monetary contraction leads to a steady decrease in output, with the maximum effect taking place after about eight quarters.

Key Terms

- **IS curve**, 89
- **LM curve**, 92
- **fiscal contraction**, **fiscal consolidation**, 94
- **fiscal expansion**, 94
- **crowding out**, **crowding in**, 96
- **monetary expansion**, 96
- **monetary contraction**, **monetary tightening**, 96
- **monetary–fiscal policy mix**, **(policy mix)**, 98
- **confidence band**, 103

Questions and Problems

**QUICK CHECK**
All Quick Check questions and problems are available on MyEconLab.

1. Using the information in this chapter, label each of the following statements true, false, or uncertain. Explain briefly.
   a. The main determinants of investment are the level of sales and the interest rate.
   b. If all the exogenous variables in the IS relation are constant, then a higher level of output can be achieved only by lowering the interest rate.
   c. The IS curve is downward sloping because goods market equilibrium implies that an increase in taxes leads to a lower level of output.
   d. If government spending and taxes increase by the same amount, the IS curve does not shift.
   e. The LM curve is upward sloping because a higher level of the money supply is needed to increase output.
   f. An increase in government spending leads to a decrease in investment.
   g. Government policy can increase output without changing the interest rate only if both monetary and fiscal policy variables change.

2. Consider first the goods market model with constant investment that we saw in Chapter 3. Consumption is given by

$$C = c_0 + c_1(Y - T)$$

and I, G, and T are given.
   a. Solve for equilibrium output. What is the value of the multiplier? (Hint: If all the independent variables in the IS relation are constant, then a higher level of output can be achieved only by lowering the interest rate.)
   b. Solve for equilibrium output. At a given interest rate, is the effect of a change in autonomous spending bigger than what it was in part (a)? Why? (Assume $c_1 + b_1 < 1$.)
   c. Solve for equilibrium output. (Hint: Eliminate the interest rate from the IS and LM relations.) Derive the multiplier (the effect of a change of one unit in autonomous spending on output).
   d. Is the multiplier you obtained in part (c) smaller or larger than the multiplier you derived in part (a)? Explain how your answer depends on the parameters in the behavioral equations for consumption, investment, and money demand.

3. The response of investment to fiscal policy
   a. Using the IS–LM diagram, show the effects on output and the interest rate of a decrease in government spending. Can you tell what happens to investment? Why?

   **Now consider the following IS–LM model:**

   $$C = c_0 + c_1(Y - T)$$
   $$I = b_0 + b_1Y - b_2i$$
   $$\frac{M}{P} = d_1Y - d_2i$$

   b. Solve for equilibrium output. Assume $c_1 + b_1 < 1$. (Hint: You may want to re-work through Problem 2 if you are having trouble with this step.)
   c. Solve for the equilibrium interest rate. (Hint: Use the LM relation.)
   d. Solve for investment.
   e. Under what conditions on the parameters of the model (i.e., $c_0$, $c_1$, and so on) will investment increase when $G$ decreases? (Hint: If $G$ decreases by one unit, by how much does $I$ increase? Be careful; you want the change in $I$ to be positive when the change in $G$ is negative.)
   f. Explain the condition you derived in part (e).

4. Consider the following IS–LM model:

   $$C = 200 + .25Y_D$$
   $$I = 150 + .25Y - 1000i$$
   $$G = 250$$
   $$T = 200$$
   $$(\frac{M}{P})^d = 2Y - 8000i$$
   $$\frac{M}{P} = 1600$$
a. Derive the IS relation. (Hint: You want an equation with Y on the left side and everything else on the right.)
b. Derive the LM relation. (Hint: It will be convenient for later use to rewrite this equation with i on the left side and everything else on the right.)
c. Solve for equilibrium real output. (Hint: Substitute the expression for the interest rate given by the LM equation into the IS equation and solve for output.)
d. Solve for the equilibrium interest rate. (Hint: Substitute the value you obtained for Y in part (c) into either the IS or LM equations and solve for i. If your algebra is correct, you should get the same answer from both equations.)
e. Solve for the equilibrium values of C and I, and verify the value you obtained for Y by adding C, I, and G.
f. Now suppose that the money supply increases to M/P = 1,840. Solve for Y, i, c, and T, and describe in words the effects of an expansionary monetary policy.
g. Set M/P equal to its initial value of 1,600. Now suppose that government spending increases to G = 400. Summarize the effects of an expansionary fiscal policy on Y, i, and C.

DIG DEEPER

All Dig Deeper questions and problems are available on MyEconLab.

5. Investment and the interest rate
The chapter argues that investment depends negatively on the interest rate because an increase in the cost of borrowing discourages investment. However, firms often finance their investment projects using their own funds.

If a firm is considering using its own funds (rather than borrowing) to finance investment projects, will higher interest rates discourage the firm from undertaking these projects? Explain. (Hint: Think of yourself as the owner of a firm that has earned profits and imagine that you are going to use the profits either to finance new investment projects or to buy bonds. Will your decision to invest in new projects in your firm be affected by the interest rate?)

6. The Bush–Greenspan policy mix
In 2001, the Fed pursued a very expansionary monetary policy. At the same time, President George W. Bush pushed through legislation that lowered income taxes.

a. Illustrate the effect of such a policy mix on output.
b. How does this policy mix differ from the Clinton–Greenspan mix?
c. What happened to output in 2001? How do you reconcile the fact that both fiscal and monetary policies were expansionary with the fact that growth was so low in 2002? (Hint: What else happened?)

7. Policy mixes
Suggest a policy mix to achieve each of the following objectives.

a. Increase Y while keeping i constant.
b. Decrease the fiscal deficit while keeping Y constant. What happens to i? To investment?

8. The (less paradoxical) paradox of saving
A chapter problem at the end of Chapter 3 considered the effect of a drop in consumer confidence on private saving and investment, when investment depended on output but not on the interest rate. Here, we consider the same experiment in the context of the IS–LM framework, in which investment depends on the interest rate and output.

a. Suppose households attempt to save more, so that consumer confidence falls. In an IS–LM diagram, show the effect of the fall in consumer confidence on output and the interest rate.
b. How will the fall in consumer confidence affect consumption, investment, and private saving? Will the attempt to save more necessarily lead to more saving? Will this attempt necessarily lead to less saving?

EXPLORE FURTHER

9. The Clinton–Greenspan policy mix
As described in this chapter, during the Clinton administration the policy mix changed toward more contractionary fiscal policy and more expansionary monetary policy. This question explores the implications of this change in the policy mix, both in theory and fact.

a. Suppose G falls, T rises, and M increases and that this combination of policies has no effect on output. Show the effects of these policies in an IS–LM diagram. What happens to the interest rate? What happens to investment?
b. Go to the Web site of the Economic Report of the President (www.gpoaccess.gov/eop/). Look at Table B-79 in the statistical appendix. What happened to federal receipts (tax revenues), federal outlays, and the budget deficit as a percentage of GDP over the period 1992 to 2000? (Note that federal outlays include transfer payments, which would be excluded from the variable G, as we define it in our IS–LM model. Ignore the difference.)
c. The Federal Reserve Board of Governors posts the recent history of the federal funds rate at http://www.federalreserve.gov/releases/h15/data.htm. You will have to choose to look at the rate on a daily, weekly, monthly, or annual interval. Look at the years between 1992 and 2000. When did monetary policy become more expansionary?
d. Go to Table B-2 of the Economic Report of the President and collect data on real GDP and real gross domestic investment for the period 1992 to 2000. Calculate investment as a percentage of GDP for each year. What happened to investment over the period?
e. Finally, go to Table B-31 and retrieve data on real GDP per capita (in chained 2005 dollars) for the period. Calculate the growth rate for each year. What was the average annual growth rate over the period 1992 to 2000? In Chapter 10 you will learn that the average annual growth rate of U.S. real GDP per capita was 2.6% between 1950 and 2004. How did growth between 1992 and 2000 compare to the Post World War II average?

10. Consumption, investment, and the recession of 2001
This question asks you to examine the movements of investment and consumption before, during, and after the recession of 2001. It also asks you to consider the response of investment and consumption to the events of September 11, 2001.

Go to the Web site of the Bureau of Economic Analysis (www.bea.gov). Find the NIPA tables, in particular the
quarterly versions of Table 1.1.1, which shows the percentage change in real GDP and its components, and Table 1.1.2, which shows the contribution of the components of GDP to the overall percentage change in GDP. Table 1.1.2 weights the percentage change of the components by their size. Investment is more variable than consumption, but consumption is much bigger than investment, so smaller percentage changes in consumption can have the same impact on GDP as much larger percentage changes in investment. Note that the quarterly percentage changes are annualized (i.e., expressed as annual rates).

Retrieval of the quarterly data on real GDP, consumption, gross private domestic investment, and non-residential fixed investment for the years 1999 to 2002 from Tables 1.1.1 and 1.1.2.

a. Identify the quarters of negative growth in 2000 and 2001. Track consumption and investment around 2000 and 2001. From Table 1.1.1, which variable had the bigger percentage change around this time? Compare non-residential fixed investment with overall investment. Which variable had the bigger percentage change?

b. From Table 1.1.2, get the contribution to GDP growth of consumption and investment for 1999 to 2001. Calculate the average of the quarterly contributions for each variable for each year. Now calculate the change in the contribution of each variable for 2000 and 2001 (i.e., subtract the average contribution of consumption in 1999 from the average contribution of consumption in 2000, subtract the average contribution of consumption in 2000 from the average contribution of consumption in 2001, and do the same for investment for both years). Which variable had the largest decrease in its contribution to growth? What do you think was the proximate cause of the recession of 2001? (Was it a fall in investment demand or a fall in consumption demand?)

d. Now look at what happened to consumption and investment after the events of September 11th in the third and fourth quarters of 2001 and in the first two quarters of 2002. Does the drop in investment at the end of 2001 make sense to you? How long did this drop in investment last? What happened to consumption about this time? How do you explain, in particular, the change in consumption in the fourth quarter of 2001? Did the events of September 11, 2001 cause the recession of 2001? Use the discussion in the chapter and your own intuition as guides in answering these questions.

Further Reading

- A description of the U.S. economy, from the period of “irrational exuberance” to the 2001 recession and the role of fiscal and monetary policy, is given by Paul Krugman, in The Great Unraveling, W.W. Norton, 2003. New York, (Warning: Krugman did not like the Bush administration or its policies!)

APPENDIX: An Alternative Derivation of the LM Relation as an Interest Rate Rule

In the text, we derived the LM relation under the assumption that the money stock remained constant. This gave us the positive relation between the interest rate and income shown, for example, in Figure 5-4(b).

As we discussed in Chapter 4, however, the assumption that the central bank keeps the money stock constant and lets the interest rate adjust when income changes is not a good description of what modern central banks do. Most central banks think instead in terms of setting the interest rate, adjusting the money supply so as to achieve the interest rate they want. Thus, we may want to derive the LM relation under the alternative assumption that the central bank sets the interest rate and adjusts the money supply as needed to achieve that goal.

To see what this implies, turn to Figure 1(a). Like Figure 5-4(a), the panel plots money supply and money demand, with the interest rate on the vertical axis and money on the horizontal axis. The money supply is given by the vertical line \( M^s \), money demand by the downward-sloping curve \( M^d \). The initial equilibrium is at point \( A \), with interest rate \( i_A \).

Now consider an increase in income that shifts money demand from \( M^d \) to \( M^{d'} \). If the central bank does not change the money supply, then the equilibrium will move from \( A \) to \( B \), and the interest rate will increase from \( i_A \) to \( i_B \). The implied LM curve, \( L_M \), the relation between the interest rate and income, is drawn in Figure 1(b). It is exactly the same as in Figure 5-4(a).

Suppose, however, that the central bank wants to keep the interest rate constant in the face of the increase in income. Can it do it? Yes. How can it do it? By increasing the money supply in response to the increase in income, from \( M^s \) to \( M^{s'} \). If it
The Short Run

The Core

(Real) Money, \( M/P \)
Income, \( Y \)

\[ M_d \] (for \( Y < Y' \))
\[ M^s' \] (for \( Y' > Y \))

Interest rate, \( i \)

Figure 1

The LM Relation as an Interest Rate Rule

(a) Depending on whether and by how much the central bank increases the money supply in response to shift in money demand coming from changes in income, the interest rate may remain constant, or increase a little, or increase a lot.

(b) We can think of the LM curve as showing whether and by how much the central bank allows the interest rate to increase in response to increases in income.

This may be too extreme a policy. Perhaps the central bank wants to allow the interest rate to increase, but by less than it would if the central bank kept the money supply constant. For example, in response to the increase in income, the central bank may choose to increase the money supply by \( M^s' < M^s \). In this case, the equilibrium will move from \( A \) to \( C \), and the interest rate will increase from \( i_A \) to \( i_C \). The resulting LM curve, denoted by \( LM'' \) in Figure 1(b), will be upward sloping but flatter than \( LM \).

To summarize: The LM relation we derived in the text gave us the relation between the interest rate and income for a given money supply. The LM relation derived in the appendix gives us the relation between the interest rate and income when the central bank follows a given interest rate rule, and lets the money supply adjust as needed. Its slope then depends on how much the central bank increases the interest rate in response to increases in income.

Which LM relation should you use? It depends on the question at hand. Take, for example, the case of an increase in the deficit, shifting the IS curve to the right. You may want to know what would happen to output and the interest rate if the central bank money supply remained constant, in which case you will use the LM relation derived in the text. But you may know that, for example, the central bank is likely to keep the interest rate constant, in which case you will use the the LM relation we derived in this appendix—in this particular case, an horizontal LM curve.

Key Term

interest rate rule, 108
Chapter 9 looks at why the current crisis has been so deep and prolonged. It shows how an initial shock in the housing market was amplified through its effects in the financial system. It shows how the room for policy to help output return to its natural level is limited in two ways: Monetary policy is limited by the presence of a liquidity trap. Fiscal policy is limited by the presence of a high level of public debt.
Think about what happens when firms respond to an increase in demand by increasing production: Higher production leads to higher employment. Higher employment leads to lower unemployment. Lower unemployment leads to higher wages. Higher wages increase production costs, leading firms to increase prices. Higher prices lead workers to ask for higher wages. Higher wages lead to further increases in prices, and so on.

So far, we have simply ignored this sequence of events: By assuming a constant price level in the IS–LM model, we in effect assumed that firms were able and willing to supply any amount of output at a given price level. So long as our focus was on the short run, this assumption was acceptable. But, as our attention turns to the medium run, we must now abandon this assumption, explore how prices and wages adjust over time, and how this, in turn, affects output. This will be our task in this and the next three chapters.

At the center of the sequence of events described in the first paragraph is the labor market, the market in which wages are determined. This chapter focuses on the labor market. It has six sections:

**Section 6-1** provides an overview of the labor market.

**Section 6-2** focuses on unemployment, how it moves over time, and how its movements affect individual workers.

**Sections 6-3 and 6-4** look at wage and price determination.

**Section 6-5** then looks at equilibrium in the labor market. It characterizes the natural rate of unemployment, the rate of unemployment to which the economy tends to return in the medium run.

**Section 6-6** gives a map of where we will be going next.
The Medium Run

The Core

Work in the home, such as cooking or raising children, is not classified as work in the official statistics. This is a reflection of the difficulty of measuring these activities—not a value judgment about what constitutes work and what doesn’t.

6-1 A Tour of the Labor Market

The total U.S. population in 2010 was 308.7 million (Figure 6-1). Excluding those who were either under working age (under 16), in the armed forces, or behind bars, the number of people potentially available for civilian employment, the noninstitutional civilian population, was 237.8 million.

The civilian labor force—the sum of those either working or looking for work—was only 153.8 million. The other 84 million people were out of the labor force, neither working in the market place nor looking for work. The participation rate, defined as the ratio of the labor force to the noninstitutional civilian population, was therefore 153.8/237.8, or 64.7%. The participation rate has steadily increased over time, reflecting mostly the increasing participation rate of women: In 1950, one woman out of three was in the labor force; now the number is close to two out of three.

Of those in the labor force, 139 million were employed, and 14.8 million were unemployed—looking for work. The unemployment rate, defined as the ratio of the unemployed to the labor force, was therefore 14.8/153.8 = 9.6. As we shall see later, 9.6% is a very high unemployment rate by historical standards.

The Large Flows of Workers

To get a sense of what a given unemployment rate implies for individual workers, consider the following analogy:

Take an airport full of passengers. It may be crowded because many planes are coming and going, and many passengers are quickly moving in and out of the airport. Or it may be because bad weather is delaying flights and passengers are stranded, waiting for the weather to improve. The number of passengers in the airport will be high in both cases, but their plights are quite different. Passengers in the second scenario are likely to be much less happy.

Figure 6-1

Population, Labor Force, Employment, and Unemployment in the United States (in millions), 2010

Source: Current Population Survey
http://www.bls.gov/cps/
In the same way, a given unemployment rate may reflect two very different realities. It may reflect an active labor market, with many separations and many hires, and so with many workers entering and exiting unemployment; or it may reflect a sclerotic labor market, with few separations, few hires, and a stagnant unemployment pool.

Finding out which reality hides behind the aggregate unemployment rate requires data on the movements of workers. The data are available in the United States from a monthly survey called the Current Population Survey (CPS). Average monthly flows, computed from the CPS for the United States from 1994 to 2011, are reported in Figure 6-2. (For more on the ins and outs of the CPS, see the Focus box “The Current Population Survey.”)

Figure 6-2 has three striking features:

- The flows of workers in and out of employment are very large.
  On average, there are 8.5 million separations each month in the United States (out of an employment pool of 132.4 million), 3.1 million change jobs (shown by the circular arrow at the top), 3.6 million move from employment to out of the labor force (shown by the arrow from employment to out of the labor force), and 1.8 million move from employment to unemployment (shown by the arrow from employment to unemployment).

- Why are there so many separations each month? About three-fourths of all separations are usually quits—workers leaving their jobs for what they perceive as a better alternative. The remaining one-fourth are layoffs. Layoffs come mostly from changes in employment levels across firms: The slowly changing aggregate employment numbers hide a reality of continual job destruction and job creation across firms. At any given time, some firms are suffering decreases in demand and decreasing their employment; other firms are enjoying increases in demand and increasing employment.

- The flows in and out of unemployment are large relative to the number of unemployed: The average monthly flow out of unemployment each month is 4.0 million: 2.1 million people get a job, and 1.9 million stop searching for a job and drop out of the labor force. Put another way, the proportion of unemployed leaving unemployment equals 4.0/8.4 or about 47% each month. Put yet another way, the numbers for employment, unemployment, and those out of the labor force in Figure 6-1 referred to 2010. The numbers for the same variables in Figure 6-2 refer to averages from 1994 to 2011. This is why they are different.

Put another, and perhaps more dramatic way: On average, every day in the United States, about 60,000 workers become unemployed.

Sclerosis, a medical term, means hardening of the arteries. By analogy, it is used in economics to describe markets that function poorly and have few transactions.

The numbers for employment, unemployment, and those out of the labor force in Figure 6-1 referred to 2010. The numbers for the same variables in Figure 6-2 refer to averages from 1994 to 2011. This is why they are different.

Figure 6-2

Average Monthly Flows between Employment, Unemployment, and Nonparticipation in the United States, 1994 to 2011 (millions)

(1) The flows of workers in and out of employment are large; (2) The flows in and out of unemployment are large relative to the number of unemployed; (3) There are also large flows in and out of the labor force, much of it directly to and from employment.

Source: Calculated from the series constructed by Fleischman and Fallick, http://www.federalreserve.gov/econresdata/researchdata.htm
The average duration of unemployment equals the inverse of the proportion of unemployed leaving unemployment each month. To see why, consider an example. Suppose the number of unemployed is constant and equal to 100, and each unemployed person remains unemployed for two months. So, at any given time, there are 50 people who have been unemployed for one month and 50 who have been unemployed for two months. Each month, the 50 unemployed who have been unemployed for two months leave unemployment. In this example, the proportion of unemployed leaving unemployment each month is 50/100, or 50%. The duration of unemployment is two months—the inverse of 1/50%.

average duration of unemployment—the average length of time people spend unemployed—is between two and three months.

This fact has an important implication. You should not think of unemployment in the United States as a stagnant pool of workers waiting indefinitely for jobs. For most (but obviously not all) of the unemployed, being unemployed is more a quick transition than a long wait between jobs. One needs, however, to make two remarks at this point. First, the United States is unusual in this respect: In many European countries, the average duration is much longer than in the United States. Second, as we shall see below, even in the United States, when unemployment is high, such as is the case today, the average duration of unemployment becomes much longer. Being unemployed becomes much more painful.

The flows in and out of the labor force are also surprisingly large: Each month, 5.5 million workers drop out of the labor force (3.6 plus 1.9), and a slightly larger number, 5.1, join the labor force (3.3 plus 1.8). You might have expected these two flows to be composed, on one side, of those finishing school and entering the labor force for the first time, and, on the other side, of workers going into retirement. But each of these two groups actually represents a small fraction of the total flows. Each month only about 400,000 new people enter the labor force, and about 300,000 retire. But the actual flows in and out of the labor force are 10.6 million, so about 15 times larger.

What this fact implies is that many of those classified as “out of the labor force” are in fact willing to work and move back and forth between participation and non-participation. Indeed, among those classified as out of the labor force, a very large proportion report that although they are not looking, they “want a job.” What they really mean by this statement is unclear, but the evidence is that many do take jobs when offered them.

This fact has another important implication. The sharp focus on the unemployment rate by economists, policy makers, and news media is partly misdirected.
Some of the people classified as “out of the labor force” are very much like the unemployed. They are in effect discouraged workers. And while they are not actively looking for a job, they will take it if they find one.

This is why economists sometimes focus on the employment rate, the ratio of employment to the population available for work, rather than on the unemployment rate. The higher unemployment, or the higher the number of people out of the labor force, the lower the employment rate.

We shall follow tradition in this book and focus on the unemployment rate as an indicator of the state of the labor market, but you should keep in mind that the unemployment rate is not the best estimate of the number of people available for work.

6-2 Movements in Unemployment

Let’s now look at movements in unemployment. Figure 6-3 shows the average value of the U.S. unemployment rate over the year, for each year, all the way back to 1948. The shaded areas represent years during which there was a recession.

Figure 6-3 has two important features:

- Until the mid-1980s, it looked as if the U.S. unemployment rate was on an upward trend, from an average of 4.5% in the 1950s to 4.7% in the 1960s, 6.2% in the 1970s, and 7.3% in the 1980s. From the 1980s on however, the unemployment rate steadily declined for more than two decades. By 2006, the unemployment rate was 4.6%. These decreases led a number of economists to conclude that the trend from 1950 to the 1980s had been reversed, and that the normal rate of unemployment in the United States had fallen. How much of the large increase in the unemployment rate since 2007 is temporary, and whether we can return to the low rates of the mid-2000s, remains to be seen.

In 2010, employment was 139 million and the population available for work was 237.8 million. The employment rate was 58.5%. The employment rate is sometimes called the employment to population ratio.
Leaving aside these trend changes, year-to-year movements in the unemployment rate are closely associated with recessions and expansions. Look, for example, at the last four peaks in unemployment in Figure 6-3. The most recent peak, at 9.6% is in 2010, is the result of the crisis. The previous two peaks, associated with the recessions of 2001 and 1990–1991 recessions, had much lower unemployment rate peaks, around 7%. Only the recession of 1982, where the unemployment rate reached 9.7%, is comparable to the current crisis. (Annual averages can mask larger values within the year. In the 1982 recession, while the average unemployment rate over the year was 9.7%, the unemployment rate actually reached 10.8% in November 1982. Similarly, the monthly unemployment rate in the crisis peaked at 10.0% in October 2009.)

How do these fluctuations in the aggregate unemployment rate affect individual workers? This is an important question because the answer determines both:

- The effect of movements in the aggregate unemployment rate on the welfare of individual workers, and
- The effect of the aggregate unemployment rate on wages.

Let’s start by asking how firms can decrease their employment in response to a decrease in demand. They can hire fewer new workers, or they can lay off the workers they currently employ. Typically, firms prefer to slow or stop the hiring of new workers first, relying on quits and retirements to achieve a decrease in employment. But doing only this may not be enough if the decrease in demand is large, so firms may then have to lay off workers.

Now think about the implications for both employed and unemployed workers.

- If the adjustment takes place through fewer hires, the chance that an unemployed worker will find a job diminishes. Fewer hires means fewer job openings; higher unemployment means more job applicants. Fewer openings and more applicants combine to make it harder for the unemployed to find jobs.
- If the adjustment takes place instead through higher layoffs, then employed workers are at a higher risk of losing their job.

In general, as firms do both, higher unemployment is associated with both a lower chance of finding a job if one is unemployed and a higher chance of losing it if one is employed. Figures 6-4 and 6-5 show these two effects at work over the period 1994 to 2010.

Figure 6-4 plots two variables against time: the unemployment rate (measured on the left vertical axis); and the proportion of unemployed workers finding a job each month (inverse scale).
month (measured on the right vertical axis). This proportion is constructed by dividing
the flow from unemployment to employment during each month by the number of un-
employed. To show the relation between the two variables more clearly, the proportion
of unemployed finding jobs is plotted on an inverted scale: Be sure you see that on the
right vertical scale, the proportion is lowest at the top and highest at the bottom.

The relation between movements in the proportion of unemployed workers find-
ing jobs and the unemployment rate is striking: Periods of higher unemployment are
associated with much lower proportions of unemployed workers finding jobs. In 2010,
for example, with unemployment close to 10%, only about 18% of the unemployed
found a job within a month, as opposed to 28% in 2007, when unemployment was
much lower.

Similarly, Figure 6-5 plots two variables against time: the unemployment rate
(measured on the left vertical axis); and the monthly separation rate from employment
(measured on the right vertical axis). The monthly separation rate is constructed by
dividing the flow from employment (to unemployment and to “out of the labor force”)
during each month by the number of employed in the month. The relation between the
separation rate and the unemployment rate plotted is quite strong: Higher unemploy-
ment implies a higher separation rate—that is, a higher chance of employed workers
losing their jobs. The probability nearly doubles between times of low unemployment
and times of high unemployment.

Let’s summarize:
When unemployment is high, workers are worse off in two ways:
■ Employed workers face a higher probability of losing their job.
■ Unemployed workers face a lower probability of finding a job; equivalently, they
can expect to remain unemployed for a longer time.

6-3 Wage Determination

Having looked at unemployment, let’s turn to wage determination, and to the relation
between wages and unemployment.

Wages are set in many ways. Sometimes they are set by collective bargaining; that is, bargaining between firms and unions. In the United States, however, collec-
tive bargaining plays a limited role, especially outside the manufacturing sector. To-
day, barely more than 10% of U.S. workers have their wages set by collective bargaining
agreements. For the rest, wages are either set by employers or by bargaining between

Collective bargaining: barg-
ing between a union (or a

group of unions) and a firm (or
a group of firms).
the employer and individual employees. The higher the skills needed to do the job, the more likely there is to be bargaining. Wages offered for entry-level jobs at McDonald’s are on a take-it-or-leave-it basis. New college graduates, on the other hand, can typically negotiate a few aspects of their contracts. CEOs and baseball stars can negotiate a lot more.

There are also large differences across countries. Collective bargaining plays an important role in Japan and in most European countries. Negotiations may take place at the firm level, at the industry level, or at the national level. Sometimes contract agreements apply only to firms that have signed the agreement. Sometimes they are automatically extended to all firms and all workers in the sector or the economy.

Given these differences across workers and across countries, can we hope to formulate anything like a general theory of wage determination? Yes. Although institutional differences influence wage determination, there are common forces at work in all countries. Two sets of facts stand out:

- Workers are typically paid a wage that exceeds their reservation wage, the wage that would make them indifferent between working or being unemployed. In other words, most workers are paid a high enough wage that they prefer being employed to being unemployed.
- Wages typically depend on labor-market conditions. The lower the unemployment rate, the higher the wages. (We shall state this more precisely in the next section.)

To think about these facts, economists have focused on two broad lines of explanation. The first is that even in the absence of collective bargaining, workers have some bargaining power, which they can and do use to obtain wages above their reservation wage. The second is that firms themselves may, for a number of reasons, want to pay wages higher than the reservation wage. Let’s look at each explanation in turn.

**Bargaining**

How much bargaining power a worker has depends on two factors. The first is how costly it would be for the firm to replace him, were he to leave the firm. The second is how hard it would be for him to find another job, were he to leave the firm. The more costly it is for the firm to replace him, and the easier it is for him to find another job, the more bargaining power he will have. This has two implications:

- How much bargaining power a worker has depends first on the nature of his job. Replacing a worker at McDonald’s is not very costly: The required skills can be taught quickly, and typically a large number of willing applicants have already filled out job application forms. In this situation, the worker is unlikely to have much bargaining power. If he asks for a higher wage, the firm can lay him off and find a replacement at minimum cost. In contrast, a highly skilled worker who knows in detail how the firm operates may be very difficult and costly to replace. This gives him more bargaining power. If he asks for a higher wage, the firm may decide that it is best to give it to him.
- How much bargaining power a worker has also depends on labor market conditions. When the unemployment rate is low, it is more difficult for firms to find acceptable replacement workers. At the same time, it is easier for workers to find other jobs. Under these conditions, workers are in a stronger bargaining position and may be able to obtain a higher wage. Conversely, when the unemployment rate is high, finding good replacement workers is easier for firms, while finding another job is harder for workers. Being in a weak bargaining position, workers may have no choice but to accept a lower wage.
In 1914, Henry Ford—the builder of the most popular car in the world at the time, the Model-T—made a stunning announcement. His company would pay all qualified employees a minimum of $5 a day for an eight-hour day. This was a very large salary increase for most employees, who had been earning an average $2.30 for a nine-hour day. From the point of view of the Ford company, this increase in pay was far from negligible—it represented about half of the company’s profits at the time.

What Ford’s motivations were is not entirely clear. Ford himself gave too many reasons for us to know which ones he actually believed. The reason was not that the company had a hard time finding workers at the previous wage. But the company clearly had a hard time retaining workers. There was a very high turnover rate, as well as high dissatisfaction among workers.

Whatever the reasons behind Ford’s decision, the results of the wage increase were astounding, as Table 1 shows:

<table>
<thead>
<tr>
<th>Turnover rate</th>
<th>1913</th>
<th>1914</th>
<th>1915</th>
</tr>
</thead>
<tbody>
<tr>
<td>Layoff rate</td>
<td>62</td>
<td>7</td>
<td>0.1</td>
</tr>
</tbody>
</table>

The annual turnover rate (the ratio of separations to employment) plunged from a high of 370% in 1913 to a low of 16% in 1915. (An annual turnover rate of 370% means that on average 31% of the company’s workers left each month, so that over the course of a year the ratio of separations to employment was 31% × 12 = 370%.) The layoff rate collapsed from 62% to nearly 0%. The average rate of absenteeism (not shown in the table), which ran at close to 10% in 1913, was down to 2.5% one year later. There is little question that higher wages were the main source of these changes.

Did productivity at the Ford plant increase enough to offset the cost of increased wages? The answer to this question is less clear. Productivity was much higher in 1914 than in 1913. Estimates of the productivity increases range from 30% to 50%. Despite higher wages, profits were also higher in 1914 than in 1913. But how much of this increase in profits was due to changes in workers’ behavior and how much was due to the increasing success of Model-T cars is harder to establish.

While the effects support efficiency wage theories, it may be that the increase in wages to $5 a day was excessive, at least from the point of view of profit maximization. But Henry Ford probably had other objectives as well, from keeping the unions out—which he did—to generating publicity for himself and the company—which he surely did.


Efficiency Wages

Regardless of workers’ bargaining power, firms may want to pay more than the reservation wage. They may want their workers to be productive, and a higher wage can help them achieve that goal. If, for example, it takes a while for workers to learn how to do a job correctly, firms will want their workers to stay for some time. But if workers are paid only their reservation wage, they will be indifferent between their staying or leaving. In this case, many of them will quit, and the turnover rate will be high. Paying a wage above the reservation wage makes it more attractive for workers to stay. It decreases turnover and increases productivity.

Behind this example lies a more general proposition: Most firms want their workers to feel good about their jobs. Feeling good promotes good work, which leads to higher productivity. Paying a high wage is one instrument the firm can use to achieve these goals. (See the Focus box “Henry Ford and Efficiency Wages.”) Economists call the theories that link the productivity or the efficiency of workers to the wage they are paid efficiency wage theories.
Like theories based on bargaining, efficiency wage theories suggest that wages depend on both the nature of the job and on labor-market conditions:

- Firms—such as high-tech firms—that see employee morale and commitment as essential to the quality of their work will pay more than firms in sectors where workers’ activities are more routine.
- Labor-market conditions will affect the wage. A low unemployment rate makes it more attractive for employed workers to quit: When unemployment is low, it is easy to find another job. That means, when unemployment decreases, a firm that wants to avoid an increase in quits will have to increase wages to induce workers to stay with the firm. When this happens, lower unemployment will again lead to higher wages. Conversely, higher unemployment will lead to lower wages.

### Wages, Prices, and Unemployment

We capture our discussion of wage determination by using the following equation:

\[ W = P^e F(u, z) \]  

(6.1)

The aggregate nominal wage \( W \) depends on three factors:

- The expected price level \( P^e \)
- The unemployment rate \( u \)
- A catchall variable \( z \) that stands for all other variables that may affect the outcome of wage setting.

Let’s look at each factor.

### The Expected Price Level

First, ignore the difference between the expected and the actual price level and ask: Why does the price level affect nominal wages? The answer: Because both workers and firms care about real wages, not nominal wages.

- Workers do not care about how many dollars they receive but about how many goods they can buy with those dollars. In other words, they do not care about the nominal wages they receive, but about the nominal wages (\( W \)) they receive relative to the price of the goods they buy (\( P \)). They care about \( W/P \).
- In the same way, firms do not care about the nominal wages they pay but about the nominal wages (\( W \)) they pay relative to the price of the goods they sell (\( P \)). So they also care about \( W/P \).

Think of it another way: If workers expect the price level—the price of the goods they buy—to double, they will ask for a doubling of their nominal wage. If firms expect the price level—the price of the goods they sell—to double, they will be willing to double the nominal wage. So, if both workers and firms expect the price level to double, they will agree to double the nominal wage, keeping the real wage constant. This is captured in equation (6.1): A doubling in the expected price level leads to a doubling of the nominal wage chosen when wages are set.

Return now to the distinction we set aside at the start of the paragraph: Why do wages depend on the expected price level, \( P^e \), rather than the actual price level, \( P \)?

Because wages are set in nominal (dollar) terms, and when they are set, the relevant price level is not yet known.
As the European Union celebrated its 30th birthday in 1988, a number of governments decided the time had come to plan a move to a common currency. They asked Jacques Delors, the President of the European Union, to prepare a report, which he presented in June 1989.

The Delors report suggested moving to a European Monetary Union (EMU) in three stages: Stage I was the abolition of capital controls. Stage II was the choice of fixed parities, to be maintained except for “exceptional circumstances.” Stage III was the adoption of a single currency.

Stage I was implemented in July 1990.

Stage II began in 1994, after the exchange rate crises of 1992–1993 had subsided. A minor but symbolic decision involved choosing the name of the new common currency. The French liked “Ecu” (European currency unit), which is also the name of an old French currency. But its partners preferred euro, and the name was adopted in 1995.

In parallel, EU countries held referendums on whether they should adopt the Maastricht treaty. The treaty, negotiated in 1991, set three main conditions for joining the EMU: low inflation, a budget deficit below 3%, and a public debt below 60%. The Maastricht treaty was not very popular and, in many countries, the outcome of the popular vote was close. In France, the treaty passed with only 51% of the votes. In Denmark, the treaty was rejected.

In 1996–1997, it looked as if few European countries would satisfy the Maastricht conditions. But a number of countries took drastic measures to reduce their budget deficit. When the time came to decide, in May 1998, which countries would be members of the Euro area, 11 countries made the cut: Austria, Belgium, Finland, France, Germany, Italy, Ireland, Luxembourg, The Netherlands, Portugal, and Spain. The United Kingdom, Denmark, and Sweden decided to stay out, at least at the beginning. Greece did not qualify initially, and didn’t join until 2001. (In 2004, it was revealed that Greece had partly “cooked the books” and understated the size of its budget deficit in order to qualify.) Since then, five more small countries, Cyprus, Malta, Slovakia, Slovenia, and Estonia, have joined.
Stage III began in January 1999. Parities between the 11 currencies and the Euro were “irrevocably” fixed. The new European Central Bank (ECB) based in Frankfurt became responsible for monetary policy for the Euro area.

From 1999 to 2002, the euro existed as a unit of account, but euro coins and bank notes did not exist. In effect, the Euro area was still functioning as an area with fixed exchange rates. The next and final step was the introduction of euro coins and bank notes in January 2002. For the first few months of 2002, national currencies and the euro then circulated side by side. Later in the year, national currencies were taken out of circulation.

Today, the euro is the only currency used in the Euro area, as the group of member countries is called. For more on the euro, go to http://www.euro.ecb.int/. The Wikipedia page on the euro is also very good.

depreciation will require many years of high unemployment and downward pressure on wages and prices in Greece and Portugal relative to the rest of the Euro area. And, at the time of writing, worries are extending beyond these two countries. While in better economic shape than Greece and Portugal, other countries, notably Spain and Italy, are also in a slump, suffering from low output and high unemployment. As members of the Euro area, they also do not have the option of a devaluation. This, in turn, is leading to worries about the ability of these countries to limit their budget deficits and to repay their debt. This fiscal crisis, which we shall study at more length in Chapter 23, is the strongest challenge faced by Euro area countries since the creation of the euro.

Hard Pegs, Currency Boards, and Dollarization

The second case for fixed exchange rates is very different from the first. It is based on the argument that there may be times when a country may want to limit its ability to use monetary policy.

Look at a country that has had very high inflation in the recent past—perhaps because it was unable to finance its budget deficit by any other means than through money creation, resulting in high money growth and high inflation. Suppose the country decides to reduce money growth and inflation. One way of convincing financial markets that it is serious about doing this is to fix its exchange rate: The need to use the money supply to maintain the parity then ties the hands of the monetary authority. To the extent that financial markets expect the parity to be maintained, they will stop worrying about money growth being used to finance the budget deficit.

Note the qualifier “To the extent that financial markets expect the parity to be maintained.” Fixing the exchange rate is not a magic solution. The country also needs to convince financial investors that, not only is the exchange rate fixed today, but it will remain fixed in the future. There are two ways in which it can do so:

- Making the fixed exchange rate be part of a more general macroeconomic package. Fixing the exchange rate while continuing to run a large budget deficit will only convince financial markets that money growth will start again and that a devaluation is soon to come.
- Making it symbolically or technically harder to change the parity, an approach known as a hard peg. An extreme form of a hard peg is simply to replace the domestic currency with a foreign currency. Because the foreign currency chosen is typically the dollar, this is known as dollarization. Few countries are willing, however, to give up their currency and adopt the currency of another country. A less extreme way is the use of a currency board. Under a currency board, a central bank stands ready to exchange

When Israel was suffering from high inflation in the 1980s, an Israeli finance minister proposed such a measure as part of a stabilization program. His proposal was perceived as an attack on the sovereignty of Israel, and he was quickly fired.
When Carlos Menem became President of Argentina in 1989, he inherited an economic mess. Inflation was running at more than 30% per month. Output growth was negative.

Menem and his economy minister, Domingo Cavallo, quickly came to the conclusion that, under these circumstances, the only way to bring money growth—and, by implication, inflation—under control was to peg the peso (Argentina’s currency) to the dollar, and to do this through a very hard peg. So, in 1991, Cavallo announced that Argentina would adopt a currency board. The central bank would stand ready to exchange pesos for dollars, on demand. Furthermore, it would do so at the highly symbolic rate of one dollar for one peso.

Both the creation of a currency board and the choice of a symbolic exchange rate had the same objective: to convince investors that the government was serious about the peg and to make it more difficult for future governments to give up the parity and devalue; and so, by making the fixed exchange rate more credible in this way, decrease the risk of a foreign exchange crisis.

For a while, the currency board appeared to work extremely well. Inflation, which had exceeded 2,300% in 1990, was down to 4% by 1994! This was clearly the result of the tight constraints the currency board put on money growth. Even more impressive, this large drop in inflation was accompanied by strong output growth. Output growth averaged 5% per year from 1991 to 1999.

Beginning in 1999, however, growth turned negative, and Argentina went into a long and deep recession. Was the recession due to the currency board? Yes and no:

- Throughout the second half of the 1990s, the dollar steadily appreciated relative to the other major world currencies. Because the peso was pegged to the dollar, the peso also appreciated. By the late 1990s, it was clear that the peso was overvalued, leading to a decrease in demand for goods from Argentina, a decline in output, and an increase in the trade deficit.

- Was the currency board fully responsible for the recession? No; there were other causes. But the currency board made it much harder to fight it. Lower interest rates and a depreciation of the peso would have helped the economy recover; but, under the currency board, this was not an option.

In 2001, the economic crisis turned into a financial and an exchange rate crisis, along the lines we described in Section 21-2:

- Because of the recession, Argentina’s fiscal deficit had increased, leading to an increase in government debt. Worried that the government might default on its debt, financial investors started asking for very high interest rates on government bonds, making the fiscal deficit even larger, and, by doing so, further increasing the risk of default.

- Worried that Argentina would abandon the currency board and devalue in order to fight the recession, investors started asking for very high interest rates in pesos, making it more costly for the government to sustain the parity with the dollar, and so making it more likely that the currency board would indeed be abandoned.

In December 2001, the government defaulted on part of its debt. In early 2002, it gave up the currency board and let the peso float. The peso sharply depreciated, reaching 3.75 pesos for 1 dollar by June 2002! People and firms that, given their earlier confidence in the peg, had borrowed in dollars found themselves with a large increase in the value of their dollar debts in terms of pesos. Many firms went bankrupt. The banking system collapsed. Despite the sharp real depreciation, which should have helped exports, GDP in Argentina fell by 11% in 2002, and unemployment increased to nearly 20%. In 2003, output growth turned positive and has been consistently high since—exceeding 8% a year—and unemployment has decreased. But it took until 2005 for GDP to reach its 1998 level again.

Does this mean that the currency board was a bad idea? Economists still disagree:

- Some economists argue that it was a good idea but that it did not go far enough. They argue that Argentina should have simply dollarized (i.e., adopted the dollar outright as its currency and eliminated the peso altogether). Eliminating the domestic currency would have eliminated the risk of a devaluation. The lesson, they argue, is that even a currency board does not provide a sufficiently hard peg for the exchange rate. Only dollarization will do.

- Other (indeed, most) economists argue that the currency board might have been a good idea at the start, but that it should not have been kept in place for so long. Once inflation was under control, Argentina should have moved from a currency board to a floating exchange rate regime. The problem is that Argentina kept the fixed parity with the dollar for too long, to the point where the peso was overvalued and an exchange rate crisis was inevitable.

The debate about “fix versus flex,” about soft pegs, hard pegs, currency boards, and common currencies is likely to go on and has taken on new importance given the fiscal problems of the euro area.

For a fascinating, fun, and strongly opinionated book about Argentina’s crisis, read Paul Blustein’s And the Money Kept Rolling In (and Out): Wall Street, the IMF, and the Bankrupting of Argentina (Public Affairs, 2005).
foreign currency for domestic currency at the official exchange rate set by the government; furthermore, the bank cannot engage in open market operations (that is, buy or sell government bonds).

Perhaps the best known example of a currency board is that adopted by Argentina in 1991 but abandoned in a crisis at the end of 2001. The story is told in the Focus box “Lessons from Argentina’s Currency Board.” Economists differ on what conclusions one should draw from what happened in Argentina. Some conclude that currency boards are not hard enough: They do not prevent exchange rate crises. So, if a country decides to adopt a fixed exchange rate, it should go all the way and dollarize. Others conclude that adopting a fixed exchange rate is a bad idea. If currency boards are used at all, they should be used only for a short period of time, until the central bank has reestablished its credibility and the country returns to a floating exchange rate regime.

Summary

- Even under a fixed exchange rate regime, countries can adjust their real exchange rate in the medium run. They can do so by relying on adjustments in the price level. Nevertheless, the adjustment can be long and painful. Exchange rate adjustments can allow the economy to adjust faster and thus reduce the pain that comes from a long adjustment.
- Exchange rate crises typically start when participants in financial markets believe a currency may soon be devalued. Defending the parity then requires very high interest rates, with potentially large adverse macroeconomic effects. These adverse effects may force the country to devalue, even if there were no initial plans for such a devaluation.
- The exchange rate today depends on both (1) the difference between current and expected future domestic interest rates, and current and expected future foreign interest rates; and (2) the expected future exchange rate.

  Any factor that increases current or expected future foreign interest rates leads to a decrease in the exchange rate today.
  Any factor that increases the expected future exchange rate leads to an increase in the exchange rate today.

  There is wide agreement among economists that flexible exchange regimes generally dominate fixed exchange rate regimes, except in two cases:
  1. When a group of countries is highly integrated and forms an optimal currency area. (You can think of a common currency for a group of countries as an extreme form of fixed exchange rates among this group of countries.) For countries to form an optimal currency area, they must either face largely similar shocks, or there must be high labor mobility across these countries.
  2. When a central bank cannot be trusted to follow a responsible monetary policy under flexible exchange rates. In this case, a strong form of fixed exchange rates, such as dollarization or a currency board, provides a way of tying the hands of the central bank.

Key Terms

gold standard, 452
float, 452
optimal currency area, 459
Maastricht treaty, 461
European Central Bank (ECB), 462
hard peg, 462
dollarization, 462
currency board, 462
Questions and Problems

QUICK CHECK
All Quick Check questions and problems are available on MyEconLab.

1. Using the information in this chapter, label each of the following statements true, false, or uncertain. Explain briefly.
   a. Britain’s return to the gold standard caused years of high unemployment.
   b. A sudden fear that a country is going to devalue may force an exchange rate crisis, even if the fear initially had no basis.
   c. Because economies tend to return to their natural level of output in the medium run, there is a never a reason to devalue.
   d. High labor mobility within Europe makes the euro area a good candidate for a common currency.
   e. Changes in the expected level of the exchange rate far in the future have little effect on the current level of the exchange rate.

2. Consider a country operating under fixed exchange rates, with aggregate demand and aggregate supply given by equations (21.1) and (21.2).

   \[ AD: Y = Y \left( \frac{E}{P^*}, G, T \right) \]
   \[ AS: P = P^*(1 + m) F(1 - \frac{Y}{L}, z) \]

   Assume that the economy is initially in medium-run equilibrium, with a constant price level and output equal to the natural level of output. Foreign output, the foreign price level, and the foreign interest rate are fixed throughout the problem. Assume that expected (domestic) inflation remains constant throughout the problem.

   a. Draw an AD–AS diagram for this economy.
   b. Now suppose there is an increase in government spending. Show the effects on the AD–AS diagram in the short run and the medium run. How do output and the price level change in the medium run?
   c. What happens to consumption in the medium run?
   d. What happens to the real exchange rate in the medium run? [Hint: Consider the effect on the price level you identified in part (b).] What happens to net exports in the medium run?
   e. Given that the exchange rate is fixed, what is the domestic nominal interest rate? Does the increase in government spending affect the domestic nominal interest rate? What happens to the real interest rate in the medium run? [Hint: Remember that expected inflation remains constant by assumption.] What happens to investment in the medium run?
   f. In a closed economy, how does an increase in government spending affect investment in the medium run? (Refer to Chapter 7 if you need a refresher.)

   g. Comment on the following statement. “In a closed economy, government spending crowds out investment. In an open economy with fixed exchange rates, government spending crowds out net exports.”

3. Nominal and real interest parity

   In equation (18.4), we wrote the nominal interest parity condition as

   \[ i_t = i^*_t - \frac{E^t_{t+1} - E_t}{E_t} \]

   In Appendix 2 to this chapter, we derive a real interest parity condition. We can rewrite the real interest parity condition in a manner analogous to equation (18.4):

   \[ r_t = r^*_t + \frac{(e^{t+1}_t - e_t)}{e_t} \]

   a. Interpret this equation. Under what circumstances will the domestic real interest rate exceed the foreign real interest rate?

   b. What is the expected nominal depreciation of the domestic currency over the coming year?

   c. What is the expected real depreciation over the coming year?

   d. If you expected a nominal appreciation of the currency over the coming year, should you hold domestic or foreign bonds?

4. Devaluation and interest rates

   Consider an open economy with a fixed exchange rate, \( \bar{E} \). Throughout the problem, assume that the foreign interest rate, \( i^* \), remains constant.

   a. Suppose that financial market participants believe that the government is committed to a fixed exchange rate. What is the expected exchange rate? According to the interest parity condition, what is the domestic interest rate?

   b. Suppose that financial market participants do not believe that the government is committed to a fixed exchange rate. Instead, they suspect that the government will either devalue or abandon the fixed exchange rate altogether and adopt a flexible exchange rate. If the government adopts a flexible exchange rate, financial market participants expect the exchange rate to depreciate from its current fixed value, \( \bar{E} \). Under these circumstances, how does the expected exchange rate compare to \( \bar{E} \)? How does the domestic interest rate compare to \( i^* \)?

   c. Suppose that financial market participants feared a devaluation, as in part (b), and a devaluation actually occurs. The government announces that it will maintain a fixed exchange rate regime but changes the level of the fixed exchange rate to \( \bar{E}' \), where \( \bar{E}' < \bar{E} \). Suppose that financial market participants believe that the government will remain committed to the new exchange rate, \( \bar{E}' \), and that
there will be no further devaluations. What happens to the domestic interest rate after the devaluation?

d. Does a devaluation necessarily lead to higher domestic interest rates? Does fear of a devaluation necessarily lead to higher domestic interest rates?

DIG DEEPER
All Dig Deeper questions and problems are available on MyEconLab.

5. Exchange rate overshooting

a. Suppose there is a permanent 10% increase in $M$ in a closed economy. What is the effect on the price level in the medium run? (Hint: If you need a refresher, review the analysis in Chapter 7.)

In a closed economy, we said that money was neutral because in the medium run, a change in the money stock affects only the price level. A change in the money stock did not affect any real variables. A change in the money stock is also neutral in an open economy with flexible exchange rates. In the medium run, a change in the money stock will not affect the real exchange rate, although it will affect the price level and the nominal exchange rate.

b. Consider an open economy with a flexible exchange rate. Write the expression for the real exchange rate. Suppose there is a 10% increase in the money stock and assume that it has the same effect on the price level in the medium run that you found in part (a). If the real exchange rate and the foreign price level are unchanged in the medium run, what must happen to the nominal exchange rate in the medium run?

c. Suppose it takes $n$ years to reach the medium run (and everyone knows this). Given your answer to part (b), what happens to $E_{t+n}^r$ (the expected exchange rate for $n$ periods from now) after a 10% increase in the money stock?

d. Consider equation (21.5). Assume that the foreign interest rate is unchanged for the next $n$ periods. Also assume, for the moment, that the domestic interest rate is unchanged for the next $n$ periods. Given your answer to part (c), what happens to the exchange rate today (at time $t$) when there is a 10% increase in the money stock?

e. Now assume that after the increase in the money stock, the domestic interest rate decreases between time $t$ and time $t+n$. Again assume that the foreign interest rate is unchanged. As compared to your answer to part (d), what happens to the exchange rate today (at time $t$)? Does the exchange rate move more in the short run than in the medium run?

The answer to part (e) is yes. In this case, the short-run depreciation is greater than the medium-run depreciation. This phenomenon is called overshooting and may help to explain why the exchange rate is so variable.

6. Self-fulfilling exchange rate crises

Consider an open economy with a fixed exchange rate, $E$. Suppose that, initially, financial market participants believe that the government is committed to the fixed exchange rate. Suddenly, however, financial market participants become fearful that the government will devalue or allow the exchange rate to float (a decision that everyone believes will cause the currency to depreciate).

a. What will happen to the expected exchange rate, $E_{t+1}^e$? (See your answer to Problem 4(b)).

Suppose that, despite the change in the expected exchange rate, the government keeps the exchange rate fixed today. Let UIP stand for the uncovered interest parity condition.

b. Draw an IS–LM–UIP diagram. How does the change in the expected exchange rate affect the UIP curve? As a result, how must the domestic interest rate change to maintain an exchange rate of $E$?

c. Given your answer to part (b), what happens to the domestic money supply if the central bank defends the fixed exchange rate? How does the LM curve shift?

d. What happens to domestic output and the domestic interest rate? Is it possible that a government that was previously committed to a fixed exchange rate might abandon it when faced with a fear of depreciation (either through devaluation or abandonment of the fixed exchange rate regime)? Is it possible that unfounded fears about a depreciation can create a crisis? Explain your answers.

7. Devaluation and credibility

Consider an open economy with a fixed exchange rate, $E$. Suppose that, initially, financial market participants believe that the government is committed to maintaining the fixed exchange rate. Let UIP stand for the uncovered interest parity condition.

Now suppose the central bank announces a devaluation. The exchange rate will remain fixed, but at a new level, $E'$, such that $E' < E$. Suppose that financial market participants believe that there will be no further devaluations and that the government will remain committed to maintaining the exchange rate at $E'$.

a. What is the domestic interest rate before the devaluation? If the devaluation is credible, what is the domestic interest rate after the devaluation? (See your answers to Problem 4.)

b. Draw an IS–LM–UIP diagram for this economy. If the devaluation is credible, how does the expected exchange rate change? How does the change in the expected exchange rate affect the UIP curve?

c. How does the devaluation affect the IS curve? Given your answer to part (b) and the shift of the IS curve, what would happen to the domestic interest rate if there is no change in the domestic money supply?

d. Given your answer to part (c), what must happen to the domestic money supply so that the domestic interest rate achieves the value you identified in part (a)? How does the LM curve shift?

e. How is domestic output affected by the devaluation?

f. Suppose that devaluation is not credible in the sense that the devaluation leads financial market participants to expect another devaluation in the future. How does the fear of further devaluation affect the expected exchange rate? How will the expected exchange rate in this case, where devaluation is not credible, compare to your answer to part (b)? Explain in words. Given this effect on the expected exchange rate, what must happen to the domestic
interest rate, as compared to your answer to part (a), to maintain the new fixed exchange rate?

EXPLORE FURTHER
8. Exchange rates and expectations

In this chapter, we emphasized that expectations have an important effect on the exchange rate. In this problem, we use data to get a sense of how large a role expectations play. Using the results in Appendix 2 at the end of the book, you can show that the uncovered interest parity condition, equation (21.4), can be rewritten as

\[
\frac{(E_t - E_{t-1})}{E_{t-1}} = (i_t - \bar{i}_t) - (\bar{i}_{t-1} - i_{t-1}) + \left(\frac{E_t^e - E_{t-1}^e}{E_{t-1}^e}\right)
\]

In words, the percentage change in the exchange rate (the appreciation of the domestic currency) is approximately equal to the change in the interest rate differential (between domestic and foreign interest rates) plus the percentage change in exchange rate expectations (the appreciation of the expected domestic currency value). We shall call the interest rate differential the spread.

a. Go to the web site of the Bank of Canada (www.bank-banque-canada.ca) and obtain data on the monthly one-year Treasury bill rate in Canada for the past 10 years. Download the data into a spreadsheet. Now go to the web site of the Federal Reserve Bank of St. Louis (research.stlouisfed.org/fred2) and download data on the monthly U.S. one-year Treasury bill rate for the same time period. (You may need to look under “Constant Maturity” Treasury securities rather than “Treasury Bills.”) For each month, subtract the Canadian interest rate from the U.S. interest rate to calculate the spread. Then, for each month, calculate the change in the spread from the preceding month. (Make sure to convert the interest rate data into the proper decimal form.)

b. At the web site of the St. Louis Fed, obtain data on the monthly exchange rate between the U.S. dollar and the Canadian dollar for the same period as your data from part (a). Again, download the data into a spreadsheet. Calculate the percentage appreciation of the U.S. dollar for each month. Using the standard deviation function in your software, calculate the standard deviation of the monthly appreciation of the U.S. dollar. The standard deviation is a measure of the variability of a data series.

c. For each month, subtract the change in the spread [part (a)] from the percentage appreciation of the dollar [part (b)]. Call this difference the change in expectations. Calculate the standard deviation of the change in expectations. How does it compare to the standard deviation of the monthly appreciation of the dollar?

There are some complications we do not take into account here. Our interest parity condition does not include a variable that measures relative asset demand. We have explored the implications of changes in relative asset demands in Problem 7 at the end of Chapter 20. In addition, changes in interest rates and expectations may be related. Still, the gist of this analysis survives in more sophisticated work. In the short run, observable economic fundamentals do not account for much of the change in the exchange rate. Much of the difference must be attributed to changing expectations.

Further Readings

To get a sense of the problems of adjustment under a common currency, read Olivier Blanchard, “Adjustment within the Euro. The Difficult Case of Portugal,” http://economics.mit.edu/files/740


APPENDIX 1: Deriving Aggregate Demand under Fixed Exchange Rates

To derive the aggregate demand for goods, start from the condition for goods market equilibrium we derived in Chapter 20, equation (20.1):

\[Y = C(Y - T) + I(Y, r) + G + NX(Y, Y^*, \epsilon)\]

This condition states that, for the goods market to be in equilibrium, output must be equal to the demand for domestic goods—that is, the sum of consumption, investment, government spending, and net exports.

Next, recall the following relations:

- The real interest rate, \(r\), is equal to the nominal interest rate, \(i\), minus expected inflation, \(\pi^e\) (see Chapter 14):
  \[r = i - \pi^e\]

- The real exchange rate, \(\epsilon\), is defined as (see Chapter 18):
  \[\epsilon = \frac{E_P}{P^*}\]
Under fixed exchange rates, the nominal exchange rate, $E$, is, by definition, fixed. Denote by $\bar{E}$ the value at which the nominal exchange rate is fixed, so:

$$E = \bar{E}$$

Under fixed exchange rates and perfect capital mobility, the domestic interest rate, $i$, must be equal to the foreign interest rate, $i^*$ (see Chapter 18):

$$i = i^*$$

Using these four relations, rewrite equation (21.1) as:

$$Y = C(Y - T) + I(Y, i^* - \pi^e) + G + NX\left(Y, Y^*, \frac{\bar{E}P}{P^*}\right)$$

This is a rich—and complicated—equilibrium condition. It tells us that, in an open economy with fixed exchange rates, equilibrium output (or, more precisely, the level of output implied by equilibrium in the goods, financial, and foreign exchange markets) depends on:

- Government spending, $G$, and taxes, $T$. An increase in government spending increases output. So does a decrease in taxes.
- The foreign nominal interest rate, $i^*$, minus expected inflation, $\pi^e$. An increase in the foreign nominal interest rate requires a parallel increase in the domestic nominal interest rate. Given expected inflation, this increase in the domestic nominal interest rate leads to an increase in the domestic real interest rate, and so to lower demand and lower output.
- Foreign output, $Y^*$. An increase in foreign output increases exports, so increases net exports. The increase in net exports increases domestic output.
- The real exchange rate, $\epsilon$, is equal to the fixed nominal exchange rate, $E$, times the domestic price level, $P$, divided by the foreign price level, $P^*$. A decrease in the real exchange rate—equivalently, a real depreciation—leads to an increase in net exports, and so an increase in output.

We focused in this chapter on the effects of only three of these variables: the real exchange rate, government spending, and taxes. We shall therefore write:

$$Y = Y\left(\frac{\bar{E}P}{P^*}, G, T\right)$$

All the other variables that affect demand are taken as given and, to simplify notation, are simply omitted from the relation. This gives us equation (21.1) in the text.

Equation (21.1) gives us the aggregate demand relation, the relation between output and the price level implied by equilibrium in the goods market and in financial markets.

Note that, in the closed economy, we had to use both the IS and the LM relations to derive the aggregate demand relation. Under fixed exchange rates, we do not need the LM relation. The reason is that the nominal interest rate, rather than being determined jointly by the IS and LM relations, is determined by the foreign interest rate. (The LM relation still holds, but, as we saw in Chapter 20, it simply determines the money stock.)

**APPENDIX 2: The Real Exchange Rate and Domestic and Foreign Real Interest Rates**

We derived in Section 21-3 a relation among the current nominal exchange rate, current and expected future domestic and foreign nominal interest rates, and the expected future nominal exchange rate (equation (21.5)). This appendix derives a similar relation, but in terms of real interest rates and the real exchange rate. It then briefly discusses how this alternative relation can be used to think about movements in the real exchange rate.

**Deriving the Real Interest Parity Condition**

Start from the nominal interest parity condition, equation (19.2):

$$(1 + i_t) = (1 + i^*_t)\frac{E_t}{E_{t+1}^*}$$

Recall the definition of the real interest rate from Chapter 14, equation (14.3):

$$(1 + r_t) = \frac{(1 + i_t)}{(1 + \pi^e_{t+1})}$$

where $\pi^e_{t+1} = (P^e_{t+1} - P_t)/P_t$ is the expected rate of inflation. Similarly, the foreign real interest rate is given by:

$$(1 + r^*_t) = \frac{(1 + i^*_t)}{(1 + \pi^e_{t+1})}$$

where $\pi^e_{t+1} = (P^e_{t+1} - P^*_t)/P^*_t$ is the expected foreign rate of inflation.

Use these two relations to eliminate nominal interest rates in the interest parity condition, so:

$$(1 + r_t) = (1 + r^*_t) \left[ \frac{E_t}{E_{t+1}^*} \frac{(1 + \pi^e_{t+1})}{(1 + \pi^e_{t+1})} \right] (21.61)$$

Note from the definition of inflation that $(1 + \pi^e_{t+1}) = P^e_{t+1}/P_t$ and, similarly, $(1 + \pi^e_{t+1}) = P^e_{t+1}/P^*_t$.

Using these two relations in the term in brackets gives:

$$\frac{E_t}{E_{t+1}^*} \frac{(1 + \pi^e_{t+1})}{(1 + \pi^e_{t+1})} = \frac{E_t P^e_{t+1}}{E_{t+1}^* P^*_t}$$

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Reorganizing terms:

\[
\frac{E_t P_t^*}{E_{t+1}^* P_{t+1}^*} = \frac{E_t P_t / P_t^*}{E_{t+1}^* P_{t+1} / P_{t+1}^*}
\]

Using the definition of the real exchange rate:

\[
\frac{E_t P_t / P_t^*}{E_{t+1}^* P_{t+1} / P_{t+1}^*} = \frac{\epsilon_t}{\epsilon_{t+1}}
\]

Replacing in equation (21.A1) gives:

\[
(1 + r_t) = (1 + r_t^*) \frac{\epsilon_t}{\epsilon_{t+1}}
\]

or, equivalently,

\[
\epsilon_t = \frac{1 + r_t}{1 + r_t^*} \epsilon_{t+1} \tag{21.A2}
\]

The real exchange rate today depends on the domestic and foreign real interest rates this year and the expected future real exchange rate next year. This equation corresponds to equation (21.4) in the text, but now in terms of the real rather than nominal exchange and interest rates.

**Solving the Real Interest Parity Condition Forward**

The next step is to solve equation (21.A2) forward, in the same way as we did it for equation (21.4). The equation above implies that the real exchange rate in year \(t + 1\) is given by:

\[
\epsilon_{t+1} = \frac{1 + r_{t+1}^e}{1 + r_{t+1}^*} \epsilon_{t+2}
\]

Taking expectations, as of year \(t\):

\[
\epsilon_{t+1} = \frac{1 + r_{t+1}^e}{1 + r_{t+1}^*} \epsilon_{t+2}
\]

Replacing in the previous relation:

\[
\epsilon_t = \frac{(1 + r_t)(1 + r_{t+1}^e)}{(1 + r_t^*)(1 + r_{t+1}^*)} \epsilon_{t+2}
\]

Solving for \(\epsilon_{t+2}^e\) and so on gives:

\[
\epsilon_t = \frac{(1 + r_t)(1 + r_{t+1}^e) \cdots (1 + r_{t+n}^e)}{(1 + r_t^*)(1 + r_{t+1}^*) \cdots (1 + r_{t+n}^*)} \epsilon_{t+n+1}
\]

This relation gives the current real exchange rate as a function of current and expected future domestic real interest rates, current and expected future foreign real interest rates, and of the expected real exchange rate in year \(t + n\).

The advantage of this relation over the relation we derived in the text between the nominal exchange rate and nominal interest rates, equation (21.5), is that it is typically easier to predict the future real exchange rate than to predict the future nominal exchange rate. If, for example, the economy suffers from a large trade deficit, we can be fairly confident that there will have to be a real depreciation—that \(\epsilon_{t+n}^e\) will have to be lower. Whether there will be a nominal depreciation—what happens to \(E \epsilon_{t+n}\)—is harder to tell: It depends on what happens to inflation, both at home and abroad over the next \(n\) years.
Chapter 22

Chapter 22 asks two questions: Given the uncertainty about the effects of macroeconomic policies, wouldn’t it be better not to use policy at all? And, even if policy can in principle be useful, can we trust policy makers to carry out the right policy? The bottom line: Uncertainty limits the role of policy. Policy makers do not always do the right thing. But, with the right institutions, policy can help and should be used.

Chapter 23

Chapter 23 looks at fiscal policy. It reviews what we have learned, chapter by chapter, and then looks more closely at the implications of the government budget constraint for the relation between debt, spending, and taxes. It then focuses on the implications and the dangers of high levels of public debt, a central issue in advanced countries today.

Chapter 24

Chapter 24 looks at monetary policy. It reviews what we have learned, chapter by chapter, and then focuses on three issues. First, the optimal rate of inflation: High inflation is bad, but how low a rate of inflation should the central bank aim for? Second, the best design policy: Should the central bank target money growth, or should it target inflation? What rule should the central bank use to adjust the interest rate? Third, the two particular challenges to monetary policy raised by the crisis: How to deal with the liquidity trap and how to best use macroprudential tools.
t many points in this book, we saw how the right mix of fiscal policy and monetary policies could potentially help a country out of a recession, improve its trade position without increasing activity and igniting inflation, slow down an overheating economy, stimulate investment and capital accumulation, and so on.

This conclusion, however, appears to be at odds with frequent demands that policy makers be tightly restrained:

In the United States, there are regular calls for the introduction of a balanced-budget amendment to the Constitution. Such a call was the first item in the “Contract with America,” the program drawn by Republicans for the mid–term U.S. elections in 1994, and reproduced in Figure 22-1. It has regularly resurfaced, most recently in July 2011, when it was proposed by a group of Republicans with close ties to the Tea Party. In Europe, the countries that adopted the euro signed a “Stability and Growth Pact,” which required them to keep their budget deficit under 3% of GDP or else face large fines. As we shall see, that pact eventually failed, but the Europeans are now exploring ways of making it stronger.

Monetary policy is also under fire. For example, the charter of the central bank of New Zealand, written in 1989, defines monetary policy’s role as the maintenance of price stability, to the exclusion of any other macroeconomic goal. In the summer of 2011, Governor Rick Perry of Texas, running for the Republican presidential nomination, declared, “If this guy [Fed Chair Ben Bernanke] prints more money between now and the election, I dunno what y’all would do to him in Iowa but we would treat him pretty ugly down in Texas. Printing more money to play politics at this particular time in American history is almost treacherous—or treasonous in my opinion.” Rick Perry, and a number of other Republicans, want the Fed Chair to be bound by rules, to have much less discretion.

This chapter looks at the case for such restraints on macroeconomic policy.

Sections 22-1 and 22-2 look at one line of argument, namely that policy makers may have good intentions, but they end up doing more harm than good.

Section 22-3 looks at another—more cynical—line, that policy makers do what is best for themselves, which is not necessarily what is best for the country.
22-1 Uncertainty and Policy

A blunt way of stating the first argument in favor of policy restraints is that those who know little should do little. The argument has two parts: Macroeconomists, and by implication the policy makers who rely on their advice, know little; and they should therefore do little. Let’s look at each part separately.

How Much Do Macroeconomists Actually Know?

Macroeconomists are like doctors treating cancer. They know a lot, but there is a lot they don’t know.

Take an economy with high unemployment, where the central bank is considering the use of monetary policy to increase economic activity. Assume that it has room to decrease the interest rate; in other words, leave aside the even more difficult issue of what to do if the economy is in the liquidity trap. Think of the sequence of links between a reduction in the interest rate that the central bank controls and an increase in output—all the questions the central bank faces when deciding whether, and by how much, to reduce the interest rate:

- Is the current high rate of unemployment above the natural rate of unemployment, or has the natural rate of unemployment itself increased (Chapter 6)?
- If the unemployment rate is close to the natural rate of unemployment, is there a significant risk that an interest rate reduction through monetary expansion will...
lead to a decrease in unemployment below the natural rate of unemployment and cause an increase in inflation (Chapter 8)?

- What will be the effect of the decrease in the short-term interest rate on the long-term interest rate (Chapter 15)? By how much will stock prices increase (Chapter 15)? By how much will the currency depreciate (Chapters 21 and 22)?

- How long will it take for lower long-term interest rates and higher stock prices to affect investment and consumption spending (Chapter 16)? How long will it take for the J-curve effects to work themselves out and for the trade balance to improve (Chapter 19)? What is the danger that the effects come too late, when the economy has already recovered?

When assessing these questions, central banks—or macroeconomic policy makers in general—do not operate in a vacuum. They rely, in particular, on macroeconometric models. The equations in these models show how these individual links have looked in the past. But different models yield different answers. This is because they have different structures, different lists of equations, and different lists of variables.

Figure 22-2 shows an example of this diversity. This example comes from a study commissioned by the Brookings Institution—a research institute in Washington, D.C.—asking the builders of the 12 main macroeconometric models to answer a similar set of questions. (The models are described in the Focus box “Twelve Macroeconometric Models.”) The goal of the study was to see how the answers would differ across models. One question was:

“Consider a case where the U.S. economy is growing at its normal growth rate, and where unemployment is at its natural rate; call this the baseline case. Suppose now that over the period of a year, the Fed increases money faster than in the baseline, so that after a year, nominal money is 4% higher than it would have been in the baseline case. From then on, nominal money grows at the same rate as in the baseline case, so the level of nominal money remains 4% higher than it would have been without the change in monetary policy. Suppose further that interest rates in the rest of the world remain unchanged. What will happen to U.S. output?”

Figure 22-2 shows the response of output to a monetary expansion. Predictions from 12 Models

Although all 12 models predict that output will increase for some time in response to a monetary expansion, the range of answers regarding the size and the length of the output response is large.
Twelve Macroeconometric Models

The Brookings study described in the text was carried out in the late 1980s (to my knowledge, this is the last time such a systematic comparison of a large class of models was made for the United States), so some of the models used in the study are no longer in use; others have changed names. The typology presented in the box remains relevant, however, and reflects the different approaches to modeling that are followed today.

- Two models, DRI (Data Resources Incorporated) and WHARTON, were commercial models. Commercial models are used to generate and sell economic forecasts to firms and financial institutions.

- Five were used to forecast and help design policy. MCM (for MultiCountry Model) was used by the Federal Reserve Board in Washington for the conduct of monetary policy; INTERLINK was used by the OECD in Paris; COMPACT was used by the Commission of the European Union in Brussels; EPA was used by the Japanese Planning Agency. Each of these four models was constructed by one team of researchers doing all the work, that is, building submodels for countries or groups of countries and linking them through trade and financial flows. In contrast, the fifth model, LINK, was composed of individual country models—models constructed in each country by researchers from that country and then linked together by trade and financial relations. The advantage of this approach is that researchers from a particular country are likely to understand that country very well; the disadvantage is that different country models may have quite different structures and may be hard to link to each other.

- Four models incorporated rational expectations explicitly: the LIVERPOOL model, based in England; MINIMOD, used at the International Monetary Fund; MSG, developed by Warwick McKibbin and Jeffrey Sachs at Harvard University; and the TAYLOR model—which we saw in Section 7-4—developed by John Taylor of Stanford University. Because it is technically difficult to solve for large models under rational expectations, these models are typically smaller models, with less detail than those listed above. But they are better at capturing the expectation effects of various policies. Thanks to more and more powerful computers, researchers are building larger and larger models with rational expectations. The modern versions of these models are called dynamic stochastic general equilibrium—or DSGE models—and are the subject of active research (more on them in Chapter 25).

- The last model, VAR (for Vector AutoRegression, the technique of estimation used to build the model), developed by Christopher Sims and Robert Litterman at the University of Minnesota, was very different from the others (Sims was awarded the Nobel Prize for his work on VARs in 2011). VAR models are not structural models but rather statistical summaries of the relations between the different variables, without an explicit economic interpretation. Their strength is in their fit of the data, with a minimum of theoretical restrictions. Their weakness is that they are, essentially, a (very big) black box.

A description of the models and of the study is given in Ralph Bryant et al., Empirical Macroeconomics for Interdependent Economies (Brookings Institution, 1988). The study shows the effects not only of monetary policy but also of fiscal policy.

A more recent study, but one that looks only at DSGE models, is given by Gunter Coenen et al., Effects of Fiscal Stimulus in Structural Models, in the American Economic Journal Macroeconomics, 2012 4(1): pp. 22–68.


Figure 22-2 shows the deviation of output from the baseline predicted by each of the 12 models. All 12 models predict that output increases for some time after the increase in money. After one year, the average deviation of output from the baseline is positive. But the range of answers is large, from nearly no change to close to an increase of 3%; even leaving out the most extreme prediction, the range is still more than 1%. Two years out, the average deviation is 1.2%; again leaving out the most extreme prediction, the range is still 2%. And six years out, the average deviation is 0.6%, and the answers range from −0.3% to 2.5%. In short, if we measure uncertainty by the range of answers from this set of models, there is indeed substantial uncertainty about the effects of policy.
Should Uncertainty Lead Policy Makers to Do Less?

Should uncertainty about the effects of policy lead policy makers to do less? In general, the answer is: yes. Consider the following example, which builds on the simulations we have just looked at.

Suppose the U.S. economy is in recession. The unemployment rate is 7% and the Fed is considering using monetary policy to expand output. To concentrate on uncertainty about the effects of policy, let’s assume the Fed knows, with certainty, everything else. Based on its forecasts, it knows that, absent changes in monetary policy, unemployment will still be 7% next year. It knows that the natural rate of unemployment is 5%, and therefore it knows that the unemployment rate is 2% above the natural rate. And it knows, from Okun’s law, that 1% more output growth for a year leads to a 0.4% reduction in the unemployment rate.

Under these assumptions, the Fed knows that if it could use monetary policy to achieve 5% more output growth over the coming year, the unemployment rate a year from now would be lower by 0.4 times 5% = 2%, so would be down to the natural rate of unemployment, 5%. By how much should the Fed increase the money supply?

Taking the average of the responses from the different models in Figure 22-2, an increase in the money supply of 4% leads to a 0.85% increase in output in the first year. Equivalently, a 1% increase in the money supply leads to a $0.85/4 = 0.21\%$ increase in output.

Suppose the Fed takes this average relation as holding with certainty. What it should then do is straightforward. To return the unemployment rate to the natural rate in one year requires 5% more output growth. And 5% output growth requires the Fed to increase the supply of money by $5%/0.21 = 23.8\%$. The Fed should therefore increase the supply of money by 23.8%. If the economy’s response is equal to the average response from the 12 models, this increase in money will return the economy to the natural rate of unemployment at the end of the year.

Suppose the Fed actually increases money by 23.8%. But let’s now take into account uncertainty, as measured by the range of responses of the different models in Figure 22-2. Recall that the range of responses of output to a 4% increase in money after one year varies from 0 to 3%; equivalently, a 1% increase in money leads to a range of increases in output from 0 to 0.75%. These ranges imply that an increase in money of 23.8% leads, across models, to an output response anywhere between 0% and 17.9% (23.8% $\times$ 0.75). These output numbers imply, in turn, a decrease in unemployment anywhere between 0% and 7%. Put another way, the unemployment rate a year hence could be anywhere between 7% and 0%!

The conclusion is clear: Given the range of uncertainty about the effects of monetary policy on output, increasing the money supply by 23.8% would be irresponsible. If the effects of money on output are as strong as suggested by one of the 12 models, unemployment by the end of the year could be 5% below the natural rate of unemployment, leading to enormous inflationary pressures. Given this uncertainty, the Fed should increase money by much less than 23.8%. For example, increasing money by 10% leads to a range for unemployment a year hence of 7% to 4%, clearly a safer range of outcomes.

Uncertainty and Restraints on Policy Makers

Let’s summarize: There is substantial uncertainty about the effects of macroeconomic policies. This uncertainty should lead policy makers to be more cautious and to use less active policies. Policies should be broadly aimed at avoiding large prolonged recessions, slowing down booms, and avoiding inflationary pressure. The higher
unemployment or the higher inflation, the more active the policies should be. But they should stop well short of **fine tuning**, of trying to achieve constant unemployment or constant output growth.

These conclusions would have been controversial 20 years ago. Back then, there was a heated debate between two groups of economists. One group, headed by Milton Friedman from Chicago, argued that because of long and variable lags, activist policy is likely to do more harm than good. The other group, headed by Franco Modigliani from MIT, had just built the first generation of large macroeconomic models and believed that economists’ knowledge was becoming good enough to allow for and increasingly **fine tuning** of the economy. Today, most economists recognize there is substantial uncertainty about the effects of policy. They also accept the implication that this uncertainty should lead to less active policies.

Note, however, that what we have developed so far is an argument for **self-restraint** by policy makers, not for **restraints on** policy makers. If policy makers understand the implications of uncertainty—and there is no particular reason to think they don’t—they will, on their own, follow less active policies. There is no reason to impose further restraints, such as the requirement that money growth be constant or that the budget be balanced. Let’s now turn to arguments for **restraints on** policy makers.

## 22-2 Expectations and Policy

One of the reasons why the effects of macroeconomic policy are uncertain is the interaction of policy and expectations. How a policy works, and sometimes whether it works at all, depends not only on how it affects current variables but also on how it affects expectations about the future (this was the main theme of Chapter 17). The importance of expectations for policy goes, however, beyond uncertainty about the effects of policy. This brings us to a discussion of **games**:

Until 30 years ago, macroeconomic policy was seen in the same way as the control of a complicated machine. Methods of **optimal control**, developed initially to control and guide rockets, were being increasingly used to design macroeconomic policy. Economists no longer think this way. It has become clear that the economy is fundamentally different from a machine, even from a very complicated one. Unlike a machine, the economy is composed of people and firms who try to anticipate what policy makers will do, and who react not only to current policy but also to expectations of future policy. Hence, macroeconomic policy must be thought of as a **game** between the policy makers and “the economy”—more concretely, the people and the firms in the economy. So, when thinking about policy, what we need is not **optimal control theory** but rather **game theory**.

Warning: When economists say “game,” they do not mean “entertainment”; they mean **strategic interactions** between **players**. In the context of macroeconomic policy, the players are the policy maker on one side and people and firms on the other. The strategic interactions are clear: What people and firms do depends on what they expect policy makers to do. In turn, what policy makers do depends on what is happening in the economy.

Game theory has given economists many insights, often explaining how some apparently strange behavior makes sense when one understands the nature of the game being played. One of these insights is particularly important for our discussion of restraints here: Sometimes you can do better in a game by giving up some of your options. To see why, let’s start with an example from outside economics—governments’ policies toward hostage takers.
Hostage Takings and Negotiations

Most governments have a stated policy that they will not negotiate with hostage takers. The reason for this stated policy is clear: to deter hostage taking by making it unattractive to take hostages.

Suppose, despite the stated policy, someone is taken hostage. Now that the hostage taking has taken place anyway, why not negotiate? Whatever compensation the hostage takers demand is likely to be less costly than the alternative—the likelihood that the hostage will be killed. So the best policy would appear to be: Announce that you will not negotiate, but if somebody is taken hostage, negotiate.

Upon reflection, it is clear this would in fact be a very bad policy. Hostage takers' decisions do not depend on the stated policy, but on what they expect will actually happen if they take a hostage. If they know that negotiations will actually take place, they will rightly consider the stated policy as irrelevant. And hostage takings will take place.

So what is the best policy? Despite the fact that once hostage takings have taken place negotiations typically lead to a better outcome, the best policy is for governments to commit not to negotiate. By giving up the option to negotiate, they are likely to prevent hostage takings in the first place.

Let's now turn to a macroeconomic example based on the relation between inflation and unemployment. As you will see, exactly the same logic is involved.

Inflation and Unemployment Revisited

Recall the relation between inflation and unemployment we derived in Chapter 8 (equation (8.9), with the time indexes omitted for simplicity):

$$\pi = \pi^e - \alpha(u - u_n)$$

(22.1)

Inflation $\pi$ depends on expected inflation $\pi^e$, and on the difference between the actual unemployment rate $u$ and the natural unemployment rate $u_n$. The coefficient $\alpha$ captures the effect of unemployment on inflation, given expected inflation: When unemployment is above the natural rate, inflation is lower than expected; when unemployment is below the natural rate, inflation is higher than expected.

Suppose the Fed announces it will follow a monetary policy consistent with zero inflation. On the assumption that people believe the announcement, expected inflation $(\pi^e)$ as embodied in wage contracts is equal to zero, and the Fed faces the following relation between unemployment and inflation:

$$\pi = -\alpha(u - u_n)$$

(22.2)

If the Fed follows through with its announced policy, it will choose an unemployment rate equal to the natural rate; from equation (22.2), inflation will be equal to zero, just as the Fed announced and people expected.

Achieving zero inflation and an unemployment rate equal to the natural rate is not a bad outcome. But it would seem the Fed can actually do even better:

- Recall from Chapter 8 that in the United States, $\alpha$ is roughly equal to 0.5. So equation (22.2) implies that, by accepting just 1% inflation, the Fed can achieve an unemployment rate of 2% below the natural rate of unemployment. Suppose the Fed—and everyone else in the economy—finds the trade-off attractive and decides to decrease unemployment by 2% in exchange for an inflation rate of 1%. This incentive to deviate from the announced policy once the other player has made his move—in this case, once wage setters have set the wage—is known in game theory as the time inconsistency of optimal policy. In our example, the Fed...
can improve the outcome this period by deviating from its announced policy of zero inflation: By accepting some inflation, it can achieve a substantial reduction in unemployment.

Unfortunately, this is not the end of the story. Seeing that the Fed has increased money growth by more than it announced it would, wage setters are likely to smarten up and begin to expect positive inflation of 1%. If the Fed still wants to achieve an unemployment rate 2% below the natural rate, it will now have to accept 2% inflation. However, if it does achieve 2% inflation, wage setters are likely to increase their expectations of inflation further, and so on.

The eventual outcome is likely to be high inflation. Because wage setters understand the Fed’s motives, expected inflation catches up with actual inflation, and the Fed will eventually be unsuccessful in its attempt to achieve an unemployment rate below the natural rate. In short, attempts by the Fed to make things better lead in the end to things being worse. The economy ends up with the same unemployment rate that would have prevailed if the Fed had followed its announced policy, but with much higher inflation.

How relevant is this example? Very relevant. Go back to Chapter 8: We can read the history of the Phillips curve and the increase in inflation in the 1970s as coming precisely from the Fed’s attempts to keep unemployment below the natural rate of unemployment, leading to higher and higher expected inflation, and higher and higher actual inflation. In that light, the shift of the original Phillips curve can be seen as the adjustment of wage setters’ expectations to the central bank’s behavior.

So what is the best policy for the Fed to follow in this case? It is to make a credible commitment that it will not try to decrease unemployment below the natural rate. By giving up the option of deviating from its announced policy, the Fed can achieve unemployment equal to the natural rate of unemployment and zero inflation. The analogy with the hostage-taking example is clear: By credibly committing not to do something that would appear desirable at the time, policy makers can achieve a better outcome: no hostage takings in our earlier example, no inflation here.

Establishing Credibility

How can a central bank credibly commit not to deviate from its announced policy?

One way to establish its credibility is for the central bank to give up—or to be stripped by law of—its policy-making power. For example, the mandate of the central bank can be defined by law in terms of a simple rule, such as setting money growth at 0% forever. (An alternative, which we discussed in Chapter 21, is to adopt a hard peg, such as a currency board or even dollarization: In this case, instead of giving up its ability to use money growth, the central bank gives up its ability to use the exchange rate and the interest rate.)

Such a law surely takes care of the problem of time inconsistency. But the tight restraint it creates comes close to throwing the baby out with the bath water. We want to prevent the central bank from pursuing too high a rate of money growth in an attempt to lower unemployment below the natural unemployment rate. But—subject to the restrictions discussed in Section 22-1—we still want the central bank to be able to expand the money supply when unemployment is far above the natural rate, and contract the money supply when unemployment is far below the natural rate. Such actions become impossible under a constant-money-growth rule. There are indeed better ways to deal with time inconsistency. In the case of monetary policy, our discussion suggests various ways of dealing with the problem.
A first step is to make the central bank independent. By an independent central bank, we mean a central bank where interest rate and money supply decisions are made independent of the influence of the currently elected politicians. Politicians, who face frequent re-elections, are likely to want lower unemployment now, even if it leads to inflation later. Making the central bank independent, and making it difficult for politicians to fire the central banker, makes it easier for the central bank to resist the political pressure to decrease unemployment below the natural rate of unemployment.

This may not be enough, however. Even if it is not subject to political pressure, the central bank will still be tempted to decrease unemployment below the natural rate: Doing so leads to a better outcome in the short run. So, a second step is to give incentives to the central bankers to take the long view—that is, to take into account the long-run costs from higher inflation. One way of doing so is to give them long terms in office, so they have a long horizon and have the incentives to build credibility.

A third step may be to appoint a “conservative” central banker, someone who dislikes inflation very much and is therefore less willing to accept more inflation in exchange for less unemployment when unemployment is at the natural rate. When the economy is at the natural rate, such a central banker will be less tempted to embark on a monetary expansion. Thus, the problem of time inconsistency will be reduced.

These are the steps many countries have taken over the last two decades. Central banks have been given more independence. Central bankers have been given long terms in office. And governments typically have appointed central bankers who are more “conservative” than the governments themselves—central bankers who appear to care more about inflation and less about unemployment than the government. (See the Focus box “Was Alan Blinder Wrong in Speaking the Truth?”)

Figure 22-3 suggests that giving central banks more independence has been successful, at least in terms of achieving lower inflation. The vertical axis gives the average inflation rate in 18 OECD countries over the period 1960–1990. The horizontal axis gives the value of an index of “central bank independence,” constructed by looking at a number of legal provisions in the central bank’s charter—for example, whether and
Was Alan Blinder Wrong in Speaking the Truth?

In the summer of 1994, President Clinton appointed Alan Blinder, an economist from Princeton, vice-chairman (in effect, second in command) of the Federal Reserve Board. A few weeks later Blinder, speaking at an economic conference, indicated his belief that the Fed has both the responsibility and the ability, when unemployment is high, to use monetary policy to help the economy recover. This statement was badly received. Bond prices fell, and most newspapers ran editorials critical of Blinder.

Why was the reaction of markets and newspapers so negative? It was surely not that Blinder was wrong. There is no doubt that monetary policy can and should help the economy out of a recession. Indeed, the Federal Reserve Bank Act of 1978 requires the Fed to pursue full employment as well as low inflation.

The reaction was negative because, in terms of the argument we developed in the text, Blinder revealed by his words that he was not a conservative central banker, that he cared about unemployment as well as inflation. With the unemployment rate at the time equal to 6.1%, close to what was thought to be the natural rate of unemployment at the time, markets interpreted Blinder’s statements as suggesting that he might want to decrease unemployment below the natural rate. Interest rates increased because of higher expected inflation—bond prices decreased.

The moral of the story: Whatever views central bankers may hold, they should try to look and sound conservative. This is why, for example, many heads of central banks are reluctant to admit, at least in public, the existence of any trade-off between unemployment and inflation, even in the short run.

Time Consistency and Restraints on Policy Makers

Let’s summarize what we have learned in this section:

We have examined arguments for putting restraints on policy makers, based on the issue of time inconsistency.

When issues of time inconsistency are relevant, tight restraints on policy makers—like a fixed-money-growth rule in the case of monetary policy, or a balanced-budget rule in the case of fiscal policy—can provide a rough solution. But the solution has large costs because it prevents the use of macroeconomic policy altogether. Better solutions typically involve designing better institutions (like an independent central bank, or a better budget process) that can reduce the problem of time inconsistency while, at the same time, allowing the use of policy for the stabilization of output. This is not, however, easy to do.

22-3 Politics and Policy

We have assumed so far that policy makers were benevolent—that they tried to do what was best for the economy. However, much public discussion challenges that assumption: Politicians or policy makers, the argument goes, do what is best for themselves, and this is not always what is best for the country.

You have heard the arguments: Politicians avoid the hard decisions and they pander to the electorate, partisan politics leads to gridlock, and nothing ever gets done. Discussing the flaws of democracy goes far beyond the scope of this book. What we can do here is to briefly review how these arguments apply to macroeconomic policy, then look at the empirical evidence and see what light it sheds on the issue of policy restraints.
Games between Policy Makers and Voters

Many macroeconomic policy decisions involve trading off short-run losses against long-run gains—or, conversely, short-run gains against long-run losses.

Take, for example, tax cuts. By definition, tax cuts lead to lower taxes today. They are also likely to lead to an increase in demand, and therefore to an increase in output for some time. But unless they are matched by equal decreases in government spending, they lead to a larger budget deficit and to the need for an increase in taxes in the future. If voters are shortsighted, the temptation for politicians to cut taxes may prove irresistible. Politics may lead to systematic deficits, at least until the level of government debt has become so high that politicians are scared into action.

Now move on from taxes to macroeconomic policy in general. Again suppose that voters are shortsighted. If the politicians’ main goal is to please voters and get reelected, what better policy than to expand aggregate demand before an election, leading to higher growth and lower unemployment? True, growth in excess of the normal growth rate cannot be sustained, and eventually the economy must return to the natural level of output: Higher growth now must be followed by lower growth later. But with the right timing and shortsighted voters, higher growth can win the elections. Thus, we might expect a clear political business cycle, with higher growth on average before elections than after elections.

You probably have heard these arguments before, in one form or another. And their logic appears convincing. The question is: How well do they fit the facts?

First, consider deficits and debt. The argument above would lead you to expect that budget deficits and high government debt have always been and will always be there. Figure 22-4 takes the long view. It gives the evolution of the ratio of government debt to GDP in the United States beginning in 1900 and shows that the reality is more complex.

Look first at the evolution of the ratio of debt to GDP from 1900 to 1980. Note that each of the three buildups in debt (represented by the shaded areas in the figure) was associated with special circumstances: World War I for the first buildup, the Great Depression for the second, and World War II for the third. These were times of unusually high military spending or unusual declines in output. Adverse circumstances—not pandering

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**Figure 22-4**

*The Evolution of the U.S. Debt to GDP Ratio since 1900*

The three major buildups of debt since 1900 have been associated with World War I, the Great Depression, and World War II. The buildup since 1980 appears different in nature.

*Source: Historical Statistics of the United States, Department of Commerce, and Economic Report of the President, Tables B-1 and B-87*
to voters—were clearly behind the large deficits and the resulting increase in debt during each of these three episodes. Note also how, in each of these three cases, the buildup was followed by a steady decrease in debt. In particular, note how the ratio of debt to GDP, which was as high as 130% in 1946, was steadily reduced to a postwar low of 33% in 1979.

The more recent evidence, however, fits the argument of shortsighted voters and pandering politicians much better. Clearly, the large increase since 2007 is due to the crisis. But, leaving it aside, note how the debt-to-GDP ratio increased from 33% in 1980 to 63% in 2007. This increase in debt can be largely traced back to two rounds of tax cuts, the first under the Reagan administration in the early 1980s, the second under the Bush administration in the early 2000s. Were these tax cuts, and the resulting deficits and increase in debt, best explained by pandering of politicians to shortsighted voters? We shall argue below that the answer is probably no, and that the main explanation lies in a game between political parties rather than in a game between policy makers and voters.

Before we do so, let us return to the political-business-cycle argument, that policy makers try to get high output growth before the elections so they will be reelected. If the political business cycle were important, we would expect to see faster growth before elections than after. Table 22-1 gives average output growth rates for each of the four years of each U.S. administration from 1948 to 2008, distinguishing between Republican and Democratic presidential administrations. Look at the last line of the table: Growth has indeed been highest on average in the last year of an administration. The average difference across years is small, however: 4.0% in the last year of an administration versus 3.3% in the first year. (We shall return below to another interesting feature in the table, namely the difference between Republican and Democratic administrations.) There is little evidence of manipulation—or at least of successful manipulation—of the economy to win elections.

### Games between Policy Makers

Another line of argument shifts the focus from games between politicians and voters to games between policy makers.

Suppose, for example, that the party in power wants to reduce spending but faces opposition to spending cuts in Congress. One way of putting pressure both on Congress as well as on the future parties in power is to cut taxes and create deficits. As debt increases over time, the increasing pressure to reduce deficits may well, in turn, force Congress and the future parties in power to reduce spending—something they would not have been willing to do otherwise.

Or suppose that, either for the reason we just saw or for any other reason, the country is facing large budget deficits. Both parties in Congress want to reduce the deficit, but they disagree about the way to do it: One party wants to reduce deficits primarily

---

**Table 22-1** Growth during Democratic and Republican Presidential Administrations since 1948 (percent per year)

<table>
<thead>
<tr>
<th>Year of the Administration</th>
<th>First</th>
<th>Second</th>
<th>Third</th>
<th>Fourth</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Democratic</td>
<td>3.3</td>
<td>5.9</td>
<td>4.2</td>
<td>3.7</td>
<td>4.2</td>
</tr>
<tr>
<td>Republican</td>
<td>3.3</td>
<td>0.7</td>
<td>3.3</td>
<td>4.1</td>
<td>2.8</td>
</tr>
<tr>
<td>Average</td>
<td>3.3</td>
<td>2.8</td>
<td>3.6</td>
<td>4.0</td>
<td>3.4</td>
</tr>
</tbody>
</table>

Source: Calculated using Series GDPCA, from 1948 to 2008: Federal Reserve Economic Data (FRED) http://research.stlouisfed.org/fred2/
through an increase in taxes; the other wants to reduce deficits primarily through a decrease in spending. Both parties may hold out on the hope that the other side will give in first. Only when debt has increased sufficiently, and it becomes urgent to reduce deficits, will one party give up.

Game theorists refer to these situations as **wars of attrition**. The hope that the other side will give in leads to long and often costly delays. Such wars of attrition happen often in the context of fiscal policy, and deficit reduction occurs long after it should.

Wars of attrition arise in other macroeconomic contexts; for example, during episodes of hyperinflation. As we shall see in Chapter 23, hyperinflations come from the use of money creation to finance large budget deficits. Although the need to reduce those deficits is usually recognized early on, support for stabilization programs—which include the elimination of those deficits—typically comes only after inflation has reached such high levels that economic activity is severely affected.

These games go a long way in explaining the rise in the ratio of debt to GDP in the United States since the early 1980s. There is little doubt that one of the goals of the Reagan administration, when it decreased taxes from 1981 to 1983, was to slow down the growth of government spending. There is also little question that, by the mid-1980s, there was general agreement among policy makers that the deficits should be reduced. But, because of disagreements between Democrats and Republicans about whether this should happen primarily through tax increases or spending cuts, it was not until the late 1990s that deficit reduction was achieved. The motivation behind the Bush administration tax cuts of the early 2000s appears to be very similar to those of the Reagan administration. And the current fights between Congress and the Obama administration on how to reduce the large deficits triggered by the crisis are mostly driven by disagreements on whether deficit reduction should be achieved mainly through spending cuts or mainly through tax increases. At the time of this writing, we are clearly in the middle of a war of attrition.

Another example of games between political parties is the movements in economic activity brought about by the alternation of parties in power. Traditionally, Republicans have worried more than Democrats about inflation and worried less than Democrats about unemployment. So we would expect Democratic administrations to show stronger growth—and thus less unemployment and more inflation—than Republican administrations. This prediction appears to fit the facts quite well. Look at Table 22-1 again. Average growth has been 4.2% during Democratic administrations, compared to 2.8% during Republican administrations. The most striking contrast is in the second year: 5.9% during Democratic administrations compared to 0.7% during Republican administrations.

This raises an intriguing question: Why is the effect so much stronger in the administration’s second year? It could just be a fluke. But the theory of unemployment and inflation we developed in Chapter 8 suggests a possible hypothesis: There are lags in the effects of policy, so it takes about a year for a new administration to affect the economy. And sustaining higher growth than normal for too long would lead to increasing inflation, so even a Democratic administration would not want to sustain higher growth throughout its term. Thus, growth rates tend to be much closer to each other during the second halves of Democratic and Republican administrations—more so than during first halves.

**Politics and Fiscal Restraints**

If politics sometimes lead to long and lasting budget deficits, can rules be put in place to limit these adverse effects?
The Stability and Growth Pact: A Short History.

The Maastricht treaty, negotiated by the countries of the European Union in 1991, set a number of convergence criteria that countries had to meet in order to qualify to join the Euro area (for more on the history of the euro, see the Focus box “The Euro: A Short History” in Chapter 21). Among them were two restrictions on fiscal policy: First, the ratio of the budget deficit to GDP had to be below 3%. Second, the ratio of its debt to GDP had to be below 60%, or at least “approaching this value at a satisfactory pace.”

In 1997, would-be members of the Euro area agreed to make some of these restrictions permanent. The Stability and Growth Pact (SGP), signed in 1997, required members of the Euro area to adhere to the following fiscal rules:

- That countries commit to balance their budget in the medium run. That they present programs to the European authorities, specifying their objectives for the current and following three years in order to show how they are making progress toward their medium-run goal.

- That countries avoid excessive deficits, except under exceptional circumstances. Following the Maastricht treaty criteria, excessive deficits were defined as deficits in excess of 3% of GDP. Exceptional circumstances were defined as declines of GDP larger than 2%.

- That sanctions be imposed on countries that ran excessive deficits. These sanctions could range from 0.2 to 0.5% of GDP—so, for a country like France, up to roughly 10 billion dollars!

Figure 1 plots the evolution of budget deficits since 1990 for the Euro area as a whole. Note how from 1993 to 2000, budget balances went from a deficit of 5.8% of Euro area GDP to a surplus of 0.1%. The performance of some of the member countries was particularly impressive: Greece reduced its deficit from 13.4% of GDP to a reported 1.4% of GDP (it was discovered in 2004 that the Greek government had cheated in reporting its deficit numbers and that the actual improvement, although impressive, was less than reported; the deficit for 2000 is now estimated to have been 4.1%); Italy’s deficit went from 10.1% of GDP in 1993 to only 0.9% of GDP in 2000.

Was the improvement entirely due to the Maastricht criteria and the SGP rules? Just as in the case of deficit reduction in the United States over the same period, the answer is no: The decrease in nominal interest rates, which decreased the interest payments on the debt, and the strong expansion of the late 1990s both played important roles. But, again as in the United States, the fiscal rules also played a significant role: The carrot—the right to become a member of the Euro area—was attractive enough to lead a number of countries to take tough measures to reduce their deficits.

Things turned around, however, after 2000. From 2000 on, deficits started increasing. The first country to break the limit was Portugal in 2001, with a deficit of 4.4%. The next two countries were France and Germany, both with deficits in excess of 3% of GDP in 2002. Italy soon followed. In each case, the government of the country decided it was more important to avoid a fiscal contraction that could lead to even slower output growth than to satisfy the rules of the SGP.

Faced with clear “excessive deficits” (and without the excuse of exceptional circumstances because output growth in each these countries was low but positive), European authorities found themselves in a quandary. Starting the excessive deficit procedure against Portugal, a small country, might have been politically feasible, although it is doubtful that Portugal would have ever been willing to pay the fine. Starting the same procedure against the two largest members of the Euro area, France and Germany, proved politically impossible. After an internal fight between the two main European authorities—the European Commission and the European Council—the European Commission wanted to proceed with the excessive deficit procedure, while the European Council, which represents the states, did not—the procedure was suspended.

The crisis made it clear that the initial rules were too inflexible. Romano Prodi, the head of the European Commission, admitted to that much: In an interview in October 2002, he stated, “I know very well that the Stability Pact is stupid, like all decisions that are rigid.” And the attitudes of both France and Germany showed that the threat to impose large fines on countries with excessive deficits was simply not credible.

For two years, the European Commission explored ways to improve the rules so as to make them more flexible and, by implication, more credible. In 2003, a new, revised SGP was adopted. It kept the 3% deficit and 60% debt numbers as thresholds but allowed for more flexibility in deviating from the rules. Growth no longer had to be less than –2% for the rules to be suspended. Exceptions were also made if the deficit came from structural reforms, or from public investment. Fines were gone, and the plan was to rely on early public warnings as well as on peer pressure from other Euro area countries.

For a while, the ratio of the deficit to GDP declined, largely due to strong growth and higher revenues. The ratio reached a low of 0.5% in 2007. But the crisis, and the associated sharp decrease in revenues, led again to a sharp increase in budget deficits. In 2010, the ratio stood at close
to 6%, twice the SGP threshold; 23 out of 27 EU countries stood in violation of the 3% deficit limit, and it was clear that the rules had to be reconsidered. In March 2011 a new set of rules, known as the Euro Plus Pact, was adopted. It requires member countries to translate the SGP rules into national legislation, either through a constitutional amendment or a framework law. Whether or not these new rules work better than the initial pact remains to be seen.

A constitutional amendment to balance the budget each year, such as the amendment proposed by the Republicans in 1994, would surely eliminate the problem of deficits. But, just like a constant-money-growth rule in the case of monetary policy, it also would eliminate the use of fiscal policy as a macroeconomic instrument altogether. This is just too high a price to pay.

A better approach is to put in place rules that put limits either on deficits or on debt. This is, however, more difficult than it sounds. Rules such as limits on the ratio of the deficit to GDP or the ratio of debt to GDP are more flexible than a balanced-budget requirement; but they may still not be flexible enough if the economy is affected by particularly bad shocks. This has been made clear by the problems faced by the Stability and Growth Pact in Europe; these problems are discussed at more length in the Focus box “The Stability and Growth Pact: A Short History.” More flexible or more complex rules, like rules that allow for special circumstances or rules that take into account the state of the economy, are harder to design and especially harder to enforce. For example, allowing the deficit to be higher if the unemployment rate is higher than the natural rate requires having a simple and unambiguous way of computing what the natural rate is, a nearly impossible task.

A complementary approach is to put in place mechanisms to reduce deficits, were such deficits to arise. Consider, for example, a mechanism that triggers automatic spending cuts when the deficit gets too large. Suppose the budget deficit is too large and it is desirable to cut spending across the board by 5%. Members of Congress will find it difficult to explain to their constituency why their favorite spending program

---

**Figure 1**  *Euro Area Budget Deficits as a Percentage of GDP, since 1990*

was cut by 5%. Now suppose the deficit triggers automatic across-the-board spending cuts of 5% without any congressional action. Knowing that other programs will be cut, members of Congress will accept cuts in their favorite programs more easily. They will also be better able to deflect the blame for the cuts: Members of Congress who succeed in limiting the cuts to their favorite program to, say, 4% (by convincing Congress to make deeper cuts in some other programs so as to maintain the lower overall level of spending) can then return to their constituents and claim they have successfully prevented even larger cuts.

This was indeed the general approach used to reduce deficits in the United States in the 1990s. The Budget Enforcement Act passed in 1990, and extended by new legislation in 1993 and 1997, introduced two main rules:

- It imposed constraints on spending. Spending was divided into two categories: discretionary spending (roughly: spending on goods and services, including defense) and mandatory spending (roughly: transfer payments to individuals). Constraints, called **spending caps**, were set on discretionary spending for the following five years. These caps were set in such a way as to require a small but steady decrease in discretionary spending (in real terms). Explicit provisions were made for emergencies. For example, spending on Operation Desert Storm during the Gulf War in 1991 was not subject to the caps.

- It required that a new transfer program could only be adopted if it could be shown not to increase deficits in the future (either by raising new revenues or by decreasing spending on an existing program). This rule is known as the pay-as-you-go or the **PAYGO rule**.

The focus on spending rather than on the deficit itself had one important implication. If there was a recession, hence a decrease in revenues, the deficit could increase without triggering a decrease in spending. This happened in 1991 and 1992 when, because of the recession, the deficit increased—despite the fact that spending satisfied the constraints imposed by the caps. This focus on spending had two desirable effects: It allowed for a larger fiscal deficit during a recession—a good thing from the point of view of macroeconomic policy; and it decreased the pressure to break the rules during a recession—a good thing from a political point of view.

By 1998, deficits were gone, and, for the first time in 20 years, the federal budget was in surplus. Not all of the deficit reduction was due to the Budget Enforcement Act rules: A decrease in defense spending due to the end of the Cold War, and a large increase in tax revenues due to the strong expansion of the second half of the 1990s were important factors. But there is wide agreement that the rules played an important role in making sure that decreases in defense spending and increases in tax revenues were used for deficit reduction rather than for increases in other spending programs.

Once budget surpluses appeared, however, Congress became increasingly willing to break its own rules. Spending caps were systematically broken, and the PAYGO rule was allowed to expire in 2002. The lesson from this, as well as from the failure of the Stability and Growth Pact described in the Focus box “The Stability and Growth Pact: A Short History”, is that, while rules can help, they cannot fully substitute for a lack of resolve from policy makers.
The effects of macroeconomic policies are always uncertain. This uncertainty should lead policy makers to be more cautious and to use less active policies. Policies must be broadly aimed at avoiding prolonged recessions, slowing down booms, and avoiding inflationary pressure. The higher the level of unemployment or inflation, the stronger the policies should be. But they should stop short of fine tuning, of trying to maintain constant unemployment or constant output growth.

Using macroeconomic policy to control the economy is fundamentally different from controlling a machine. Unlike a machine, the economy is composed of people and firms who try to anticipate what policy makers will do and who react not only to current policy but also to expectations of future policy. In this sense, macroeconomic policy can be thought of as a game between policy makers and people in the economy.

When playing a game, it is sometimes better for a player to give up some of his options. For example: When a hostage taking occurs, it is better to negotiate with the hostage takers. But a government that credibly commits to not negotiating with hostage takers—a government that gives up the option of negotiation—is actually more likely to deter hostage takings.

The same argument applies to various aspects of macroeconomic policy. By credibly committing not to use monetary policy to decrease unemployment below the natural rate of unemployment, a central bank can alleviate fears that money growth will be high, and in the process decrease both expected and actual inflation. When issues of time inconsistency are relevant, tight restraints on policy makers—such as a fixed-money-growth rule in the case of monetary policy—can provide a rough solution. But the solution can have large costs if it prevents the use of macroeconomic policy altogether. Better methods typically involve designing better institutions (such as an independent central bank) that can reduce the problem of time inconsistency without eliminating monetary policy as a macroeconomic policy tool.

Another argument for putting restraints on policy makers is that policy makers may play games either with the public or among themselves, and these games may lead to undesirable outcomes. Politicians may try to fool a shortsighted electorate by choosing policies with short-run benefits but large long-term costs—for example, large budget deficits. Political parties may delay painful decisions, hoping that the other party will make the adjustment and take the blame. In cases like this, tight restraints on policy, such as a constitutional amendment to balance the budget, again provide a rough solution. Better ways typically involve better institutions and better ways of designing the process through which policy and decisions are made. However, the design and consistent implementation of such fiscal frameworks has proven very difficult in practice, as demonstrated both in the United States and the European Union.

Key Terms

dynamic stochastic general equilibrium (DSGE) models, 476
fine tuning, 478
optimal control, 478
game, 478
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game theory, 478
strategic interactions, 478
players, 478
time inconsistency, 479
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Stability and Growth Pact, SGP, 487
spending caps, 488
PAYGO rule, 488

Questions and Problems

QUICK CHECK

All Quick Check questions and problems are available on MyEconLab.

1. Using the information in this chapter, label each of the following statements true, false, or uncertain. Explain briefly.
   a. There is so much uncertainty about the effects of monetary policy that we would be better off not using it.
   b. Elect a Democrat as president if you want low unemployment.
   c. There is clear evidence of political business cycles in the United States: low unemployment during election campaigns and higher unemployment the rest of the time.
   d. Rules are ineffective in reducing budget deficits.
   e. Governments would be wise to announce a no-negotiation policy with hostage takers.
f. If hostages are taken, it is clearly wise for governments to negotiate with hostage takers, even if the government has announced a no-negotiation policy.
g. When a central bank announces a target inflation rate, it has no incentive to deviate from the target.

2. Implementing a political business cycle

You are the economic adviser to a newly elected president. In four years she will face another election. Voters want a low unemployment rate and a low inflation rate. However, you believe that voting decisions are influenced heavily by the values of unemployment and inflation in the last year before the election, and that the economy’s performance in the first three years of a president’s administration has little effect on voting behavior.

Assume that inflation last year was 10%, and that the unemployment rate was equal to the natural rate. The Phillips curve is given by

$$\pi_t = \pi_{t-1} - \alpha(u_t - u_n)$$

Assume that you can use fiscal and monetary policy to achieve any unemployment rate you want for each of the next four years. Your task is to help the president achieve low unemployment and low inflation in the last year of her administration.

a. Suppose you want to achieve a low unemployment rate (i.e., an unemployment rate below the natural rate) in the year before the next election (four years from today). What will happen to inflation in the fourth year?
b. Given the effect on inflation you identified in part (a), what would you advise the president to do in the early years of her administration to achieve low inflation in the fourth year?
c. Now suppose the Phillips curve is given by

$$\pi_t = \pi_{t}^e - \alpha(u_t - u_n)$$

In addition, assume that people form inflation expectations, $\pi_t^e$, based on consideration of the future (as opposed to looking only at inflation last year), and are aware that the president has an incentive to carry out the policies you described in parts (a) and (b). Are the policies you described in parts (a) and (b) likely to be successful? Why or why not?

3. Suppose the government amends the constitution to prevent government officials from negotiating with terrorists. What are the advantages of such a policy? What are the disadvantages?

4. New Zealand rewrote the charter of its central bank in the early 1990s to make low inflation its only goal.

Why would New Zealand want to do this?

DIG DEEPER

All Dig Deeper questions and problems are available on MyEconLab.

5. Political expectations, inflation, and unemployment

Consider a country with two political parties, Democrats and Republicans. Democrats care more about unemployment than Republicans, and Republicans care more about inflation than Democrats. When Democrats are in power, they choose an inflation rate of $\pi_D$, and when Republicans are in power, they choose an inflation rate of $\pi_R$. We assume that

$$\pi_D > \pi_R$$

The Phillips curve is given by

$$\pi_t = \pi_t^e - \alpha(u_t - u_n)$$

An election is about to be held. Assume that expectations about inflation for the coming year (represented by $\pi_t^e$) are formed before the election. (Essentially, this assumption means that wages for the coming year are set before the election.) Moreover, Democrats and Republicans have an equal chance of winning the election.

a. Solve for expected inflation, in terms of $\pi_D$ and $\pi_R$.
b. Suppose the Democrats win the election and implement their target inflation rate, $\pi_D$. Given your solution for expected inflation in part (a), how will the unemployment rate compare to the natural rate of unemployment?
c. Suppose the Republicans win the election and implement their target inflation rate, $\pi_R$. Given your solution for expected inflation in part (a), how will the unemployment rate compare to the natural rate of unemployment?
d. Do these results fit the evidence in Table 22-1? Why or why not?
e. Now suppose that everyone expects the Democrats to win the election, and the Democrats indeed win. If the Democrats implement their target inflation rate, how will the unemployment rate compare to the natural rate?

6. Deficit reduction as a prisoner’s dilemma game

Suppose there is a budget deficit. It can be reduced by cutting military spending, by cutting welfare programs, or by cutting both. The Democrats have to decide whether to support cuts in military spending. The Republicans have to decide whether to support cuts in welfare programs.

The possible outcomes are represented in the following table:

<table>
<thead>
<tr>
<th>Welfare Cuts</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defense Cuts</td>
<td>( R = 1, D = -2 )</td>
<td>( R = -2, D = 3 )</td>
</tr>
<tr>
<td>Cuts</td>
<td>( R = 3, D = -2 )</td>
<td>( R = -1, D = -1 )</td>
</tr>
</tbody>
</table>

The table presents payoffs to each party under the various outcomes. Think of a payoff as a measure of happiness for a given party under a given outcome. If Democrats vote for welfare cuts, and Republicans vote against cuts in military spending, the Republicans receive a payoff of 3, and the Democrats receive a payoff of –2.

a. If the Republicans decide to cut military spending, what is the best response of the Democrats? Given this response, what is the payoff for the Republicans?
b. If the Republicans decide not to cut military spending, what is the best response of the Democrats? Given this response, what is the payoff for the Republicans?
c. What will the Republicans do? What will the Democrats do? Will the budget deficit be reduced? Why or why not? (A game with a payoff structure like the one in this problem, and that produces the outcome you have just described, is known as a prisoner’s dilemma.) Is there a way to improve the outcome?

EXPLORE FURTHER
7. Games, precommitment, and time inconsistency in the news
Current events offer abundant examples of disputes in which the parties are involved in a game, try to commit themselves to lines of action in advance, and face issues of time inconsistency. Examples arise in the domestic political process, international affairs, and labor-management relations.

a. Choose a current dispute (or one resolved recently) to investigate. Do an internet search to learn the issues involved in the dispute, the actions taken by the parties to date, and the current state of play.

Further Readings
- If you want to learn more on these issues, a useful reference is Political Economy in Macroeconomics, by Alan Drazen (Princeton University Press, 2000).
- For an argument that inflation decreased as a result of the increased independence of central banks in the 1990s, read “Central Bank Independence and Inflation” in the 2009 Annual Report of the Federal Reserve Bank of St. Louis http://www.stlouisfed.org/publications/ar/2009/
- A leading proponent of the view that governments misbehave and should be tightly restrained is James Buchanan, from George Mason University. Buchanan received the Nobel Prize in 1986 for his work on public choice. Read, for example, his book with Richard Wagner, Democracy in Deficit: The Political Legacy of Lord Keynes (Academic Press, 1977).
- For an interpretation of the increase in inflation in the 1970s as the result of time inconsistency, see “Did Time Consistency Contribute to the Great Inflation?” by Henry Chappell and Rob McGregor, Economics & Politics 2004 16(3): pp. 233–251.
At the time of writing, fiscal policy is at the center of current policy discussions. In most advanced economies, the crisis has led to large budget deficits and a large increase in debt-to-GDP ratios. In Greece, the government has indicated that it will be unable to fully repay its debt and is negotiating with its creditors. The problem goes beyond Greece. In a number of countries, investors have started worrying about whether debt can indeed be repaid and are asking for higher interest rates to compensate for the risk of default. This calls for governments to strongly reduce deficits, stabilize the debt, and reassure investors. At the same time however, the recovery is weak and a fiscal contraction is likely to slow it down further, at least in the short run. Thus, governments face a difficult choice: Reduce deficits rapidly and reassure markets that they will pay their debt, at the risk of lower growth or even a recession; or reduce deficits more slowly in order to avoid further slowing the recovery, at the risk of not convincing investors that debt will be stabilized.

The purpose of this chapter is to review what we have learned about fiscal policy so far, to explore in more depth the dynamics of deficits and debt, and to shed light on the problems associated with high public debt.

Section 23-1 takes stock of what we have learned about fiscal policy in this book so far.

Section 23-2 looks more closely at the government budget constraint and examines its implications for the relation between budget deficits, the interest rate, the growth rate, and government debt.

Section 23-3 takes up three issues for which the government budget constraint plays a central role, from the proposition that deficits do not really matter, to how to run fiscal policy in the cycle, to whether to finance wars through taxes or through debt.

Section 23-4 discusses the dangers associated with high government debt, from higher taxes, to higher interest rates, to default, and to high inflation.
What We Have Learned

Let’s review what we have learned about fiscal policy:

■ In Chapter 3 we looked at how government spending and taxes affected demand and output in the short run.
  
  We saw how, in the short run, a fiscal expansion—increases in government spending, or decreases in taxes—increases output.

■ In Chapter 5 we looked at the short-run effects of fiscal policy on output and on the interest rate.
  
  We saw how a fiscal expansion leads to an increase in output and an increase in the interest rate. We also saw how fiscal policy and monetary policy can be used together to affect both the level and the composition of output.

■ In Chapter 7 we looked at the effects of fiscal policy in the short run and in the medium run.
  
  We saw that, in the medium run (that is, taking the capital stock as given), a fiscal expansion has no effect on output but is reflected in a different composition of spending. The interest rate is higher, and investment spending is lower.

■ In Chapter 9 we looked at the case when the interest rate is equal to zero and the economy is in a liquidity trap.
  
  We saw that, in this case, conventional monetary policy cannot be used to increase output, and thus fiscal policy has an even more important role to play.

■ In Chapter 11 we looked at how saving, both private and public, affects the level of capital accumulation and the level of output in the long run.
  
  We saw how, once capital accumulation is taken into account, a larger budget deficit, and, by implication, a lower national saving rate, decreases capital accumulation, leading to a lower level of output in the long run.

■ In Chapter 17 we returned to the short-run effects of fiscal policy, taking into account not only fiscal policy’s direct effects through taxes and government spending, but also its effects on expectations.
  
  We saw how the effects of fiscal policy depend on expectations of future fiscal and monetary policy. In particular, we saw how a deficit reduction may, in some circumstances, lead to an increase in output, even in the short run.

■ In Chapter 19 we looked at the effects of fiscal policy when the economy is open in the goods market.
  
  We saw how fiscal policy affects both output and the trade balance, and we examined the relation between the budget deficit and the trade deficit. We saw how fiscal policy and exchange rate adjustments can be used together to affect both the level of output and its composition.

■ In Chapter 20 we looked at the role of fiscal policy in an economy open in both goods markets and financial markets.
  
  We saw how, when capital is mobile, the effects of fiscal policy depend on the exchange rate regime. Fiscal policy has a stronger effect on output under fixed exchange rates than under flexible exchange rates.

■ In Chapter 22 we looked at the problems facing policy makers in general, from uncertainty about the effects of policy to issues of time consistency and credibility. These issues arise in the analysis of fiscal policy as well as monetary policy. We looked at the pros and cons of putting restraints on the conduct of fiscal policy, from spending caps to a constitutional amendment to balance the budget.
In deriving these conclusions, we did not pay close attention to the government budget constraint—that is, the relation among debt, deficits, spending, and taxes. This relation is important, however, in understanding both how we got to where we are today and the choices faced by policy makers. It is the focus of the next section.

### 23-2 The Government Budget Constraint: Deficits, Debt, Spending, and Taxes

Suppose that, starting from a balanced budget, the government decreases taxes, creating a budget deficit. What will happen to the debt over time? Will the government need to increase taxes later? If so, by how much?

#### The Arithmetic of Deficits and Debt

To answer these questions, we must begin with a definition of the budget deficit. We can write the budget deficit in year \( t \) as

\[
\text{deficit}_t = rB_{t-1} + G_t - T_t \tag{23.1}
\]

All variables are in real terms:

- \( B_{t-1} \) is government debt at the end of year \( t - 1 \), or, equivalently, at the beginning of year \( t \); \( r \) is the real interest rate, which we shall assume to be constant here. Thus \( rB_{t-1} \) equals the real interest payments on the government debt in year \( t \).
- \( G_t \) is government spending on goods and services during year \( t \).
- \( T_t \) is taxes minus transfers during year \( t \).

In words: The budget deficit equals spending, including interest payments on the debt, minus taxes net of transfers.

Note two characteristics of equation (23.1):

- We measure interest payments as real interest payments—that is, the product of the real interest rate times existing debt—rather than as actual interest payments—that is, the product of the nominal interest rate and the existing debt. As the Focus box “Inflation Accounting and the Measurement of Deficits” shows, this is the correct way of measuring interest payments. Official measures of the deficit, however, use actual (nominal) interest payments and are therefore incorrect. When inflation is high, official measures can be seriously misleading. The correct measure of the deficit is sometimes called the inflation-adjusted deficit.
- For consistency with our earlier definition of \( G \) as spending on goods and services, \( G \) does not include transfer payments. Transfers are instead subtracted from \( T \), so that \( T \) stands for taxes minus transfers. Official measures of government spending add transfers to spending on goods and services and define revenues as taxes, not taxes net of transfers.

These are only accounting conventions. Whether transfers are added to spending or subtracted from taxes makes a difference to the measurement of \( G \) and \( T \), but clearly does not affect \( G - T \), and therefore does not affect the measure of the deficit.

The government budget constraint then simply states that the change in government debt during year \( t \) is equal to the deficit during year \( t \):

\[
B_t - B_{t-1} = \text{deficit}_t
\]

If the government runs a deficit, government debt increases. If the government runs a surplus, government debt decreases.

---

Do not confuse the words “deficit” and “debt.” (Many journalists and politicians do.) Debt is a stock—what the government owes as a result of past deficits. The deficit is a flow—how much the government borrows during a given year.

Transfer payments are government transfers to individuals, such as unemployment benefits or Medicare.

Let \( G \) represent spending on goods and services; \( Tr \), transfers; and \( Tax \), total taxes. For simplicity, assume interest payments \( rB \) equal zero. Then

\[
\text{Deficit} = G + Tr - Tax
\]

This can be rewritten in two (equivalent) ways:

\[
\text{Deficit} = G - (Tax - Tr)
\]

The deficit equals spending on goods and services minus net taxes—that is, taxes minus transfers. This is the way we write it in the text.

\[
\text{Deficit} = (G + Tr) - Tax
\]

The deficit equals total spending—spending on goods and services plus transfers—minus total taxes. This is the way the government usually reports spending and revenues. Table A1-4 in Appendix 1 at the end of this book presents the U.S. federal budget in this way.
Inflation Accounting and the Measurement of Deficits

Official measures of the budget deficit are constructed (dropping the time indexes, which are not needed here) as nominal interest payments, $iB$, plus spending on goods and services, $G$, minus taxes net of transfers, $T$.

$$\text{official measure of the deficit} = iB + G - T$$

This is an accurate measure of the cash flow position of the government. If it is positive, the government is spending more than it receives and must therefore issue new debt. If it is negative, the government buys back previously issued debt.

But this is not an accurate measure of the change in real debt—that is, the change in how much the government owes, expressed in terms of goods rather than dollars.

To see why, consider the following example. Suppose the official measure of the deficit is equal to zero, so the government neither issues nor buys back debt. Suppose inflation is positive and equal to 10%. Then, at the end of the year, the real value of the debt has decreased by 10%. If we define—as we should—the deficit as the change in the real value of government debt, the government has decreased its real debt by 10% over the year. In other words, it has in fact run a budget surplus equal to 10% times the initial level of debt.

More generally: If $B$ is debt and $\pi$ is inflation, the official measure of the deficit overstates the correct measure by an amount equal to $\pi B$. Put another way, the correct measure of the deficit is obtained by subtracting $\pi B$ from the official measure:

$$\text{correct measure of the deficit} = iB + G - T - \pi B = (i - \pi)B + G - T = rB + G - T$$

where $r = i - \pi$ is the (realized) real interest rate. The correct measure of the deficit is then equal to real interest payments plus government spending minus taxes net of transfers—this is the measure we have used in the text.

The difference between the official and the correct measures of the deficit equals $\pi B$. So, the higher the rate of inflation, $\pi$, or the higher the level of debt, $B$, the more inaccurate the official measure is. In countries in which both inflation and debt are high, the official measure may record a very large budget deficit, when in fact real government debt is decreasing. This is why we should always do the inflation adjustment before deriving conclusions about the position of fiscal policy.

Figure 1 plots the official measure and the inflation-adjusted measure of the (federal) budget deficit for the United States since 1969. The official measure shows a deficit in every year from 1970 to 1997. The inflation-adjusted measure shows instead alternating deficits and surpluses until the late 1970s. Both measures, however, show how much larger the deficit became after 1980, how things improved in the 1990s, and how they have deteriorated in the 2000s. Today, with inflation running at about 1–2% a year and the ratio of debt to GDP equal to roughly 90%, the difference between the two measures is roughly equal to 1–2% times 90%, or 0.9–1.8% of GDP.

![Figure 1 Official and Inflation-Adjusted Federal Budget Deficits for the United States since 1969](http://research.stlouisfed.org/fred2/)
Using the definition of the deficit (equation (23.1)), we can rewrite the government budget constraint as

$$B_t - B_{t-1} = rB_{t-1} + G_t - T_t$$  \hspace{1cm} (23.2)$$

The government budget constraint links the change in government debt to the initial level of debt (which affects interest payments) and to current government spending and taxes. It is often convenient to decompose the deficit into the sum of two terms:

- **Interest payments on the debt**, $rB_{t-1}$.
- **The difference between spending and taxes**, $G_t - T_t$. This term is called the primary deficit (equivalently, $T_t - G_t$ is called the primary surplus).

Using this decomposition, we can rewrite equation (23.2) as

<table>
<thead>
<tr>
<th>Change in the debt</th>
<th>Interest Payments</th>
<th>Primary Deficit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$B_t - B_{t-1}$</td>
<td>$rB_{t-1}$</td>
<td>$(G_t - T_t)$</td>
</tr>
</tbody>
</table>

Or, moving $B_{t-1}$ to the right side of the equation and reorganizing,

$$B_t = (1 + r)B_{t-1} + (G_t - T_t)$$  \hspace{1cm} (23.3)$$

This relation states that the debt at the end of year $t$ equals $(1 + r)$ times the debt at the end of year $t - 1$, plus the primary deficit during year $t$, $(G_t - T_t)$. Let’s look at some of its implications.

**Current versus Future Taxes**

Consider first a one-year decrease in taxes for the path of debt and future taxes. Start from a situation where, until year 1, the government has balanced its budget, so that initial debt is equal to zero. During year 1, the government decreases taxes by 1 (think one billion dollars, for example) for one year. Thus, debt at the end of year 1, $B_1$, is equal to 1. The question we take up: What happens thereafter?

**Full Repayment in Year 2**

Suppose the government decides to fully repay the debt during year 2. From equation (23.3), the budget constraint for year 2 is given by

$$B_2 = (1 + r)B_1 + (G_2 - T_2)$$

If the debt is fully repaid during year 2, then the debt at the end of year 2 is equal to zero: $B_2 = 0$. Replacing $B_1$ by 1 and $B_2$ by 0 and transposing terms gives

$$(G_2 - T_2) = (1 + r)1 = (1 + r)$$

To repay the debt fully during year 2, the government must run a primary surplus equal to $(1 + r)$. It can do so in one of two ways: a decrease in spending or an increase in taxes. We shall assume here and in the rest of this section that the adjustment comes through taxes, so that the path of spending is unaffected. It follows that the decrease in taxes by 1 during year 1 must be offset by an increase in taxes by $(1 + r)$ during year 2.

The path of taxes and debt corresponding to this case is given in Figure 23-1(a): If the debt is fully repaid during year 2, the decrease in taxes of 1 in year 1 requires an increase in taxes equal to $(1 + r)$ in year 2.
Now suppose the government decides to wait until year $t$ to repay the debt. So, from year 2 to year $t-1$, the primary deficit is equal to zero—taxes are equal to spending, not including interest payments on the debt.

During year 2, the primary deficit is zero. So, from equation (23.3), debt at the end of year 2 is:

$$B_2 = (1 + r)B_1 + 0 = (1 + r)1 = (1 + r)$$

where the second equality uses the fact that $B_1 = 1$.

With the primary deficit still equal to zero during year 3, debt at the end of year 3 is

$$B_3 = (1 + r)B_2 + 0 = (1 + r)(1 + r)1 = (1 + r)^2$$

Solving for debt at the end of year 4 and so on, it is clear that as long as the government keeps a primary deficit equal to zero, debt grows at a rate equal to the interest rate, and thus debt at the end of year $t - 1$ is given by

$$B_{t-1} = (1 + r)^{t-2}$$  \hspace{1cm} (23.4)

Despite the fact that taxes are cut only in year 1, debt keeps increasing over time, at a rate equal to the interest rate. The reason is simple: Although the primary deficit is equal to zero, debt is now positive, and so are interest payments on the debt. Each year, the government must issue more debt to pay the interest on existing debt.

In year $t$, the year in which the government decides to repay the debt, the budget constraint is

$$B_t = (1 + r)B_{t-1} + (G_t - T_t)$$

If debt is fully repaid during year $t$, then $B_t$ (debt at the end of year $t$) is zero. Replacing $B_t$ by zero and $B_{t-1}$ by its expression from equation (23.4) gives

$$0 = (1 + r)(1 + r)^{t-2} + (G_t - T_t)$$
Reorganizing and bringing \(( G_t - T_t )\) to the left side of the equation implies

\[ T_t - G_t = (1 + r)^{t-1} \]

To repay the debt, the government must run a primary surplus equal to \((1 + r)^{t-1}\) during year \(t\). If the adjustment is done through taxes, the initial decrease in taxes of 1 during year 1 leads to an increase in taxes of \((1 + r)^{t-1}\) during year \(t\). The path of taxes and debt corresponding to the case where debt is repaid in year 5 is given in Figure 23-1(b).

This example yields our first set of conclusions:

- If government spending is unchanged, a decrease in taxes must eventually be offset by an increase in taxes in the future.
- The longer the government waits to increase taxes, or the higher the real interest rate is, the higher the eventual increase in taxes must be.

### Debt Stabilization in Year \(t\)

We have assumed so far that the government fully repays the debt. Let’s now look at what happens to taxes if the government only stabilizes the debt. (Stabilizing the debt means changing taxes or spending so that debt remains constant from then on.)

Suppose the government decides to stabilize the debt from year 2 on. Stabilizing the debt from year 2 on means the debt at the end of year 2 and thereafter remains at the same level as it was at the end of year 1.

From equation (23.3), the budget constraint for year 2 is

\[ B_2 = (1 + r)B_1 + (G_2 - T_2) \]

Under our assumption that debt is stabilized in year 2, \(B_2 = B_1 = 1\). Setting \(B_2 = B_1 = 1\) in the preceding equation yields

\[ 1 = (1 + r) + (G_2 - T_2) \]

Reorganizing, and bringing \((G_2 - T_2)\) to the left side of the equation,

\[ T_2 - G_2 = (1 + r) - 1 = r \]

To avoid a further increase in debt during year 1, the government must run a primary surplus equal to real interest payments on the existing debt. It must do so in each of the following years as well: Each year, the primary surplus must be sufficient to cover interest payments, leaving the debt level unchanged. The path of taxes and debt is shown in Figure 23-1(c): Debt remains equal to 1 from year 1 on. Taxes are permanently higher from year 1 on, by an amount equal to \(r\); equivalently, from year 1 on, the government runs a primary surplus equal to \(r\).

The logic of this argument extends directly to the case where the government waits until year \(t\) to stabilize the debt. Whenever the government stabilizes, it must from then on run a primary surplus sufficient to pay the interest on the debt.

This example yields our second set of conclusions:

- The legacy of past deficits is higher government debt.
- To stabilize the debt, the government must eliminate the deficit.
- To eliminate the deficit, the government must run a primary surplus equal to the interest payments on the existing debt. This requires higher taxes forever.
The Evolution of the Debt-to-GDP Ratio

We have focused so far on the evolution of the level of debt. But in an economy in which output grows over time, it makes more sense to focus instead on the ratio of debt to output. To see how this change in focus modifies our conclusions, we need to go from equation (23.3) to an equation that gives the evolution of the debt-to-GDP ratio—the debt ratio for short.

Deriving the evolution of the debt ratio takes a few steps. Do not worry: The final equation is easy to understand.

First divide both sides of equation (23.3) by real output, $Y_t$, to get

$$\frac{B_t}{Y_t} = \frac{1}{1 + \frac{r}{2} B_t - 1} Y_t - 1 + \frac{G_t - T_t}{Y_t}$$

Next rewrite $B_t - 1$ as $1\frac{B_t}{Y_t} - 1\frac{Y_t}{Y_t}$, as $1\frac{B_t}{Y_t} > 1\frac{Y_t}{Y_t} - 1\frac{B_t - 1}{Y_t}$ (in other words, multiply the numerator and the denominator by $Y_t - 1$):

$$\frac{B_t}{Y_t} = \frac{1}{1 + \frac{r}{2} B_t - 1} Y_t - 1 + \frac{G_t - T_t}{Y_t}$$

Note that all the terms in the equation are now in terms of ratios to output, $Y$. To simplify this equation, assume that output growth is constant and denote the growth rate of output by $g$, so $Y_t - 1$ can be written as $1/(1 + g)$. And use the approximation $(1 + r)/(1 + g) = 1 + r - g$.

Using these two assumptions, rewrite the preceding equation as

$$\frac{B_t}{Y_t} = (1 + r - g) \frac{B_{t-1}}{Y_{t-1}} + \frac{G_t - T_t}{Y_t}$$

Finally, reorganize to get

$$\frac{B_t}{Y_{t-1}} - \frac{B_{t-1}}{Y_{t-1}} = (r - g) \frac{B_{t-1}}{Y_{t-1}} + \frac{G_t - T_t}{Y_t} \tag{23.5}$$

This took many steps, but the final relation has a simple interpretation.

The change in the debt ratio over time (the left side of the equation) is equal to the sum of two terms:
- The first term is the difference between the real interest rate and the growth rate times the initial debt ratio.
- The second term is the ratio of the primary deficit to GDP.

Compare equation (23.5), which gives the evolution of the ratio of debt to GDP, to equation (23.2), which gives the evolution of the level of debt itself. The difference is the presence of $r - g$ in equation (23.5) compared to $r$ in equation (23.2). The reason for the difference is simple: Suppose the primary deficit is zero. Debt will then increase at a rate equal to the real interest rate, $r$. But if GDP is growing as well, the ratio of debt to GDP will grow more slowly; it will grow at a rate equal to the real interest rate minus the growth rate of output, $r - g$.

Equation (23.5) implies that the increase in the ratio of debt to GDP will be larger:
- the higher the real interest rate,
- the lower the growth rate of output,
- the higher the initial debt ratio,
- the higher the ratio of the primary deficit to GDP.
How Countries Decreased Their Debt Ratios after World War II

After World War II, many countries had very high debt ratios, often in excess of 100% of GDP. Yet, two or three decades later, the debt ratios were much lower, often below 50%. How did they do it? The answer is given in Table 1.

Table 1 looks at four countries: Australia, Canada, New Zealand, and the United Kingdom. Column 1 gives the period during which debt ratios decreased. The first year is either 1945 or 1946. The last year is the year in which the debt ratio reached its lowest point; the period of adjustment varies from 13 years in Canada, to 30 years in the United Kingdom. Column 2 gives debt ratios at the start and at the end of the period. The most striking numbers here are those for the United Kingdom: an initial debt ratio of 270% of GDP in 1946 and an impressive decline, down to 47% in 1974.

To interpret the numbers in the table, go back to equation (23.5). It tells us that there are two, not mutually exclusive, ways in which a country can reduce its debt ratio. The first is through high primary surpluses. Suppose, for example, that \( \frac{1}{H_1} - g \) was equal to 0. Then the decrease in the debt ratio over some period would just be the sum of the ratios of primary surpluses to GDP over the period. The second is through a low \( \frac{1}{H_1} - g \), so either through low real interest rates or through high growth, or both.

With this in mind, columns 3 to 5 give first the average ratio of the primary balance to GDP, then the average growth rate of GDP and the average real interest rate, over the relevant period.

Look first at primary balances in column 3. Note how all four countries indeed ran primary surpluses on average over the period. But note also that these primary surpluses account only for a small part of the decline in the debt ratio. Look, for example, at the United Kingdom. The sum of the ratios of the primary surpluses to GDP over the period is equal to 2.1% times 30 = 63% of GDP, so accounting for less than a third of the decline in the debt ratio, 223% (270 – 47) of GDP.

Now look at the growth rates and the real interest rates in columns 4 and 5. Note how high growth rates and how low real interest rates were during the period. Take Australia, for example. The average value of \( (r - g) \) during the period was –6.9% (–2.3% – 4.6%). This implies that, even if the primary balance had been equal to zero, the debt ratio would have declined each year by 6.9%. In other words, the decline in debt was not mainly the result of primary surpluses, but the result of sustained high growth and sustained negative real interest rates.

This leads to a final question: Why were real interest rates so low? The answer is given in column 6. During the period, average inflation was relatively high. This inflation, combined with consistently low nominal interest rates, is what accounts for the negative real interest rates. Put another way, a large part of the decrease in debt ratios was achieved by paying bond holders a negative real return on their bonds for many years.

Building on this relation, the Focus box “How Countries Decreased Their Debt Ratios after World War II” shows how governments that inherited very high debt ratios at the end of the war steadily decreased them through a combination of low real interest rates, high growth rates, and primary surpluses. The next section shows how our analysis can also be used to shed light on a number of other fiscal policy issues.
Having looked at the mechanics of the government budget constraint, we can now take up three issues in which this constraint plays a central role.

Ricardian Equivalence

How does taking into account the government budget constraint affect the way we should think of the effects of deficits on output?

One extreme view is that once the government budget constraint is taken into account, neither deficits nor debt have an effect on economic activity! This argument is known as the Ricardian equivalence proposition. David Ricardo, a nineteenth-century English economist, was the first to articulate its logic. His argument was further developed and given prominence in the 1970s by Robert Barro, then at Chicago, now at Harvard University. For this reason, the argument is also known as the Ricardo-Barro proposition.

The best way to understand the logic of the proposition is to use the example of tax changes from Section 23-1:

- Suppose that the government decreases taxes by 1 (again, think one billion dollars) this year. And as it does so, it announces that, to repay the debt, it will increase taxes by $\frac{1}{1+r}$ next year. What will be the effect of the initial tax cut on consumption?

- One possible answer is: No effect at all. Why? Because consumers realize that the tax cut is not much of a gift: Lower taxes this year are exactly offset, in present value, by higher taxes next year. Put another way, their human wealth—the present value of after-tax labor income—is unaffected. Current taxes go down by 1, but the present value of next year’s taxes goes up by $\frac{1}{1+r}/(1 + r) = 1$, and the net effect of the two changes is exactly equal to zero.

- Another way of coming to the same answer—this time looking at saving rather than looking at consumption—is as follows: To say that consumers do not change their consumption in response to the tax cut is the same as saying that private saving increases one-for-one with the deficit. So the Ricardian equivalence proposition says that if a government finances a given path of spending through deficits, private saving will increase one-for-one with the decrease in public saving, leaving total saving unchanged. The total amount left for investment will not be affected. Over time, the mechanics of the government budget constraint imply that government debt will increase. But this increase will not come at the expense of capital accumulation.

Under the Ricardian equivalence proposition, a long sequence of deficits and the associated increase in government debt are no cause for worry. As the government is dissaving, the argument goes, people are saving more in anticipation of the higher taxes to come. The decrease in public saving is offset by an equal increase in private saving. Total saving is therefore unaffected, and so is investment. The economy has the same capital stock today that it would have had if there had been no increase in debt. High debt is no cause for concern.

How seriously should we take the Ricardian equivalence proposition? Most economists would answer: “Seriously, but surely not seriously enough to think that deficits and debt are irrelevant.” A major theme of this book has been that expectations matter; that consumption decisions depend not only on current income but also on future income. If it were widely believed that a tax cut this year is going to be followed by an

See Chapter 16 for a definition of human wealth and a discussion of its role in consumption.
offsetting increase in taxes next year, the effect on consumption would indeed probably be small. Many consumers would save most or all of the tax cut in anticipation of higher taxes next year. (Replace “year” by “month” or “week” and the argument becomes even more convincing.)

Of course, tax cuts rarely come with the announcement of corresponding tax increases a year later. Consumers have to guess when and how taxes will eventually be increased. This fact does not by itself invalidate the Ricardian equivalence argument: No matter when taxes will be increased, the government budget constraint still implies that the present value of future tax increases must always be equal to the decrease in taxes today. Take the second example we looked at in Section 23-1—drawn in Figure 23-1(b)—in which the government waits $t$ years to increase taxes, and so increases taxes by $(1 + r)^{t-1}$. The present value in year 0 of this expected tax increase is $(1 + r)^{t-1}/(1 + r)^{t-1} = 1$—exactly equal to the original tax cut. The change in human wealth from the tax cut is still zero.

But insofar as future tax increases appear more distant and their timing more uncertain, consumers are in fact more likely to ignore them. This may be the case because they expect to die before taxes go up, or, more likely, because they just do not think that far into the future. In either case, Ricardian equivalence is likely to fail.

So, it is safe to conclude that budget deficits have an important effect on activity—although perhaps a smaller effect than we thought before going through the Ricardian equivalence argument. In the short run, larger deficits are likely to lead to higher demand and to higher output. In the long run, higher government debt lowers capital accumulation and, as a result, lowers output.

**Deficits, Output Stabilization, and the Cyclically Adjusted Deficit**

The fact that budget deficits do, indeed, have long-run adverse effects on capital accumulation and, in turn, on output, does not imply that fiscal policy should not be used to reduce output fluctuations. Rather, it implies that deficits during recessions should be offset by surpluses during booms, so as not to lead to a steady increase in debt.

To help assess whether fiscal policy is on track, economists have constructed deficit measures that tell them what the deficit would be, under existing tax and spending rules, if output were at the natural level of output. Such measures come under many names, ranging from the full-employment deficit, to the mid-cycle deficit, to the standardized employment deficit, to the structural deficit (the term used by the OECD). We shall use cyclically adjusted deficit, the term we find the most intuitive.

Such a measure gives a simple benchmark against which to judge the direction of fiscal policy: If the actual deficit is large but the cyclically adjusted deficit is zero, then current fiscal policy is consistent with no systematic increase in debt over time. The debt will increase as long as output is below the natural level of output; but as output returns to its natural level, the deficit will disappear and the debt will stabilize.

It does not follow that the goal of fiscal policy should be to maintain a cyclically adjusted deficit equal to zero at all times. In a recession, the government may want to run a deficit large enough that even the cyclically adjusted deficit is positive. In this case, the fact that the cyclically adjusted deficit is positive provides a useful warning. The warning is that the return of output to its natural level will not be enough to stabilize the debt: The government will have to take specific measures, from tax increases to cuts in spending, to decrease the deficit at some point in the future.

The theory underlying the concept of cyclically adjusted deficit is simple. The practice of it has proven tricky. To see why, we need to look at how measures of the cyclically adjusted deficit are constructed. Construction requires two steps. First,
establish how much lower the deficit would be if output were, say, 1% higher. Second, assess how far output is from its natural level.

- The first step is straightforward. A reliable rule of thumb is that a 1% decrease in output leads automatically to an increase in the deficit of about 0.5% of GDP. This increase occurs because most taxes are proportional to output, whereas most government spending does not depend on the level of output. That means a decrease in output, which leads to a decrease in revenues and not much change in spending, naturally leads to a larger deficit.

If output is, say, 5% below its natural level, the deficit as a ratio to GDP will therefore be about 2.5% larger than it would be if output were at the natural level of output. (This effect of activity on the deficit has been called an automatic stabilizer: A recession naturally generates a deficit, and therefore a fiscal expansion, which partly counteracts the recession.)

- The second step is more difficult. Recall from Chapter 6 that the natural level of output is the output level that would be produced if the economy were operating at the natural rate of unemployment. Too low an estimate of the natural rate of unemployment will lead to too high an estimate of the natural level of output and therefore to too optimistic a measure of the cyclically adjusted deficit.

This difficulty explains in part what happened in Europe in the 1980s. Based on the assumption of an unchanged natural unemployment rate, the cyclically adjusted deficits of the 1980s did not look that bad: If European unemployment had returned to its level of the 1970s, the associated increase in output would have been sufficient to reestablish budget balance in most countries. But, it turned out, much of the increase in unemployment reflected an increase in the natural unemployment rate, and unemployment remained very high during the 1980s. As a result, the decade was characterized by high deficits and large increases in debt ratios in most countries.

**Wars and Deficits**

Wars typically bring about large budget deficits. As we saw in Chapter 22, the two largest increases in U.S. government debt in the twentieth century took place during World War I and World War II. We examine the case of World War II further in the Focus box “Deficits, Consumption, and Investment in the United States during World War II.”

Is it right for governments to rely so much on deficits to finance wars? After all, war economies are usually operating at low unemployment, so the output stabilization reasons for running deficits we just examined are irrelevant. The answer, nevertheless, is yes. In fact, there are two good reasons to run deficits during wars:

- The first is distributional: Deficit finance is a way to pass some of the burden of the war to those alive after the war, and it seems only fair for future generations to share in the sacrifices the war requires.

- The second is more narrowly economic: Deficit spending helps reduce tax distortions.

Let’s look at each reason in turn:

**Passing on the Burden of the War**

Wars lead to large increases in government spending. Consider the implications of financing this increased spending either through increased taxes or through debt. To distinguish this case from our earlier discussion of output stabilization, let’s also assume that output is fixed at the natural level of output.

- Suppose that the government relies on deficit finance. With government spending sharply up, there will be a very large increase in the demand for goods. Given...
Deficits, Consumption, and Investment in the United States during World War II

In 1939, the share of U.S. government spending on goods and services in GDP was 15%. By 1944, it had increased to 45%! The increase was due to increased spending on national defense, which went from 1% of GDP in 1939 to 36% in 1944.

Faced with such a massive increase in spending, the U.S. government reacted with large tax increases. For the first time in U.S. history, the individual income tax became a major source of revenues; individual income tax revenues, which were 1% of GDP in 1939, increased to 8.5% in 1944. But the tax increases were still far less than the increase in government expenditures. The increase in federal revenues, from 7.2% of GDP in 1939 to 22.7% in 1944, was only a little more than half the increase in expenditures.

The result was a sequence of large budget deficits. By 1944, the federal deficit reached 22% of GDP. The ratio of debt to GDP, already high at 53% in 1939 because of the deficits the government had run during the Great Depression, reached 110%!

Was the increase in government spending achieved at the expense of consumption or private investment? (As we saw in Chapter 19, it could in principle have come from higher imports and a current account deficit. But the United States had nobody to borrow from during the war. Rather, it was lending to some of its allies: Transfers from the U.S. government to foreign countries were equal to 6% of U.S. GDP in 1944.)

It was met in large part by a decrease in consumption: The share of consumption in GDP fell by 23 percentage points, from 74% to 51%. Part of the decrease in consumption may have been due to anticipations of higher taxes after the war; part of it was due to the unavailability of many consumer durables. Patriotism also probably motivated people to save more and buy the war bonds issued by the government to finance the war.

It was also met by a 6% decrease in the share of (private) investment in GDP—from 10% to 4%. Part of the burden of the war was therefore passed on in the form of lower capital accumulation to those living after the war.

Suppose instead that the government finances the spending increase through an increase in taxes—say income taxes. Consumption will decline sharply. Exactly how much depends on consumers’ expectations: The longer they expect the war to last, then the longer they will expect higher taxes to last, and the more they will decrease their consumption. In any case, the increase in government spending will be partly offset by a decrease in consumption. Interest rates will increase by less than they would have increased under deficit spending, and investment will therefore decrease by less.

In short, for a given output, the increase in government spending requires either a decrease in consumption and/or a decrease in investment. Whether the government relies on tax increases or deficits determines whether consumption or investment does more of the adjustment when government spending goes up.

How does this affect who bears the burden of the war? The more the government relies on deficits, the smaller the decrease in consumption during the war and the larger the decrease in investment. Lower investment means a lower capital stock after the war, and therefore lower output after the war. By reducing capital accumulation, deficits become a way of passing some of the burden of the war onto future generations.

Reducing Tax Distortions

There is another argument for running deficits, not only during wars but, more generally, in times when government spending is exceptionally high. Think, for example, of reconstruction after an earthquake or the costs involved in the reunification of Germany in the early 1990s.

The argument is as follows: If the government were to increase taxes in order to finance the temporary increase in spending, tax rates would have to be very high. Very
high tax rates can lead to very high economic distortions: Faced with very high income tax rates, people work less or engage in illegal, untaxed activities. Rather than moving the tax rate up and down so as to always balance the budget, it is better (from the point of view of reducing distortions) to maintain a relatively constant tax rate—to smooth taxes. Tax smoothing implies running large deficits when government spending is exceptionally high, and small surpluses the rest of the time.

**23-4 The Dangers of High Debt**

Suppose that, for good or bad reasons, large deficits have led to a high debt ratio. What should the government do then? Simply trying to stabilize the debt at this high level is unwise: The lesson from history is that high debt can lead to vicious cycles and makes the conduct of fiscal policy extremely difficult. Let’s look at this more closely.

**High Debt, Default Risk, and Vicious Cycles**

Return to equation (23.5):

\[
\frac{B_t}{Y_t} - \frac{B_{t-1}}{Y_{t-1}} = (r - g) \frac{B_{t-1}}{Y_{t-1}} + \frac{(G_t - T_t)}{Y_t}
\]

Take a country with a high debt ratio, say, 100%. Suppose the real interest rate is 3% and the growth rate is 2%. The first term on the right is \((3\% - 2\%) \times 100\% = 1\%\) of GDP. Suppose further that the government is running a primary surplus of 1%, thus just enough to keep the debt ratio constant (the right side of the equation equals \((3\% - 2\%) \times 100\% + (-1\%) = 0\%\)).

Now suppose financial investors start to worry that the government may not be able to fully repay the debt. They ask for a higher interest rate, to compensate for what they perceive as a higher risk of default on the debt. But this in turn makes it more difficult for the government to stabilize the debt. Suppose, for example, that the interest rate increases from 3% to, say, 8%. Then, just to stabilize the debt, the government now needs to run a primary surplus of 6% (the right side of the equation is then equal to \((8\% - 2\%) \times 100 + (-6 = 0)\)). Suppose that, in response to the increase in the interest rate, the government indeed takes measures to increase the primary surplus to 6%. The spending cuts or tax increases that are needed are likely to prove politically costly, potentially generating more political uncertainty, a higher risk of default, and thus a further increase in the interest rate. Also, the sharp fiscal contraction is likely to lead to a recession, decreasing the growth rate. Both the increase in the real interest rate and the decrease in growth further increase \((r - g)\), requiring an even larger surplus to stabilize the debt. At some point, the government may become unable to increase the primary surplus sufficiently, and the debt ratio starts increasing, leading financial markets to become even more worried and require an even higher interest rate. Increases in the interest rate and increases in the debt ratio feed on each other. The result is a debt explosion.

In short, the higher the ratio of debt to GDP, the larger the potential for catastrophic debt dynamics. Even if the fear that the government may not fully repay the debt was initially unfounded, it can easily become self-fulfilling. The increased interest the government must pay on its debt can lead the government to lose control of its budget and lead to an increase in debt to a level such that the government is unable to repay the debt, thus validating the initial fears.

The lesson is clear. When a government inherits a high debt ratio, it should aim at decreasing it over time. As equation (23.5) made clear, it can achieve this through a combination of primary surpluses, high growth rates, and low real interest rates.
The U.S. Budget Deficit Challenge

So far, investors do not appear worried about U.S. budget deficits. Even long-term interest rates on U.S. government bonds are very low. Nevertheless, it is clear that first stabilizing and then decreasing the U.S. debt ratio will require major adjustments in fiscal policy.

A useful starting point is to look at the evolution of federal deficits from 2011 to 2021 as projected by the Congressional Budget Office (or CBO for short). The CBO is a nonpartisan agency of Congress that helps Congress assess the costs and the effects of fiscal decisions; one of CBO’s tasks is to prepare projections of revenues, spending, and deficits under current fiscal rules. Figure 1 presents these projections, by fiscal year, as of January 2011. (The fiscal year runs from October 1 of the previous calendar year to September 30 of the current calendar year.)

The orange line shows projected deficits under current rules (these are called baseline projections). According to this projection, the future looks better than the present: The deficit decreases from close to 10% in 2011 to close to 3% in 2014.

Unfortunately, this projection is misleading. It is based on three assumptions—three budget rules that Congress has said it would follow, but is in fact unlikely to follow:

The first assumption is that nominal discretionary spending will increase only at the rate of inflation—in other words, will remain constant in real terms. A more realistic assumption, based on past experience, is that discretionary spending will increase at the same rate as GDP—in other words, that the ratio of discretionary spending to GDP will remain constant. The red line shows what will happen under this alternative assumption. The deficit stabilizes not at 3% of GDP but at more than 4% of GDP.

The second assumption is the provision that most of the tax cuts introduced by the Bush administration in 2001 and extended by the Obama administration will expire in 2012. It seems very likely that most of these tax reductions will instead continue past 2012.

The third assumption is that the rules governing the alternative minimum tax, or AMT, will not be changed. This alternative tax was introduced to ensure that the richest taxpayers would pay at least some taxes. Because the income threshold at which it is triggered is not indexed to

This is not CBO’s fault. In making projections, it is not allowed to second guess Congress.

![Figure 1: Deficit Projections. Federal Government Deficit, Fiscal Years 2010 to 2021](source)

Source: Congressional Budget Office, Tables 1-6 and 1-7; The Budget and Economic Outlook: Fiscal Years 2011 to 2021, January 2011.
inflation, the number of taxpayers subject to this alternative tax has steadily increased. It is widely believed that the tax will be redefined and the income threshold will be indexed.

The dark blue line shows the projected path of the deficit under the joint assumptions that discretionary spending will increase with nominal GDP, that tax cuts will be extended, and that the AMT will be indexed for inflation. Under these assumptions, the deficit stabilizes at 6% of GDP in 2012.

In short, looking at the medium run, the fiscal situation looks bad. And even more serious challenges arise in the longer run.

About half of U.S. federal spending is on entitlement programs. These are programs that require the payment of benefits to all who meet the eligibility requirements established by the law. The three largest programs are Social Security (which provides benefits to retirees), Medicare (which provides health care to retirees), and Medicaid (which provides health care to the poor). Table 1 shows actual and projected spending on each of these three programs, under current rules, as a percent of GDP, from 2011 to 2050.

The numbers are striking: Under current rules, Social Security benefits are projected to increase from 4.8% of GDP in 2011 to 5.9% in 2050. Medicare and Medicaid benefits are projected to increase from 5.6% to 11.8%. The ratio of entitlement spending to GDP (the sum of the two numbers) is projected therefore to increase by 7.3% of GDP over the next 40 years. These projected increases have two main sources:

- The first is the aging of America, the rapid increase in the proportion of people over 65 that will take place as the Baby Boom generation begins to reach retirement age, from year 2011 on. The old age dependency ratio—the ratio of the population 65 years old or more to the population between 20 and 64 years—is projected to increase from about 20% in 2000 to above 40% in 2050. This evolution explains the projected growth in Social Security benefits and some of the increase in Medicare.
- The second, which explains the rest of the growth of Medicare and all the growth in Medicaid, is the steadily and rapidly increasing cost of health care.

Can these increases in entitlement spending be offset by decreases in other government expenditures? The answer is a clear no. Even if all expenditures other than transfers were eliminated, there would still not be enough to cover the projected increase in entitlement spending: In 2010, total government expenditures, excluding interest payments and transfers, were equal to 7.9% of GDP, about the same as the 7.3% projected increase in entitlement spending.

It is therefore clear that major changes in entitlement programs will have to take place. Social Security benefits may have to be reduced (relative to projections), and the provision of medical care will have to be limited (again, relative to projections). There is also little doubt that taxes, such as the payroll taxes used to finance Social Security, will have to be increased. If such changes are not achieved, there will be good reasons to worry about U.S. debt dynamics.

<table>
<thead>
<tr>
<th>Table 1 Projected Spending on Social Security, Medicare, and Medicaid (Percent of GDP), 2011–2050</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Social Security</td>
</tr>
<tr>
<td>Medicare/Medicaid</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

Source: Congressional Budget Office. Figure 3-2 and Figure 4-1; CBO’s 2011 Long-Term Budget Outlook

At the time of writing, this is far from an abstract issue. Investors’ worries about default risk are affecting interest rates in a number of European countries in Europe. (For the time being, and despite the fact that the U.S. debt ratio is close to 100%, investors do not appear overly worried about the U.S. budget situation, and interest rates on U.S. government bonds have remained low. Whether investors should worry is discussed in the Focus box “The U.S. Budget Deficit Challenge.”)

Figure 23-2 shows the evolution of interest rates on government bonds for Italy, Spain, and Belgium from January to October 2011. For each country, it plots the difference, also called the spread, between the two-year interest rate on the country’s government bond and the two-year interest rate on German government bonds. The reason for comparing interest rates to German interest rates is that German bonds are considered nearly riskless. Thus, the spreads plotted in the figure reflect the risk
premia that investors require in order to hold the bonds of each of the three countries. The spreads are measured, on the vertical axis, in basis points (a basis point is a hundredth of a percent).

Note how all three spreads have increased since the beginning of 2011. As of October 2011, the spread on Italian bonds exceeded 400 basis points (equivalently, 4%), the spread on Spanish bonds exceeded 300 basis points, and the spread of Belgian bonds exceeded 200 basis points. These spreads make it more difficult for the governments to decrease their debt ratios. The worry is that, were the spreads were to increase further, the primary surpluses that would be needed to stabilize debt might not be politically feasible. So, in all three countries, governments are taking strong measures to convince markets that they will not only stabilize their debt ratios, but decrease them over time. If they succeed, interest rates will indeed come down, making it easier for governments to achieve their goal. When we read this book, we are likely to know whether they have succeeded or not.

We can now turn to the next question: What if a government does not succeed in stabilizing the debt, and debt and interest rates explode? Then, historically, one of two things happens: Either the government explicitly defaults on its debt; or the government relies increasingly on money finance, which typically leads to very high inflation. Let’s look at each outcome in turn.

**Debt Default**

At some point, when a government finds itself facing very high interest rates, it may decide to default. Default is often partial, and creditors take what is known as a haircut: A haircut of 30%, for example, means that creditors receive only 70% of what they were owed. Default also comes under many names, many of them euphemisms—probably to make the prospects more appealing (or less unappealing) to creditors. It is called debt restructuring, or debt rescheduling (when interest payments are deferred rather than cancelled), or, quite ironically, private sector involvement (the private sector, i.e., the creditors, are asked to get involved, i.e., to
accept a haircut). It may be unilaterally imposed by the government, or it may be the result of a negotiation with creditors: Creditors, knowing that they will not be fully repaid in any case, may prefer to work out a deal with the government. At the time of writing, Greece is indeed involved in negotiations with its creditors, with haircuts around 50%.

When debt is very high, default would seem like an appealing solution: Having a lower level of debt after default reduces the size of the required fiscal consolidation and thus makes it more credible. It lowers required taxes, potentially allowing for higher growth. But default comes with very high costs. If debt is held, for example, by pension funds, the retirees may suffer very much from the default. If it is held by banks, then banks may go bankrupt, with major adverse effects on the economy. If debt is held instead mostly by foreigners, then the country’s reputation may be lost, and it may be very difficult for the government to borrow abroad for a long time. So, in general, and rightly so, governments are very reluctant to default on their debt.

### Money Finance

Most of the time, fiscal and monetary policies proceed independently. The government finances its deficit through borrowing. The central bank chooses the supply of money so as to achieve its objective (for example, low inflation). But, when the fiscal situation is bad, either because deficits are large or debt is high, and the interest rate faced by the government is high, it becomes increasingly tempting for the government to want to finance itself through money finance. Fiscal policy then determines the behavior of the money supply, a case known as fiscal dominance.

Governments do not literally finance themselves through money creation. As we saw in Chapter 4, it is the central bank that creates money. But when the central bank finds itself in the fiscal dominance case, the central bank must do what the government tells it to do. The government issues new bonds and tells the central bank to buy them. The central bank then pays the government with the money it creates, and the government uses that money to finance its deficit. This process is called debt monetization.

How large a deficit can a government finance through such money creation? Let $H$ be the amount of central bank money in the economy. (We shall refer to central bank money simply as money for short in what follows.) Let $\Delta H$ be money creation; that is, the change in the nominal money stock from one month to the next. (When we look at numbers below, you will understand why we use the month rather than, say, the year, as the unit of time.) The revenue, in real terms (that is, in terms of goods), that the government generates by creating an amount of money equal to $\Delta H$ is therefore $\Delta H / P$—money creation during the period divided by the price level. This revenue from money creation is called seignorage.

We can summarize what we have just learned by writing

$$\text{seignorage} = \frac{\Delta H}{P}$$

Seignorage is equal to money creation divided by the price level. To see what rate of (central bank) nominal money growth is required to generate a given amount of seignorage, we can rewrite $\Delta H / P$ as

$$\frac{\Delta H}{P} = \frac{\Delta H}{H} \frac{H}{P}$$
In words: We can think of seignorage \( \frac{\Delta H}{P} \) as the product of the rate of nominal money growth \( \frac{\Delta H}{H} \) and the real money stock \( \frac{H}{P} \). Replacing this expression in the previous equation gives

\[
\text{seignorage} = \frac{\Delta H}{H} \frac{H}{P}
\]

This gives us a relation between seignorage, the rate of nominal money growth, and real money balances. To think about relevant magnitudes, it is convenient to take one more step and divide both sides of the equation by monthly GDP, \( Y \), to get:

\[
\frac{\text{seignorage}}{Y} = \frac{\Delta H}{H} \left( \frac{H}{P} \right) \frac{1}{Y}
\]

(23.6)

Suppose the government is running a budget deficit equal to 10% of GDP and decides to finance it through seignorage, so \( \frac{\text{deficit}}{Y} = \frac{\text{seignorage}}{Y} = 10\% \). The average ratio of central bank money to monthly GDP in advanced countries is roughly equal to 1, so choose \( \frac{H}{P} = 1 \). This implies that nominal money growth must satisfy

\[
\frac{\Delta H}{H} \times 1 = 10\% \Rightarrow \frac{\Delta H}{H} = 10\%
\]

To finance a deficit of 10% of GDP through seignorage, given a ratio of central bank money to monthly GDP of 1, the monthly growth rate of nominal money must be equal to 10%.

This is surely a very high rate of money growth, but one might conclude that this is an acceptable price to pay to finance the deficit. Unfortunately, this conclusion would be wrong. As money growth increases, inflation is likely to follow. And very high inflation is likely to lead people to want to reduce their demand for money, and in turn the demand for central bank money. In other words, as the government increases \( \frac{\Delta H}{H}, \frac{H}{P} \) is likely to decrease. As it does so, the government needs to increase the rate of money growth further to achieve the same level of revenues. But higher money growth leads to further inflation, a further decrease in \( \frac{H}{P} \), and the need for further money growth. Soon, high inflation is likely to turn into \textit{hyperc inflation}, the term that economists use for very high inflation—typically inflation in excess of 30% per month.

This scenario has been replayed many times in the past. You probably have heard of the hyperinflation that existed in post World War I Germany: In 1913, the value of all currency circulating in Germany was 6 billion marks. Ten years later, in October 1923, 6 billion marks was barely enough to buy a one-kilo loaf of rye bread in Berlin. A month later, the price of the same loaf of bread had increased to 428 billion marks. But the German hyperinflation is not the only one. Table 23-1 summarizes the seven major hyperinflations that followed World War I and World War II. They share a number of features. They were all short (lasting a year or so) but intense, with money growth and inflation running at 50% \textit{per month} or more. In all, the increases in the price levels were staggering. As we can see, the largest price increase actually occurred not in Germany, but in Hungary after World War II. What cost one Hungarian pengö in August 1945, cost 3,800 trillions of trillions of pengös less than a year later!

Inflation rates of that magnitude have not been seen since the 1940s. But many countries have experienced very high inflation as a result of money finance. Monthly inflation ran above 20% in many Latin American countries in the late 1980s. The most recent example of very high inflation is Zimbabwe, where, in 2008, monthly inflation reached 500% before a stabilization program was adopted in early 2009.

Hungary has the distinction of having not one, but two hyperinflations in this period, one after World War I and one after World War II.
It will come as no surprise that hyperinflations have enormous economic costs:

■ The transaction system works less and less well. One famous example of inefficient exchange occurred in Germany at the end of its hyperinflation: People actually had to use wheelbarrows to cart around the huge amounts of currency they needed for their daily transactions.

■ Price signals become less and less useful: Because prices change so often, it is difficult for consumers and producers to assess the relative prices of goods and to make informed decisions. The evidence shows that the higher the rate of inflation, the higher the variation in the relative prices of different goods. Thus the price system, which is crucial to the functioning of a market economy, also becomes less and less efficient.

■ Swings in the inflation rate become larger. It becomes harder to predict what inflation will be in the near future, whether it will be, say, 500% or 1,000% over the next year. Borrowing at a given nominal interest rate becomes more and more of a gamble. If we borrow at, say, 1,000% for a year, we may end up paying a real interest rate of 500% or 0%; a large difference! The result is that borrowing and lending typically come to a stop in the final months of hyperinflation, leading to a large decline in investment.

So, as inflation becomes very high, there is typically an increasing consensus that it should be stopped. Eventually, the government reduces the deficit and no longer has recourse to money finance. Inflation stops, but not before the economy has suffered substantial costs.

How likely is such a scenario to play again in the future? Much depends on the relation between the government and the central bank. To the extent that central banks have become more independent, the danger is lower than in the past. But it cannot be excluded.

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Table 23-1 Seven Hyperinflations of the 1920s and 1940s

<table>
<thead>
<tr>
<th>Country</th>
<th>Start</th>
<th>End</th>
<th>(P_T / P_0)</th>
<th>Average Monthly Inflation Rate (%)</th>
<th>Average Monthly Money Growth (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>Oct. 1921</td>
<td>Aug. 1922</td>
<td>70</td>
<td>47</td>
<td>31</td>
</tr>
<tr>
<td>Germany</td>
<td>Aug. 1922</td>
<td>Nov. 1923</td>
<td>(1.0 \times 10^0)</td>
<td>322</td>
<td>314</td>
</tr>
<tr>
<td>Greece</td>
<td>Nov. 1943</td>
<td>Nov. 1944</td>
<td>(4.7 \times 10^6)</td>
<td>365</td>
<td>220</td>
</tr>
<tr>
<td>Hungary 1</td>
<td>Mar. 1923</td>
<td>Feb. 1924</td>
<td>44</td>
<td>46</td>
<td>33</td>
</tr>
<tr>
<td>Hungary 2</td>
<td>Aug. 1945</td>
<td>Jul. 1946</td>
<td>(3.8 \times 10^{27})</td>
<td>19,800</td>
<td>12,200</td>
</tr>
<tr>
<td>Poland</td>
<td>Jan. 1923</td>
<td>Jan. 1924</td>
<td>699</td>
<td>82</td>
<td>72</td>
</tr>
<tr>
<td>Russia</td>
<td>Dec. 1921</td>
<td>Jan. 1924</td>
<td>(1.2 \times 10^5)</td>
<td>57</td>
<td>49</td>
</tr>
</tbody>
</table>

\(P_T / P_0\): Price level in the last month of hyperinflation divided by the price level in the first month.


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A joke heard in Israel during the high inflation of the 1980s: “Why is it cheaper to take the taxi rather than the bus? Because in the bus, you have to pay the fare at the beginning of the ride. In the taxi, you pay only at the end.”

We are discussing here the costs of very high inflation. The discussion today in OECD countries is about the costs of, say, 4% inflation versus 0%. The issues are quite different in that case, and we return to this topic in Chapter 24.