Science is a parasite: the greater the patient population the better the advance in physiology and pathology; and out of pathology arises therapy. The year 1932 was the trough of the great depression, and from its rotten soil was belatedly begot a new subject that today we call macroeconomics.

—Paul Samuelson

In Chapter 11 we assembled the pieces of the IS–LM model as a step toward understanding short-run economic fluctuations. We saw that the IS curve represents the equilibrium in the market for goods and services, that the LM curve represents the equilibrium in the market for real money balances, and that the IS and LM curves together determine the interest rate and national income in the short run when the price level is fixed. Now we turn our attention to applying the IS–LM model to analyze three issues.

First, we examine the potential causes of fluctuations in national income. We use the IS–LM model to see how changes in the exogenous variables (government purchases, taxes, and the money supply) influence the endogenous variables (the interest rate and national income) for a given price level. We also examine how various shocks to the goods market (the IS curve) and the money market (the LM curve) affect the interest rate and national income in the short run.

Second, we discuss how the IS–LM model fits into the model of aggregate supply and aggregate demand we introduced in Chapter 10. In particular, we examine how the IS–LM model provides a theory to explain the slope and position of the aggregate demand curve. Here we relax the assumption that the price level is fixed and show that the IS–LM model implies a negative relationship between the price level and national income. The model can also tell us what events shift the aggregate demand curve and in what direction.

Third, we examine the Great Depression of the 1930s. As this chapter’s opening quotation indicates, this episode gave birth to short-run macroeconomic theory, for it led Keynes and his many followers to argue that aggregate demand...
was the key to understanding fluctuations in national income. With the benefit of hindsight, we can use the IS–LM model to discuss the various explanations of this traumatic economic downturn.

The IS–LM model has played a central role in the history of economic thought, and it offers a powerful lens through which to view economic history, but it has much modern significance as well. Throughout this chapter we will see that the model can also be used to shed light on more recent fluctuations in the economy; two case studies in the chapter use it to examine the recessions that began in 2001 and 2008. Moreover, as we will see in Chapter 15, the logic of the IS–LM model provides a good foundation for understanding newer and more sophisticated theories of the business cycle.

12-1 Explaining Fluctuations With the IS–LM Model

The intersection of the IS curve and the LM curve determines the level of national income. When one of these curves shifts, the short-run equilibrium of the economy changes, and national income fluctuates. In this section we examine how changes in policy and shocks to the economy can cause these curves to shift.

How Fiscal Policy Shifts the IS Curve and Changes the Short-Run Equilibrium

We begin by examining how changes in fiscal policy (government purchases and taxes) alter the economy’s short-run equilibrium. Recall that changes in fiscal policy influence planned expenditure and thereby shift the IS curve. The IS–LM model shows how these shifts in the IS curve affect income and the interest rate.

Changes in Government Purchases Consider an increase in government purchases of ΔG. The government-purchases multiplier in the Keynesian cross tells us that this change in fiscal policy raises the level of income at any given interest rate by ΔG/(1 − MPC). Therefore, as Figure 12-1 shows, the IS curve shifts to the right by this amount. The equilibrium of the economy moves from point A to point B. The increase in government purchases raises both income and the interest rate.

To understand fully what’s happening in Figure 12-1, it helps to keep in mind the building blocks for the IS–LM model from the preceding chapter—the Keynesian cross and the theory of liquidity preference. Here is the story. When the government increases its purchases of goods and services, the economy’s planned expenditure rises. The increase in planned expenditure stimulates the production of goods and services, which causes total income Y to rise. These effects should be familiar from the Keynesian cross.

Now consider the money market, as described by the theory of liquidity preference. Because the economy’s demand for money depends on income, the rise
in total income increases the quantity of money demanded at every interest rate. The supply of money, however, has not changed, so higher money demand causes the equilibrium interest rate $r$ to rise.

The higher interest rate arising in the money market, in turn, has ramifications back in the goods market. When the interest rate rises, firms cut back on their investment plans. This fall in investment partially offsets the expansionary effect of the increase in government purchases. Thus, the increase in income in response to a fiscal expansion is smaller in the IS–LM model than it is in the Keynesian cross (where investment is assumed to be fixed). You can see this in Figure 12-1. The horizontal shift in the IS curve equals the rise in equilibrium income in the Keynesian cross. This amount is larger than the increase in equilibrium income here in the IS–LM model. The difference is explained by the crowding out of investment due to a higher interest rate.

**Changes in Taxes**  In the IS–LM model, changes in taxes affect the economy much the same as changes in government purchases do, except that taxes affect expenditure through consumption. Consider, for instance, a decrease in taxes of $\Delta T$. The tax cut encourages consumers to spend more and, therefore, increases planned expenditure. The tax multiplier in the Keynesian cross tells us that this change in policy raises the level of income at any given interest rate by $\Delta T \times MPC / (1 - MPC)$. Therefore, as Figure 12-2 illustrates, the IS curve shifts to the right by this amount. The equilibrium of the economy moves from point A to point B. The tax cut raises both income and the interest rate. Once again, because the higher interest rate depresses investment, the increase in income is smaller in the IS–LM model than it is in the Keynesian cross.
How Monetary Policy Shifts the $LM$ Curve and Changes the Short-Run Equilibrium

We now examine the effects of monetary policy. Recall that a change in the money supply alters the interest rate that equilibrates the money market for any given level of income and, thus, shifts the $LM$ curve. The $IS$–$LM$ model shows how a shift in the $LM$ curve affects income and the interest rate.

Consider an increase in the money supply. An increase in $M$ leads to an increase in real money balances $M/P$ because the price level $P$ is fixed in the short run. The theory of liquidity preference shows that for any given level of income, an increase in real money balances leads to a lower interest rate. Therefore, the $LM$ curve shifts downward, as in Figure 12-3. The equilibrium moves from point A to point B. The increase in the money supply lowers the interest rate and raises the level of income.

Once again, to tell the story that explains the economy’s adjustment from point A to point B, we rely on the building blocks of the $IS$–$LM$ model—the Keynesian cross and the theory of liquidity preference. This time, we begin with the money market, where the monetary-policy action occurs. When the Federal Reserve increases the supply of money, people have more money than they want to hold at the prevailing interest rate. As a result, they start depositing this extra money in banks or using it to buy bonds. The interest rate $r$ then falls until people are willing to hold all the extra money that the Fed has created; this brings the money market to a new equilibrium. The lower interest rate, in turn, has ramifications for the goods market. A lower interest rate stimulates planned investment, which increases planned expenditure, production, and income $Y$. 

FIGURE 12-2
A Decrease in Taxes in the $IS$–$LM$ Model
A decrease in taxes shifts the $IS$ curve to the right. The equilibrium moves from point A to point B. Income rises from $Y_1$ to $Y_2$, and the interest rate rises from $r_1$ to $r_2$. 

3. ... and the interest rate.

2. ... which raises income ...

1. The IS curve shifts to the right by $\Delta T \times \frac{MPC}{1 - MPC}$
Thus, the IS–LM model shows that monetary policy influences income by changing the interest rate. This conclusion sheds light on our analysis of monetary policy in Chapter 10. In that chapter we showed that in the short run, when prices are sticky, an expansion in the money supply raises income. But we did not discuss how a monetary expansion induces greater spending on goods and services—a process called the monetary transmission mechanism. The IS–LM model shows an important part of that mechanism: An increase in the money supply lowers the interest rate, which stimulates investment and thereby expands the demand for goods and services. The next chapter shows that in open economies, the exchange rate also has a role in the monetary transmission mechanism; for large economies such as that of the United States, however, the interest rate has the leading role.

The Interaction Between Monetary and Fiscal Policy

When analyzing any change in monetary or fiscal policy, it is important to keep in mind that the policymakers who control these policy tools are aware of what the other policymakers are doing. A change in one policy, therefore, may influence the other, and this interdependence may alter the impact of a policy change.

For example, suppose Congress raises taxes. What effect will this policy have on the economy? According to the IS–LM model, the answer depends on how the Fed responds to the tax increase.

Figure 12–4 shows three of the many possible outcomes. In panel (a), the Fed holds the money supply constant. The tax increase shifts the IS curve to the left. Income falls (because higher taxes reduce consumer spending), and the interest rate falls (because lower income reduces the demand for money). The fall in income indicates that the tax hike causes a recession.
The Response of the Economy to a Tax Increase

How the economy responds to a tax increase depends on how the central bank responds.

In panel (a) the Fed holds the money supply constant. In panel (b) the Fed holds the interest rate constant by reducing the money supply. In panel (c) the Fed holds the level of income constant by increasing the money supply. In each case, the economy moves from point A to point B.
In panel (b), the Fed wants to hold the interest rate constant. In this case, when the tax increase shifts the IS curve to the left, the Fed must decrease the money supply to keep the interest rate at its original level. This fall in the money supply shifts the LM curve upward. The interest rate does not fall, but income falls by a larger amount than if the Fed had held the money supply constant. Whereas in panel (a) the lower interest rate stimulated investment and partially offset the contractionary effect of the tax hike, in panel (b) the Fed deepens the recession by keeping the interest rate high.

In panel (c), the Fed wants to prevent the tax increase from lowering income. It must, therefore, raise the money supply and shift the LM curve downward enough to offset the shift in the IS curve. In this case, the tax increase does not cause a recession, but it does cause a large fall in the interest rate. Although the level of income is not changed, the combination of a tax increase and a monetary expansion does change the allocation of the economy’s resources. The higher taxes depress consumption, while the lower interest rate stimulates investment. Income is not affected because these two effects exactly balance.

From this example we can see that the impact of a change in fiscal policy depends on the policy the Fed pursues—that is, on whether it holds the money supply, the interest rate, or the level of income constant. More generally, whenever analyzing a change in one policy, we must make an assumption about its effect on the other policy. The most appropriate assumption depends on the case at hand and the many political considerations that lie behind economic policymaking.

**Shocks in the IS–LM Model**

Because the IS–LM model shows how national income is determined in the short run, we can use the model to examine how various economic disturbances affect income. So far we have seen how changes in fiscal policy shift the IS curve and how changes in monetary policy shift the LM curve. Similarly, we can group other disturbances into two categories: shocks to the IS curve and shocks to the LM curve.

Shocks to the IS curve are exogenous changes in the demand for goods and services. Some economists, including Keynes, have emphasized that such changes in demand can arise from investors’ *animal spirits*—exogenous and perhaps
self-fulfilling waves of optimism and pessimism. For example, suppose that firms become pessimistic about the future of the economy and that this pessimism causes them to build fewer new factories. This reduction in the demand for investment goods causes a contractionary shift in the investment function: at every interest rate, firms want to invest less. The fall in investment reduces planned expenditure and shifts the IS curve to the left, reducing income and employment. This fall in equilibrium income in part validates the firms’ initial pessimism.

Shocks to the IS curve may also arise from changes in the demand for consumer goods. Suppose, for instance, that the election of a popular president increases consumer confidence in the economy. This induces consumers to save less for the future and consume more today. We can interpret this change as an upward shift in the consumption function. This shift in the consumption function increases planned expenditure and shifts the IS curve to the right, and this raises income.

Shocks to the LM curve arise from exogenous changes in the demand for money. For example, suppose that new restrictions on credit card availability increase the amount of money people choose to hold. According to the theory of liquidity preference, when money demand rises, the interest rate necessary to equilibrate the money market is higher (for any given level of income and money supply). Hence, an increase in money demand shifts the LM curve upward, which tends to raise the interest rate and depress income.

In summary, several kinds of events can cause economic fluctuations by shifting the IS curve or the LM curve. Remember, however, that such fluctuations are not inevitable. Policymakers can try to use the tools of monetary and fiscal policy to offset exogenous shocks. If policymakers are sufficiently quick and skillful (admittedly, a big if), shocks to the IS or LM curves need not lead to fluctuations in income or employment.

**CASE STUDY**

**The U.S. Recession of 2001**

In 2001, the U.S. economy experienced a pronounced slowdown in economic activity. The unemployment rate rose from 3.9 percent in September 2000 to 4.9 percent in August 2001, and then to 6.3 percent in June 2003. In many ways, the slowdown looked like a typical recession driven by a fall in aggregate demand.

Three notable shocks explain this event. The first was a decline in the stock market. During the 1990s, the stock market experienced a boom of historic proportions, as investors became optimistic about the prospects of the new information technology. Some economists viewed the optimism as excessive at the time, and in hindsight this proved to be the case. When the optimism faded, average stock prices fell by about 25 percent from August 2000 to August 2001. The fall in the market reduced household wealth and thus consumer spending. In addition, the declining perceptions of the profitability of the new technologies led to a fall in investment spending. In the language of the IS–LM model, the IS curve shifted to the left.
The second shock was the terrorist attacks on New York City and Washington, DC, on September 11, 2001. In the week after the attacks, the stock market fell another 12 percent, which at the time was the biggest weekly loss since the Great Depression of the 1930s. Moreover, the attacks increased uncertainty about what the future would hold. Uncertainty can reduce spending because households and firms postpone some of their plans until the uncertainty is resolved. Thus, the terrorist attacks shifted the IS curve farther to the left.

The third shock was a series of accounting scandals at some of the nation’s most prominent corporations, including Enron and WorldCom. The result of these scandals was the bankruptcy of some companies that had fraudulently represented themselves as more profitable than they truly were, criminal convictions for the executives who had been responsible for the fraud, and new laws aimed at regulating corporate accounting standards more thoroughly. These events further depressed stock prices and discouraged business investment—a third leftward shift in the IS curve.

Fiscal and monetary policymakers responded quickly to these events. Congress passed a major tax cut in 2001, including an immediate tax rebate, and a second major tax cut in 2003. One goal of these tax cuts was to stimulate consumer spending. (See the Case Study on Cutting Taxes to Stimulate the Economy in Chapter 11.) In addition, after the terrorist attacks, Congress increased government spending by appropriating funds to assist in New York’s recovery and to bail out the ailing airline industry. These fiscal measures shifted the IS curve to the right.

At the same time, the Federal Reserve pursued expansionary monetary policy, shifting the LM curve to the right. Money growth accelerated, and interest rates fell. The interest rate on three-month Treasury bills fell from 6.2 percent in November 2000 to 3.4 percent in August 2001, just before the terrorist attacks. After the attacks and corporate scandals hit the economy, the Fed increased its monetary stimulus, and the Treasury bill rate fell to 0.9 percent in July 2003—the lowest level in many decades.

Expansionary monetary and fiscal policy had the intended effects. Economic growth picked up in the second half of 2003 and was strong throughout 2004. By July 2005, the unemployment rate was back down to 5.0 percent, and it stayed at or below that level for the next several years. Unemployment would begin rising again in 2008, however, when the economy experienced another recession. The causes of the 2008 recession are examined in another Case Study later in this chapter.

What Is the Fed’s Policy Instrument—The Money Supply or the Interest Rate?

Our analysis of monetary policy has been based on the assumption that the Fed influences the economy by controlling the money supply. By contrast, when the media report on changes in Fed policy, they often just say that the Fed has raised or lowered interest rates. Which is right? Even though these two views may seem different, both are correct, and it is important to understand why.
In recent years, the Fed has used the federal funds rate—the interest rate that banks charge one another for overnight loans—as its short-term policy instrument. When the Federal Open Market Committee meets about every six weeks to set monetary policy, it votes on a target for this interest rate that will apply until the next meeting. After the meeting is over, the Fed’s bond traders (who are located in New York) are told to conduct the open-market operations necessary to hit that target. These open-market operations change the money supply and shift the \(LM\) curve so that the equilibrium interest rate (determined by the intersection of the \(IS\) and \(LM\) curves) equals the target interest rate that the Federal Open Market Committee has chosen.

As a result of this operating procedure, Fed policy is often discussed in terms of changing interest rates. Keep in mind, however, that behind these changes in interest rates are the necessary changes in the money supply. A newspaper might report, for instance, that “the Fed has lowered interest rates.” To be more precise, we can translate this statement as meaning “the Federal Open Market Committee has instructed the Fed bond traders to buy bonds in open-market operations so as to increase the money supply, shift the \(LM\) curve, and reduce the equilibrium interest rate to hit a new lower target.”

Why has the Fed chosen to use an interest rate, rather than the money supply, as its short-term policy instrument? One possible answer is that shocks to the \(LM\) curve are more prevalent than shocks to the \(IS\) curve. When the Fed targets interest rates, it automatically offsets \(LM\) shocks by adjusting the money supply, although this policy exacerbates \(IS\) shocks. If \(LM\) shocks are the more prevalent type, then a policy of targeting the interest rate leads to greater economic stability than a policy of targeting the money supply. (Problem 8 at the end of this chapter asks you to analyze this issue more fully.)

In Chapter 15 we extend our theory of short-run fluctuations to explicitly include a monetary policy that targets the interest rate and that changes its target in response to economic conditions. The \(IS–LM\) model presented here is a useful foundation for that more complicated and realistic analysis. One lesson from the \(IS–LM\) model is that when a central bank sets the money supply, it determines the equilibrium interest rate. Thus, in some ways, setting the money supply and setting the interest rate are two sides of the same coin.

**12-2 IS–LM as a Theory of Aggregate Demand**

We have been using the \(IS–LM\) model to explain national income in the short run when the price level is fixed. To see how the \(IS–LM\) model fits into the model of aggregate supply and aggregate demand introduced in Chapter 10, we now examine what happens in the \(IS–LM\) model if the price level is allowed to change. By examining the effects of changing the price level, we can finally deliver what was promised when we began our study of the \(IS–LM\) model: a theory to explain the position and slope of the aggregate demand curve.
Recall from Chapter 10 that the aggregate demand curve describes a relationship between the price level and the level of national income. In Chapter 10 this relationship was derived from the quantity theory of money. That analysis showed that for a given money supply, a higher price level implies a lower level of income. Increases in the money supply shift the aggregate demand curve to the right, and decreases in the money supply shift the aggregate demand curve to the left.

To understand the determinants of aggregate demand more fully, we now use the IS–LM model, rather than the quantity theory, to derive the aggregate demand curve. First, we use the IS–LM model to show why national income falls as the price level rises—that is, why the aggregate demand curve is downward sloping. Second, we examine what causes the aggregate demand curve to shift.

To explain why the aggregate demand curve slopes downward, we examine what happens in the IS–LM model when the price level changes. This is done in Figure 12-5. For any given money supply $M$, a higher price level $P$ reduces the supply of real money balances $M/P$. A lower supply of real money balances shifts the $LM$ curve upward, which raises the equilibrium interest rate and lowers the equilibrium level of income, as shown in panel (a). Here the price level rises from $P_1$ to $P_2$, and income falls from $Y_1$ to $Y_2$. The aggregate demand curve in panel (b) plots this negative relationship between national income and the price level. In other words, the aggregate demand curve shows the set of equilibrium points that arise in the IS–LM model as we vary the price level and see what happens to income.

**FIGURE 12-5**

(a) The IS–LM Model

1. A higher price level $P$ shifts the $LM$ curve upward, ...

2. ... lowering income $Y$.

(b) The Aggregate Demand Curve

3. The AD curve summarizes the relationship between $P$ and $Y$.

**Deriving the Aggregate Demand Curve with the IS–LM Model** Panel (a) shows the IS–LM model: an increase in the price level from $P_1$ to $P_2$ lowers real money balances and thus shifts the $LM$ curve upward. The shift in the $LM$ curve lowers income from $Y_1$ to $Y_2$. Panel (b) shows the aggregate demand curve summarizing this relationship between the price level and income: the higher the price level, the lower the level of income.
What causes the aggregate demand curve to shift? Because the aggregate demand curve summarizes the results from the IS–LM model, events that shift the IS curve or the LM curve (for a given price level) cause the aggregate demand curve to shift. For instance, an increase in the money supply raises income in the IS–LM model for any given price level; it thus shifts the aggregate demand curve to the right, as shown in panel (a) of Figure 12-6. Similarly, an increase in government purchases or a decrease in taxes raises income in the

**FIGURE 12-6**

(a) Expansionary Monetary Policy

1. A monetary expansion shifts the LM curve, ...

(b) Expansionary Fiscal Policy

1. A fiscal expansion shifts the IS curve, ...

How Monetary and Fiscal Policies Shift the Aggregate Demand Curve Panel (a) shows a monetary expansion. For any given price level, an increase in the money supply raises real money balances, shifts the LM curve downward, and raises income. Hence, an increase in the money supply shifts the aggregate demand curve to the right. Panel (b) shows a fiscal expansion, such as an increase in government purchases or a decrease in taxes. The fiscal expansion shifts the IS curve to the right and, for any given price level, raises income. Hence, a fiscal expansion shifts the aggregate demand curve to the right.
IS–LM model for a given price level; it also shifts the aggregate demand curve to the right, as shown in panel (b) of Figure 12-6. Conversely, a decrease in the money supply, a decrease in government purchases, or an increase in taxes lowers income in the IS–LM model and shifts the aggregate demand curve to the left. Anything that changes income in the IS–LM model other than a change in the price level causes a shift in the aggregate demand curve. The factors shifting aggregate demand include not only monetary and fiscal policy but also shocks to the goods market (the IS curve) and shocks to the money market (the LM curve).

We can summarize these results as follows: A change in income in the IS–LM model resulting from a change in the price level represents a movement along the aggregate demand curve. A change in income in the IS–LM model for a given price level represents a shift in the aggregate demand curve.

### The IS–LM Model in the Short Run and Long Run

The IS–LM model is designed to explain the economy in the short run when the price level is fixed. Yet, now that we have seen how a change in the price level influences the equilibrium in the IS–LM model, we can also use the model to describe the economy in the long run when the price level adjusts to ensure that the economy produces at its natural rate. By using the IS–LM model to describe the long run, we can show clearly how the Keynesian model of income determination differs from the classical model of Chapter 3.

Panel (a) of Figure 12-7 shows the three curves that are necessary for understanding the short-run and long-run equilibria: the IS curve, the LM curve,
and the vertical line representing the natural level of output $\bar{Y}$. The $LM$ curve is, as always, drawn for a fixed price level $P_1$. The short-run equilibrium of the economy is point K, where the $IS$ curve crosses the $LM$ curve. Notice that in this short-run equilibrium, the economy’s income is less than its natural level.

Panel (b) of Figure 12-7 shows the same situation in the diagram of aggregate supply and aggregate demand. At the price level $P_1$, the quantity of output demanded is below the natural level. In other words, at the existing price level, there is insufficient demand for goods and services to keep the economy producing at its potential.

In these two diagrams we can examine the short-run equilibrium at which the economy finds itself and the long-run equilibrium toward which the economy gravitates. Point K describes the short-run equilibrium, because it assumes that the price level is stuck at $P_1$. Eventually, the low demand for goods and services causes prices to fall, and the economy moves back toward its natural rate. When the price level reaches $P_2$, the economy is at point C, the long-run equilibrium. The diagram of aggregate supply and aggregate demand shows that at point C, the quantity of goods and services demanded equals the natural level of output. This long-run equilibrium is achieved in the $IS$–$LM$ diagram by a shift in the $LM$ curve: the fall in the price level raises real money balances and therefore shifts the $LM$ curve to the right.

We can now see the key difference between the Keynesian and classical approaches to the determination of national income. The Keynesian assumption (represented by point K) is that the price level is stuck. Depending on monetary policy, fiscal policy, and the other determinants of aggregate demand, output may deviate from its natural level. The classical assumption (represented by point C) is that the price level is fully flexible. The price level adjusts to ensure that national income is always at its natural level.

To make the same point somewhat differently, we can think of the economy as being described by three equations. The first two are the $IS$ and $LM$ equations:

\[
Y = C(Y - T) + I(r) + G \quad IS,
\]

\[
M/P = L(r, Y) \quad LM.
\]

The $IS$ equation describes the equilibrium in the goods market, and the $LM$ equation describes the equilibrium in the money market. These two equations contain three endogenous variables: $Y$, $P$, and $r$. To complete the system, we need a third equation. The Keynesian approach completes the model with the assumption of fixed prices, so the Keynesian third equation is

\[
P = P_1.
\]

This assumption implies that the remaining two variables $r$ and $Y$ must adjust to satisfy the remaining two equations $IS$ and $LM$. The classical approach completes the model with the assumption that output reaches its natural level, so the classical third equation is

\[
Y = \bar{Y}.
\]

This assumption implies that the remaining two variables $r$ and $P$ must adjust to satisfy the remaining two equations $IS$ and $LM$. Thus, the classical approach fixes
output and allows the price level to adjust to satisfy the goods and money market equilibrium conditions, whereas the Keynesian approach fixes the price level and lets output move to satisfy the equilibrium conditions.

Which assumption is most appropriate? The answer depends on the time horizon. The classical assumption best describes the long run. Hence, our long-run analyses of national income in Chapter 3 and prices in Chapter 5 assume that output equals its natural level. The Keynesian assumption best describes the short run. Therefore, our analysis of economic fluctuations relies on the assumption of a fixed price level.

12-3 The Great Depression

Now that we have developed the model of aggregate demand, let’s use it to address the question that originally motivated Keynes: what caused the Great Depression? Even today, almost a century after the event, economists continue to debate the cause of this major economic downturn. The Great Depression provides an extended case study to show how economists use the IS–LM model to analyze economic fluctuations.¹

Before turning to the explanations economists have proposed, look at Table 12-1, which presents some statistics regarding the Depression. These statistics are the battlefield on which debate about the Depression takes place. What do you think happened? An IS shift? An LM shift? Or something else?

The Spending Hypothesis: Shocks to the IS Curve

Table 12-1 shows that the decline in income in the early 1930s coincided with falling interest rates. This fact has led some economists to suggest that the cause of the decline may have been a contractionary shift in the IS curve. This view is sometimes called the spending hypothesis because it places primary blame for the Depression on an exogenous fall in spending on goods and services.

Economists have attempted to explain this decline in spending in several ways. Some argue that a downward shift in the consumption function caused the contractionary shift in the IS curve. The stock market crash of 1929 may have been partly responsible for this shift: by reducing wealth and increasing uncertainty about the future prospects of the U.S. economy, the crash may have induced consumers to save more of their income rather than spend it.

Others explain the decline in spending by pointing to the large drop in investment in housing. Some economists believe that the residential investment boom of the 1920s was excessive and that once this “overbuilding” became apparent,

the demand for residential investment declined drastically. Another possible explanation for the fall in residential investment is the reduction in immigration in the 1930s: a more slowly growing population demands less new housing.

Once the Depression began, several events occurred that could have reduced spending further. First, many banks failed in the early 1930s, in part because of inadequate bank regulation, and these bank failures may have exacerbated the fall in investment spending. Banks play the crucial role of getting the funds available for investment to those households and firms that can best use them. The closing of many banks in the early 1930s may have prevented some businesses from getting the funds they needed for capital investment and, therefore, may have led to a further contraction in investment spending.²

The fiscal policy of the 1930s also contributed to the contractionary shift in the IS curve. Politicians at that time were more concerned with balancing the budget than with using fiscal policy to keep production and employment at their natural levels. The Revenue Act of 1932 increased various taxes, especially those falling on lower- and middle-income consumers.³ The Democratic platform of that year expressed concern about the budget deficit and advocated an “immediate and drastic reduction

---
of governmental expenditures.” In the midst of historically high unemployment, policymakers searched for ways to raise taxes and reduce government spending.

There are, therefore, several ways to explain a contractionary shift in the IS curve. Keep in mind that these different views may all be true. There may be no single explanation for the decline in spending. It is possible that all of these changes coincided and that together they led to a massive reduction in spending.

### The Money Hypothesis: A Shock to the LM Curve

Table 12–1 shows that the money supply fell 25 percent from 1929 to 1933, during which time the unemployment rate rose from 3.2 percent to 25.2 percent. This fact provides the motivation and support for what is called the money hypothesis, which places primary blame for the Depression on the Federal Reserve for allowing the money supply to fall by such a large amount. The best-known advocates of this interpretation are Milton Friedman and Anna Schwartz, who defended it in their treatise on U.S. monetary history. Friedman and Schwartz argue that contractions in the money supply have caused most economic downturns and that the Great Depression is a particularly vivid example.

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We discussed the reasons for this large decrease in the money supply in Chapter 4, where we examined the money supply process in more detail. In particular, see the Case Study on Bank Failures and the Money Supply in the 1930s.
Using the IS–LM model, we might interpret the money hypothesis as explaining the Depression by a contractionary shift in the LM curve. Seen in this way, however, the money hypothesis runs into two problems.

The first problem is the behavior of real money balances. Monetary policy leads to a contractionary shift in the LM curve only if real money balances fall. Yet from 1929 to 1931 real money balances rose slightly because the fall in the money supply was accompanied by an even greater fall in the price level. Although the monetary contraction may have been responsible for the rise in unemployment from 1931 to 1933, when real money balances did fall, it cannot easily explain the initial downturn from 1929 to 1931.

The second problem for the money hypothesis is the behavior of interest rates. If a contractionary shift in the LM curve triggered the Depression, we should have observed higher interest rates. Yet nominal interest rates fell continuously from 1929 to 1933.

These two reasons appear sufficient to reject the view that the Depression was instigated by a contractionary shift in the LM curve. But was the fall in the money stock irrelevant? Next, we turn to another mechanism through which monetary policy might have been responsible for the severity of the Depression—the deflation of the 1930s.

**The Money Hypothesis Again: The Effects of Falling Prices**

From 1929 to 1933 the price level fell 22 percent. Many economists blame this deflation for the severity of the Great Depression. They argue that the deflation may have turned what in 1931 was a typical economic downturn into an unprecedented period of high unemployment and depressed income. If correct, this argument gives new life to the money hypothesis. Because the falling money supply was, plausibly, responsible for the falling price level, it could have been responsible for the severity of the Depression. To evaluate this argument, we must discuss how changes in the price level affect income in the IS–LM model.

**The Stabilizing Effects of Deflation** In the IS–LM model we have developed so far, falling prices raise income. For any given supply of money $M$, a lower price level implies higher real money balances $M/P$. An increase in real money balances causes an expansionary shift in the LM curve, which leads to higher income.

Another channel through which falling prices expand income is called the Pigou effect. Arthur Pigou, a prominent classical economist in the 1930s, pointed out that real money balances are part of households’ wealth. As prices fall and real money balances rise, consumers should feel wealthier and spend more. This increase in consumer spending should cause an expansionary shift in the IS curve, also leading to higher income.

These two reasons led some economists in the 1930s to believe that falling prices would help stabilize the economy. That is, they thought that a decline in the price level would automatically push the economy back toward full employment. Yet other economists were less confident in the economy’s ability to correct itself. They pointed to other effects of falling prices, to which we now turn.
The Destabilizing Effects of Deflation

Economists have proposed two theories to explain how falling prices could depress income rather than raise it. The first, called the debt-deflation theory, describes the effects of unexpected falls in the price level. The second explains the effects of expected deflation.

The debt-deflation theory begins with an observation from Chapter 5: unanticipated changes in the price level redistribute wealth between debtors and creditors. If a debtor owes a creditor $1,000, then the real amount of this debt is $1,000/\( P \), where \( P \) is the price level. A fall in the price level raises the real amount of this debt—the amount of purchasing power the debtor must repay the creditor. Therefore, an unexpected deflation enriches creditors and impoverishes debtors.

The debt-deflation theory then posits that this redistribution of wealth affects spending on goods and services. In response to the redistribution from debtors to creditors, debtors spend less and creditors spend more. If these two groups have equal spending propensities, there is no aggregate impact. But it seems reasonable to assume that debtors have higher propensities to spend than creditors—perhaps that is why the debtors are in debt in the first place. In this case, debtors reduce their spending by more than creditors raise theirs. The net effect is a reduction in spending, a contractionary shift in the IS curve, and lower national income.

To understand how expected changes in prices can affect income, we need to add a new variable to the IS–LM model. Our discussion of the model so far has not distinguished between the nominal and real interest rates. Yet we know from previous chapters that investment depends on the real interest rate and that money demand depends on the nominal interest rate. If \( i \) is the nominal interest rate and \( E\pi \) is expected inflation, then the ex ante real interest rate is \( i - E\pi \).

We can now write the IS–LM model as

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

\[
M/P = L(i, Y) \quad \text{LM}.
\]

Expected inflation enters as a variable in the IS curve. Thus, changes in expected inflation shift the IS curve.

Let's use this extended IS–LM model to examine how changes in expected inflation influence the level of income. We begin by assuming that everyone expects the price level to remain the same. In this case, there is no expected inflation (\( E\pi = 0 \)), and these two equations produce the familiar IS–LM model. Figure 12–8 depicts this initial situation with the LM curve and the IS curve labeled IS\(_1\). The intersection of these two curves determines the nominal and real interest rates, which for now are the same.

Now suppose that everyone suddenly expects that the price level will fall in the future, so that \( E\pi \) becomes negative. The real interest rate is now higher at any given nominal interest rate. This increase in the real interest rate depresses planned investment spending, shifting the IS curve from IS\(_1\) to IS\(_2\). (The vertical distance of the downward shift exactly equals the expected deflation.) Thus, an expected deflation leads to a reduction in national income from \( Y_1 \) to \( Y_2 \). The nominal interest rate falls from \( i_1 \) to \( i_2 \), while the real interest rate rises from \( r_1 \) to \( r_2 \).

Here is the story behind this figure. When firms come to expect deflation, they become reluctant to borrow to buy investment goods because they believe
PART IV
Business Cycle Theory: The Economy in the Short Run

they will have to repay these loans later in more valuable dollars. The fall in investment depresses planned expenditure, which in turn depresses income. The fall in income reduces the demand for money, and this reduces the nominal interest rate that equilibrates the money market. The nominal interest rate falls by less than the expected deflation, so the real interest rate rises.

Note that there is a common thread in these two stories of destabilizing deflation. In both, falling prices depress national income by causing a contractionary shift in the IS curve. Because a deflation of the size observed from 1929 to 1933 is unlikely except in the presence of a major contraction in the money supply, these two explanations assign some of the responsibility for the Depression—especially its severity—to the Fed. In other words, if falling prices are destabilizing, then a contraction in the money supply can lead to a fall in income, even without a decrease in real money balances or a rise in nominal interest rates.

**Could the Depression Happen Again?**

Economists study the Depression both because of its intrinsic interest as a major economic event and to provide guidance to policymakers so that it will not happen again. To state with confidence whether this event could recur, we would need to know why it happened. Because there is not yet agreement on the causes of the Great Depression, it is impossible to rule out with certainty another depression of this magnitude.

Yet most economists believe that the mistakes that led to the Great Depression are unlikely to be repeated. The Fed seems unlikely to allow the money supply to fall by one-fourth. Many economists believe that the deflation of the early 1930s was responsible for the depth and length of the Depression. And it seems likely that such a prolonged deflation was possible only in the presence of a falling money supply.

**FIGURE 12-8**

*Expected Deflation in the IS–LM Model* An expected deflation (a negative value of $E\pi$) raises the real interest rate for any given nominal interest rate, and this depresses investment spending. The reduction in investment shifts the IS curve downward. The level of income falls from $Y_1$ to $Y_2$. The nominal interest rate falls from $i_1$ to $i_2$, and the real interest rate rises from $r_1$ to $r_2$. 

Interest rate, $i$

$Y_2$ $Y_1$

Income, output, $Y$

$r_1 = i_1$

$r_2$

$i_2$

$E\pi$

IS$_1$

IS$_2$

LM
The fiscal-policy mistakes of the Depression are also unlikely to be repeated. Fiscal policy in the 1930s not only failed to help but actually further depressed aggregate demand. Few economists today would advocate such a rigid adherence to a balanced budget in the face of massive unemployment.

In addition, there are many institutions today that would help prevent the events of the 1930s from recurring. The system of federal deposit insurance makes widespread bank failures less likely. The income tax causes an automatic reduction in taxes when income falls, which stabilizes the economy. Finally, economists know more today than they did in the 1930s. Our knowledge of how the economy works, limited as it still is, should help policymakers formulate better policies to combat such widespread unemployment.

**CASE STUDY**

The Financial Crisis and Great Recession of 2008 and 2009

In 2008, the U.S. economy experienced a financial crisis, followed by a deep economic downturn. Several of the developments during this time were reminiscent of events during the 1930s, causing many observers to fear that the economy might experience a second Great Depression.

The story of the 2008 crisis begins a few years earlier with a substantial boom in the housing market. The boom had several sources. In part, it was fueled by low interest rates. As we saw in a previous Case Study in this chapter, the Federal Reserve lowered interest rates to historically low levels in the aftermath of the recession of 2001. Low interest rates helped the economy recover, but by making it less expensive to get a mortgage and buy a home, they also contributed to a rise in housing prices.

In addition, developments in the mortgage market made it easier for *subprime borrowers*—those borrowers with higher risk of default based on their income and credit history—to get mortgages to buy homes. One of these developments was *securitization*, the process by which one mortgage originator makes loans and then sells them to an investment bank, which in turn bundles them together into a variety of “mortgage-backed securities” and then sells them to a third financial institution (such as a bank, pension fund, or insurance company). These securities pay a return as long as homeowners continue to repay their loans, but they lose value if homeowners default. Unfortunately, it seems that the ultimate holders of these mortgage-backed securities sometimes failed to fully appreciate the risks they were taking. Some economists blame insufficient regulation for these high-risk loans. Others believe the problem was not too little regulation but the wrong kind: some government policies encouraged this high-risk lending to make the goal of homeownership more attainable for low-income families.

Together, these forces drove up housing demand and housing prices. From 1995 to 2006, average housing prices in the United States more than doubled. Some observers view this rise in housing prices as a speculative bubble, as more people bought homes, hoping and expecting that the prices would continue to rise.
The high price of housing, however, proved unsustainable. From 2006 to 2009, housing prices nationwide fell about 30 percent. Such price fluctuations should not necessarily be a problem in a market economy. After all, price movements are how markets equilibrate supply and demand. But, in this case, the price decline led to a series of problematic repercussions.

The first of these repercussions was a substantial rise in mortgage defaults and home foreclosures. During the housing boom, many homeowners had bought their homes with mostly borrowed money and minimal down payments. When housing prices declined, these homeowners were underwater: they owed more on their mortgages than their homes were worth. Many of these homeowners stopped paying their loans. The banks servicing the mortgages responded to the defaults by taking the houses away in foreclosure procedures and then selling them off. The banks’ goal was to recoup whatever they could. The increase in the number of homes for sale, however, exacerbated the downward spiral of housing prices.

A second repercussion was large losses at the various financial institutions that owned mortgage-backed securities. In essence, by borrowing large sums to buy high-risk mortgages, these companies had bet that housing prices would keep rising; when this bet turned bad, they found themselves at or near the point of bankruptcy. Even healthy banks stopped trusting one another and avoided interbank lending because it was hard to discern which institution would be the next to go out of business. Because of these large losses at financial institutions and the widespread fear and distrust, the ability of the financial system to make loans even to creditworthy customers was impaired. Chapter 20 discusses financial crises, including this one, in more detail.

A third repercussion was a substantial rise in stock market volatility. Many companies rely on the financial system to get the resources they need for business expansion or to help them manage their short-term cash flows. With the financial system less able to perform its normal operations, the profitability of many companies was called into question. Because it was hard to know how bad things would get, stock market volatility reached levels not seen since the 1930s.

Falling housing prices, increasing foreclosures, financial instability, and higher volatility together led to a fourth repercussion: a decline in consumer confidence. In the midst of all the uncertainty, households started putting off spending plans. In particular, expenditure on durable goods such as cars and household appliances plummeted.

As a result of all these events, the economy experienced a large contractionary shift in the IS curve. Production, income, and employment declined. The unemployment rate rose from 4.7 percent in October 2007 to 10.0 percent in October 2009.

Policymakers responded vigorously as the crisis unfolded. First, the Fed cut its target for the federal funds rate from 5.25 percent in September 2007 to about zero in December 2008. Second, in October 2008, Congress appropriated $700 billion for the Treasury to use to rescue the financial system. In large part these funds were used for equity injections into banks. That is, the Treasury put funds into the banking system, which the banks could use to make loans; in exchange for these funds, the U.S. government became a part owner of these banks, at least temporarily. Third, as discussed in Chapter 11, one of Barack Obama’s first acts when he became president in January 2009 was to support a major increase in government spending to
expand aggregate demand. Finally, the Federal Reserve engaged in various unconventional monetary policies, such as buying long-term bonds, to lower long-term interest rates and thereby encourage borrowing and private spending.

In the end, policymakers can take some credit for having averted another Great Depression. Unemployment rose to only 10 percent, compared with 25 percent in 1933. Other data tell a similar story. Figure 12-9 compares the path of industrial production during the Great Depression of the 1930s and during the Great Recession of 2008–2009. (Industrial production measures the output of the nation’s manufacturers, mines, and utilities. Because of the consistency of its data sources, it is one of the more reliable time series for historical comparisons of short-run fluctuations.) The figure shows that, in the Great Depression, industrial production declined for about three years, falling by more than 50 percent, and it took more than seven years to return to its previous peak. By contrast, in the Great Recession, industrial production declined for only a year and half, falling only 17 percent, and it took less than six years to recover.

This comparison, however, gives only limited comfort. Even though the Great Recession of 2008–2009 was shorter and less severe than the Great Depression, it was nonetheless a devastating event for many families.

**FIGURE 12-9**

The Great Recession and the Great Depression

This figure compares industrial production during the Great Recession of 2008–2009 and during the Great Depression of the 1930s. Output is normalized to be 100 for the peak before the downturn (December 2007 and August 1929). The data show that the recent downturn was much shallower and shorter.

Data from: Board of Governors of the Federal Reserve System.
The Liquidity Trap (Also Known as the Zero Lower Bound)

In the United States in the 1930s, interest rates reached very low levels. As Table 12-1 shows, U.S. interest rates were well under 1 percent throughout the second half of the 1930s. A similar situation occurred during the economic downturn of 2008–2009. In December 2008, the Federal Reserve cut its target for the federal funds rate to the range of zero to 0.25 percent, and it kept the rate at that level at least until this book was going to press in early 2015.

Some economists describe this situation as a liquidity trap. According to the IS–LM model, expansionary monetary policy works by reducing interest rates and stimulating investment spending. But if interest rates have already fallen almost to zero, then perhaps monetary policy is no longer effective. Nominal interest rates cannot fall below zero: rather than making a loan at a negative nominal interest rate, a person would just hold cash. In this environment, expansionary monetary policy increases the supply of money, making the public’s asset portfolio more liquid, but because interest rates can’t fall any farther, the extra liquidity might not have any effect. Aggregate demand, production, and employment may be “trapped” at low levels. The liquidity trap is sometimes called the problem of the zero lower bound.

Other economists are skeptical about the relevance of liquidity traps and believe that central banks continue to have tools to expand the economy, even after the interest rate target hits the lower bound of zero. One possibility is that a central bank could try to lower longer-term interest rates. It can accomplish this by committing to keep the target interest rate (typically a very short-term interest rate) low for an extended period of time. A policy of announcing future monetary actions is sometimes called forward guidance. A central bank can also lower longer-term interest rates by conducting expansionary open-market operations in a larger variety of financial instruments than it normally does. For example, it could buy long-term government bonds, mortgages, and corporate debt and thereby lower the interest rates on these kinds of loans, a policy sometimes called quantitative easing. During the downturn of 2008–2009 and its aftermath, the Federal Reserve actively pursued a policy of forward guidance and quantitative easing.

Another way that monetary expansion can expand the economy despite the zero lower bound is that it could cause the currency to lose value in the market for foreign-currency exchange. This depreciation would make the nation’s goods cheaper abroad, stimulating export demand. This mechanism goes beyond the closed-economy IS–LM model we have used in this chapter, but it fits well with the open-economy version of the model developed in the next chapter.

Some economists have argued that the possibility of a liquidity trap argues for a target rate of inflation greater than zero. Under zero inflation, the real interest rate, like the nominal interest, can never fall below zero. But if the normal rate of inflation is, say, 4 percent, then the central bank can easily push the real interest rate to negative 4 percent by lowering the nominal interest rate toward zero. Put differently, a higher target for the inflation rate means a higher nominal interest rate in normal times (recall the Fisher effect), which in turn gives the central
bank more room to cut interest rates when the economy experiences recessionary shocks. Thus, a higher inflation target gives monetary policymakers more room to stimulate the economy when needed, reducing the likelihood that the economy will hit the zero lower bound and fall into a liquidity trap.5

12-4 Conclusion

The purpose of this chapter and the previous one has been to deepen our understanding of aggregate demand. We now have the tools to analyze the effects of monetary and fiscal policy in the long run and in the short run. In the long run, prices are flexible, and we use the classical analysis of Parts Two and Three of this book. In the short run, prices are sticky, and we use the IS–LM model to examine how changes in policy influence the economy.

The model in this and the previous chapter provides the basic framework for analyzing the economy in the short run, but it is not the whole story. In Chapter 13 we examine how international interactions affect the theory of aggregate demand. In Chapter 14 we examine the theory behind short-run aggregate supply. Subsequent chapters further refine the theory and examine various issues that arise as the theory is applied to formulate macroeconomic policy. The IS–LM model presented in this and the previous chapter provides the starting point for this further analysis.

Summary

1. The IS–LM model is a general theory of the aggregate demand for goods and services. The exogenous variables in the model are fiscal policy, monetary policy, and the price level. The model explains two endogenous variables: the interest rate and the level of national income.

2. The IS curve represents the negative relationship between the interest rate and the level of income that arises from equilibrium in the market for goods and services. The LM curve represents the positive relationship between the interest rate and the level of income that arises from equilibrium in the market for real money balances. Equilibrium in the IS–LM model—the intersection of the IS and LM curves—represents simultaneous

equilibrium in the market for goods and services and in the market for real money balances.

3. The aggregate demand curve summarizes the results from the \( IS-LM \) model by showing equilibrium income at any given price level. The aggregate demand curve slopes downward because a lower price level increases real money balances, lowers the interest rate, stimulates investment spending, and thereby raises equilibrium income.

4. Expansionary fiscal policy—an increase in government purchases or a decrease in taxes—shifts the \( IS \) curve to the right. This shift in the \( IS \) curve increases the interest rate and income. The increase in income represents a rightward shift in the aggregate demand curve. Similarly, contractionary fiscal policy shifts the \( IS \) curve to the left, lowers the interest rate and income, and shifts the aggregate demand curve to the left.

5. Expansionary monetary policy shifts the \( LM \) curve downward. This shift in the \( LM \) curve lowers the interest rate and raises income. The increase in income represents a rightward shift of the aggregate demand curve. Similarly, contractionary monetary policy shifts the \( LM \) curve upward, raises the interest rate, lowers income, and shifts the aggregate demand curve to the left.

**KEY CONCEPTS**

- Monetary transmission mechanism
- Pigou effect
- Debt-deflation theory
- Liquidity trap

**QUESTIONS FOR REVIEW**

1. Explain why the aggregate demand curve slopes downward.

2. What is the impact of an increase in taxes on the interest rate, income, consumption, and investment?

3. What is the impact of a decrease in the money supply on the interest rate, income, consumption, and investment?

4. Describe the possible effects of falling prices on equilibrium income.

**PROBLEMS AND APPLICATIONS**

1. According to the \( IS-LM \) model, what happens in the short run to the interest rate, income, consumption, and investment under the following circumstances? Be sure your answer includes an appropriate graph.
   - a. The central bank increases the money supply.
   - b. The government increases government purchases.
   - c. The government increases taxes.
   - d. The government increases government purchases and taxes by equal amounts.

2. Use the \( IS-LM \) model to predict the short-run effects of each of the following shocks on income, the interest rate, consumption, and investment. In each case, explain what the Fed should do to keep income at its
initial level. Be sure to use a graph in each of your answers.

a. After the invention of a new high-speed computer chip, many firms decide to upgrade their computer systems.

b. A wave of credit card fraud increases the frequency with which people make transactions in cash.

c. A best-seller titled *Retire Rich* convinces the public to increase the percentage of their income devoted to saving.

d. The appointment of a new “dovish” Federal Reserve chair increases expected inflation.

3. **LaunchPad** • Consider the economy of Hicksonia.

   a. The consumption function is given by

   \[ C = 300 + 0.6(Y - T) \]

   The investment function is

   \[ I = 700 - 80r \]

   Government purchases and taxes are both 500. For this economy, graph the IS curve for \( r \) ranging from 0 to 8.

   b. The money demand function in Hicksonia is

   \[ (M/P)^d = Y - 200r \]

   The money supply \( M \) is 3,000 and the price level \( P \) is 3. Graph the LM curve for \( r \) ranging from 0 to 8.

   c. Find the equilibrium interest rate \( r \) and the equilibrium level of income \( Y \).

   d. Suppose that government purchases are increased from 500 to 700. How does the IS curve shift? What are the new equilibrium interest rate and level of income?

   e. Suppose instead that the money supply is increased from 3,000 to 4,500. How does the LM curve shift? What are the new equilibrium interest rate and level of income?

   f. With the initial values for monetary and fiscal policy, suppose that the price level rises from 3 to 5. What happens? What are the new equilibrium interest rate and level of income?

   g. For the initial value of monetary and fiscal policy, derive and graph an equation for the aggregate demand curve. What happens to this aggregate demand curve if fiscal or monetary policy changes, as in parts (d) and (e)?

4. **LaunchPad** • An economy is initially described by the following equations:

   \[
   C = 500 + 0.75(Y - T) \\
   I = 1,000 - 50r \\
   M/P = Y - 200r \\
   G = 1000 \\
   T = 1000 \\
   M = 6,000 \\
   P = 2
   \]

   a. Derive and graph the IS curve and the LM curve. Calculate the equilibrium interest rate and level of income. Label that point A on your graph.

   b. Suppose that a newly elected president cuts taxes by 20 percent. Assuming the money supply is held constant, what are the new equilibrium interest rate and level of income? What is the tax multiplier?

   c. Now assume that the central bank adjusts the money supply to hold the interest rate constant. What is the new level of income? What must the new money supply be? What is the tax multiplier?

   d. Now assume that the central bank adjusts the money supply to hold the level of income constant. What is the new equilibrium interest rate? What must the money supply be? What is the tax multiplier?

   e. Show the equilibria you calculated in parts (b), (c), and (d) on the graph you drew in part (a). Label them points B, C, and D.

5. Determine whether each of the following statements is true or false, and explain why. For each true statement, discuss whether there is anything unusual about the impact of monetary and fiscal policy in that special case.

   a. If investment does not depend on the interest rate, the LM curve is horizontal.
b. If investment does not depend on the interest rate, the IS curve is vertical.

c. If money demand does not depend on the interest rate, the IS curve is horizontal.

d. If money demand does not depend on the interest rate, the LM curve is vertical.

e. If money demand does not depend on income, the LM curve is horizontal.

f. If money demand is extremely sensitive to the interest rate, the LM curve is horizontal.

6. Monetary policy and fiscal policy often change at the same time.

a. Suppose that the government wants to raise investment but keep output constant. In the IS–LM model, what mix of monetary and fiscal policy will achieve this goal?

b. In the early 1980s, the U.S. government cut taxes and ran a budget deficit while the Fed pursued a tight monetary policy. What effect should this policy mix have?

7. Use the IS–LM diagram to describe both the short-run effects and the long-run effects of the following changes on national income, the interest rate, the price level, consumption, investment, and real money balances.

a. An increase in the money supply

b. An increase in government purchases

c. An increase in taxes

8. The Fed is considering two alternative monetary policies:

• holding the money supply constant and letting the interest rate adjust, or

• adjusting the money supply to hold the interest rate constant.

In the IS–LM model, which policy will better stabilize output under the following conditions? Explain your answer.

a. All shocks to the economy arise from exogenous changes in the demand for goods and services.

b. All shocks to the economy arise from exogenous changes in the demand for money.

9. Suppose that the demand for real money balances depends on disposable income. That is, the money demand function is

\[ M/P = L(r, Y - T). \]

Using the IS–LM model, discuss whether this change in the money demand function alters the following.

a. The analysis of changes in government purchases

b. The analysis of changes in taxes

10. This problem asks you to analyze the IS–LM model algebraically. Suppose consumption is a linear function of disposable income:

\[ C(Y - T) = a + b(Y - T), \]

where \( a > 0 \) and \( 0 < b < 1 \). The parameter \( b \) is the marginal propensity to consume, and the parameter \( a \) is a constant sometimes called autonomous consumption. Suppose also that investment is a linear function of the interest rate:

\[ I(r) = c - dr, \]

where \( c > 0 \) and \( d > 0 \). The parameter \( d \) measures the sensitivity of investment to the interest rate, and the parameter \( c \) is a constant sometimes called autonomous investment.

a. Solve for \( Y \) as a function of \( r \), the exogenous variables \( G \) and \( T \), and the model’s parameters \( a \), \( b \), \( c \), and \( d \).

b. How does the slope of the IS curve depend on the parameter \( d \), the interest sensitivity of investment? Refer to your answer to part (a), and explain the intuition.

c. Which will cause a bigger horizontal shift in the IS curve, a $100 tax cut or a $100 increase in government spending? Refer to your answer to part (a), and explain the intuition.

Now suppose demand for real money balances is a linear function of income and the interest rate:

\[ L(r, Y) = eY - fr, \]
where \( e > 0 \) and \( f > 0 \). The parameter \( e \) measures the sensitivity of money demand to income, while the parameter \( f \) measures the sensitivity of money demand to the interest rate.

d. Solve for \( r \) as a function of \( Y, M, \) and \( P \) and the parameters \( e \) and \( f \).

e. Using your answer to part (d), determine whether the \( LM \) curve is steeper for large or small values of \( f \), and explain the intuition.

f. How does the size of the shift in the \( LM \) curve resulting from a $100 increase in \( M \) depend on

i. the value of the parameter \( e \), the income sensitivity of money demand?

ii. the value of the parameter \( f \), the interest sensitivity of money demand?

g. Use your answers to parts (a) and (d) to derive an expression for the aggregate demand curve. Your expression should show \( Y \) as a function of \( P \), of exogenous policy variables \( M, G, \) and \( T \); and of the model’s parameters. This expression should not contain \( r \).

h. Use your answer to part (g) to prove that the aggregate demand curve has a negative slope.

i. Use your answer to part (g) to prove that increases in \( G \) and \( M \), and decreases in \( T \), shift the aggregate demand curve to the right. How does this result change if the parameter \( f \), the interest sensitivity of money demand, equals zero? Explain the intuition for your result.

For any problem marked with LaunchPad, there is a Work It Out online tutorial available for a similar problem. To access these interactive, step-by-step tutorials and other resources, visit LaunchPad for Macroeconomics, 9e at www.macmillanhighered.com/launchpad/mankiw9e