CHAPTER 12

The Open Economy Revisited: The Mundell–Fleming Model and the Exchange-Rate Regime

The world is still a closed economy, but its regions and countries are becoming increasingly open. . . . The international economic climate has changed in the direction of financial integration, and this has important implications for economic policy.

—*Robert Mundell, 1963*

When conducting monetary and fiscal policy, policymakers often look beyond their own country's borders. Even if domestic prosperity is their sole objective, it is necessary for them to consider the rest of the world. The international flow of goods and services and the international flow of capital can affect an economy in profound ways. Policymakers ignore these effects at their peril.

In this chapter we extend our analysis of aggregate demand to include international trade and finance. The model developed in this chapter is called the **Mundell–Fleming model.** This model has been described as "the dominant policy paradigm for studying open-economy monetary and fiscal policy." In 1999, Robert Mundell was awarded the Nobel Prize for his work in open-economy macroeconomics, including this model.[1]

The Mundell–Fleming model is a close relative of the *IS–LM* model. Both models stress the interaction between the goods market and the money market. Both models assume that the price level is fixed and then show what causes short-run fluctuations in aggregate income (or, equivalently, shifts in the aggregate demand curve). The key difference is that the *IS–LM* model assumes a closed economy, whereas the

[1] The quotation is from Maurice Obstfeld and Kenneth Rogoff, *Foundations of International Macroeconomics* (Cambridge, Mass.: MIT Press, 1996)—a leading graduate-level textbook in open-economy macroeconomics. The Mundell–Fleming model was developed in the early 1960s. Mundell's contributions are collected in Robert A. Mundell, *International Economics* (New York: Macmillan, 1968). For Fleming's contribution, see J. Marcus Fleming, "Domestic Financial Policies Under Fixed and Under Floating Exchange Rates," *IMF Staff Papers* 9 (November 1962): 369–379. Fleming died in 1976, so he was not eligible to share in the Nobel award.

Mundell–Fleming model assumes an open economy. The Mundell–Fleming model extends the short-run model of national income from Chapters 10 and 11 by including the effects of international trade and finance discussed in Chapter 5.

The Mundell–Fleming model makes one important and extreme assumption: it assumes that the economy being studied is a small open economy with perfect capital mobility. That is, the economy can borrow or lend as much as it wants in world financial markets and, as a result, the economy's interest rate is determined by the world interest rate. Here is how Mundell himself, in his original 1963 article, explained why he made this assumption:

> In order to present my conclusions in the simplest possible way and to bring the implications for policy into sharpest relief, I assume the extreme degree of mobility that prevails when a country cannot maintain an interest rate different from the general level prevailing abroad. This assumption will overstate the case but it has the merit of posing a stereotype towards which international financial relations seem to be heading. At the same time it might be argued that the assumption is not far from the truth in those financial centers, of which Zurich, Amsterdam, and Brussels may be taken as examples, where the authorities already recognize their lessening ability to dominate money market conditions and insulate them from foreign influences. It should also have a high degree of relevance to a country like Canada whose financial markets are dominated to a great degree by the vast New York market.

As we will see, Mundell's assumption of a small open economy with perfect capital mobility will prove useful in developing a tractable and illuminating model.[2]

One lesson from the Mundell–Fleming model is that the behavior of an economy depends on the exchange-rate system it has adopted. Indeed, the model was first developed in large part to understand how alternative exchange-rate regimes work and how the choice of exchange-rate regime impinges on monetary and fiscal policy. We begin by assuming that the economy operates with a floating exchange rate. That is, we assume that the central bank allows the exchange rate to adjust to changing economic conditions. We then examine how the economy operates under a fixed exchange rate. After developing the model, we will be in a position to address an important policy question: what exchange-rate system should a nation adopt?

12-1 The Mundell–Fleming Model

In this section we construct the Mundell–Fleming model, and in the following sections we use the model to examine the impact of various policies. As you will see, the Mundell–Fleming model is built from components we have used in previous chapters. But these pieces are put together in a new way to address a new set of questions.

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[2] This assumption—and thus the Mundell–Fleming model—does not apply exactly to a large open economy such as that of the United States. In the conclusion to this chapter (and more fully in the appendix), we consider what happens in the more complex case in which international capital mobility is less than perfect or a nation is so large that it can influence world financial markets.

The Key Assumption: Small Open Economy With Perfect Capital Mobility

Let's begin with the assumption of a small open economy with perfect capital mobility. As we saw in Chapter 5, this assumption means that the interest rate in this economy r is determined by the world interest rate r^*. Mathematically, we can write this assumption as

$$r = r^*.$$

This world interest rate is assumed to be exogenously fixed because the economy is sufficiently small relative to the world economy that it can borrow or lend as much as it wants in world financial markets without affecting the world interest rate.

Although the idea of perfect capital mobility is expressed with a simple equation, it is important not to lose sight of the sophisticated process that this equation represents. Imagine that some event occurred that would normally raise the interest rate (such as a decline in domestic saving). In a small open economy, the domestic interest rate might rise by a little bit for a short time, but as soon as it did, foreigners would see the higher interest rate and start lending to this country (by, for instance, buying this country's bonds). The capital inflow would drive the domestic interest rate back toward r^*. Similarly, if any event started to drive the domestic interest rate downward, capital would flow out of the country to earn a higher return abroad, and this capital outflow would drive the domestic interest rate back up to r^*. Hence, the $r = r^*$ equation represents the assumption that the international flow of capital is rapid enough to keep the domestic interest rate equal to the world interest rate.

The Goods Market and the *IS** Curve

The Mundell–Fleming model describes the market for goods and services much as the *IS–LM* model does, but it adds a new term for net exports. In particular, the goods market is represented with the following equation:

$$Y = C(Y - T) + I(r) + G + NX(e).$$

This equation states that aggregate income Y is the sum of consumption C, investment I, government purchases G, and net exports NX. Consumption depends positively on disposable income $Y - T$. Investment depends negatively on the interest rate. Net exports depend negatively on the exchange rate e. As before, we define the exchange rate e as the amount of foreign currency per unit of domestic currency—for example, e might be 100 yen per dollar.

You may recall that in Chapter 5 we related net exports to the real exchange rate (the relative price of goods at home and abroad) rather than the nominal exchange rate (the relative price of domestic and foreign currencies). If e is the nominal exchange rate, then the real exchange rate ϵ equals eP/P^*, where P is the domestic price level and P^* is the foreign price level. The Mundell–Fleming model, however, assumes that the price levels at home and abroad are fixed, so the real exchange rate is proportional to the nominal exchange rate. That is, when the domestic currency appreciates (and the nominal exchange rate rises from, say, 100 to 120 yen per dollar), foreign goods become cheaper compared to domestic goods, and this causes exports to fall and imports to rise.

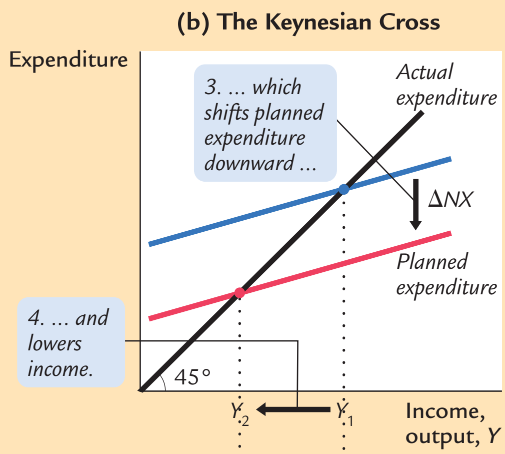
The goods-market equilibrium condition above has two financial variables affecting expenditure on goods and services (the interest rate and the exchange rate), but the situation can be simplified using the assumption of perfect capital mobility, so $r = r^*$. We obtain

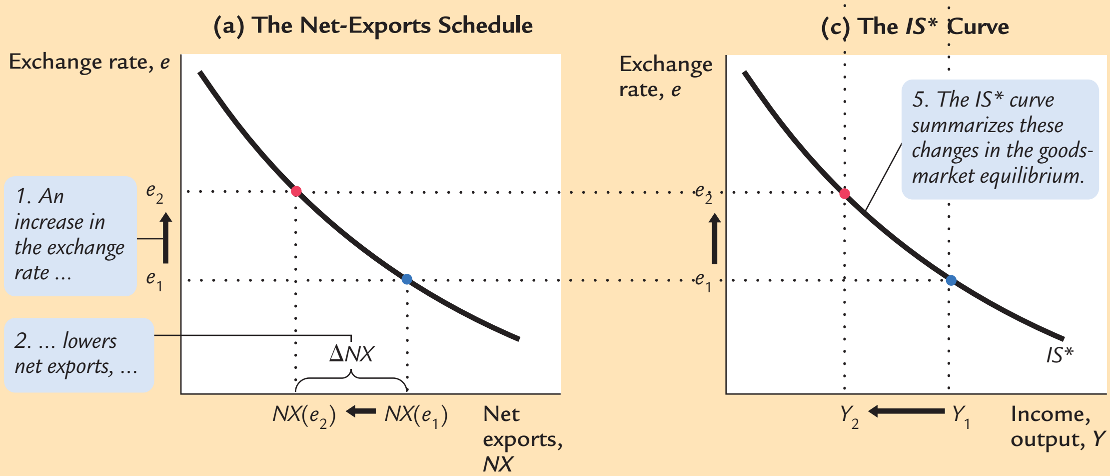
$$Y = C(Y - T) + I(r^*) + G + NX(e).$$

Let's call this the IS^* equation. (The asterisk reminds us that the equation holds the interest rate constant at the world interest rate r^*.) We can illustrate this equation on a graph in which income is on the horizontal axis and the exchange rate is on the vertical axis. This curve is shown in panel (c) of Figure 12-1.

FIGURE 12-1

The IS^* Curve The IS^* curve is derived from the net-exports schedule and the Keynesian cross. Panel (a) shows the net-exports schedule: an increase in the exchange rate from e_1 to e_2 lowers net exports from $NX(e_1)$ to $NX(e_2)$. Panel (b) shows the Keynesian cross: a decrease in net exports from $NX(e_1)$ to $NX(e_2)$ shifts the planned-expenditure schedule downward and reduces income from Y_1 to Y_2. Panel (c) shows the IS^* curve summarizing this relationship between the exchange rate and income: the higher the exchange rate, the lower the level of income.





The *IS** curve slopes downward because a higher exchange rate reduces net exports, which in turn lowers aggregate income. To show how this works, the other panels of Figure 12-1 combine the net-exports schedule and the Keynesian cross to derive the *IS** curve. In panel (a), an increase in the exchange rate from e_1 to e_2 lowers net exports from $NX(e_1)$ to $NX(e_2)$. In panel (b), the reduction in net exports shifts the planned-expenditure schedule downward and thus lowers income from Y_1 to Y_2. The *IS** curve summarizes this relationship between the exchange rate e and income Y.

The Money Market and the *LM** Curve

The Mundell–Fleming model represents the money market with an equation that should be familiar from the *IS–LM* model:

$$M/P = L(r, Y).$$

This equation states that the supply of real money balances M/P equals the demand $L(r, Y)$. The demand for real balances depends negatively on the interest rate and positively on income Y. The money supply M is an exogenous variable controlled by the central bank, and because the Mundell–Fleming model is designed to analyze short-run fluctuations, the price level P is also assumed to be exogenously fixed.

Once again, we add the assumption that the domestic interest rate equals the world interest rate, so $r = r^*$:

$$M/P = L(r^*, Y).$$

Let's call this the *LM** equation. We can represent it graphically with a vertical line, as in panel (b) of Figure 12-2. The *LM** curve is vertical because the exchange rate does not enter into the *LM** equation. Given the world interest rate, the *LM** equation determines aggregate income, regardless of the exchange rate. Figure 12-2 shows how the *LM** curve arises from the world interest rate and the *LM* curve, which relates the interest rate and income.

Putting the Pieces Together

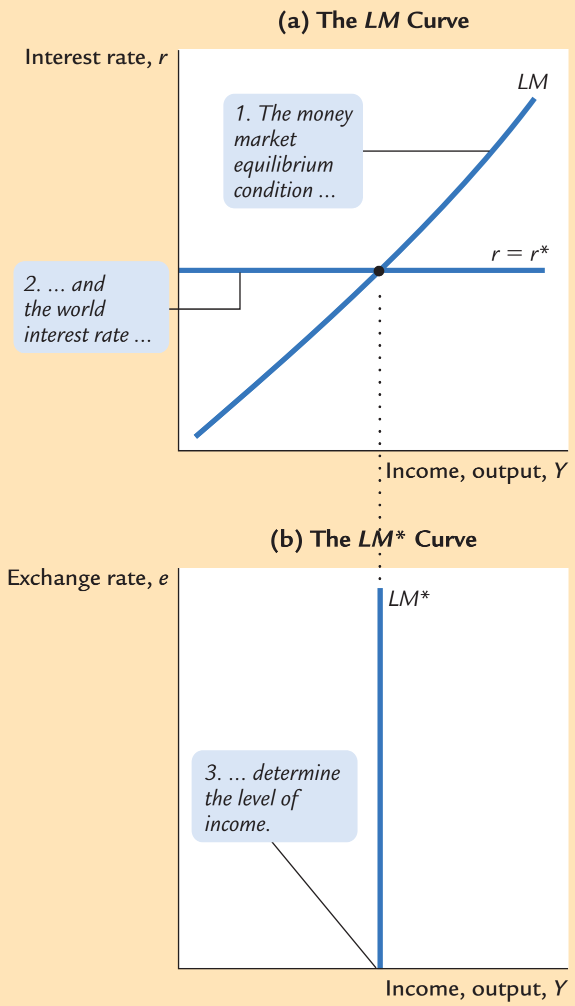
According to the Mundell–Fleming model, a small open economy with perfect capital mobility can be described by two equations:

$$Y = C(Y - T) + I(r^*) + G + NX(e) \qquad IS^*,$$

$$M/P = L(r^*, Y) \qquad LM^*.$$

The first equation describes equilibrium in the goods market; the second describes equilibrium in the money market. The exogenous variables are

FIGURE 12-2

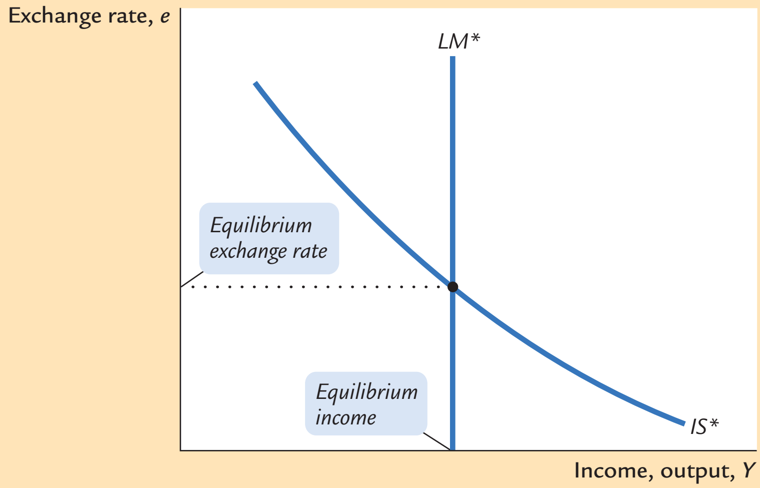


The *LM Curve** Panel (a) shows the standard *LM* curve [which graphs the equation $M/P = L(r, Y)$] together with a horizontal line representing the world interest rate r^*. The intersection of these two curves determines the level of income, regardless of the exchange rate. Therefore, as panel (b) shows, the *LM** curve is vertical.

fiscal policy G and T, monetary policy M, the price level P, and the world interest rate r^*. The endogenous variables are income Y and the exchange rate e.

Figure 12-3 illustrates these two relationships. The equilibrium for the economy is found where the IS^* curve and the LM^* curve intersect. This intersection shows the exchange rate and the level of income at which the goods market and the money market are both in equilibrium. With this diagram, we can use the Mundell–Fleming model to show how aggregate income Y and the exchange rate e respond to changes in policy.

FIGURE 12-3



The Mundell–Fleming Model This graph of the Mundell–Fleming model plots the goods-market equilibrium condition IS^* and the money market equilibrium condition LM^*. Both curves are drawn holding the interest rate constant at the world interest rate. The intersection of these two curves shows the level of income and the exchange rate that satisfy equilibrium both in the goods market and in the money market.

12-2 The Small Open Economy Under Floating Exchange Rates

Before analyzing the impact of policies in an open economy, we must specify the international monetary system in which the country has chosen to operate. That is, we must consider how people engaged in international trade and finance can convert the currency of one country into the currency of another.

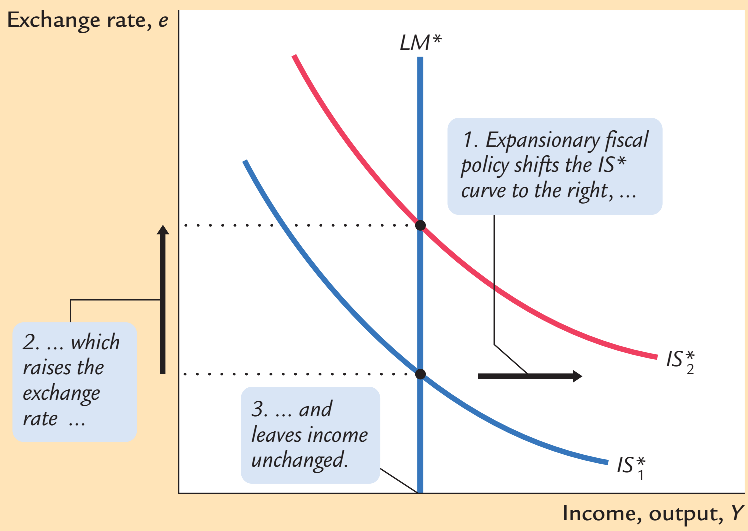
We start with the system relevant for most major economies today: **floating exchange rates.** Under a system of floating exchange rates, the exchange rate is set by market forces and is allowed to fluctuate in response to changing economic conditions. In this case, the exchange rate e adjusts to achieve simultaneous equilibrium in the goods market and the money market. When something happens to change that equilibrium, the exchange rate is allowed to move to a new equilibrium value.

Let's now consider three policies that can change the equilibrium: fiscal policy, monetary policy, and trade policy. Our goal is to use the Mundell–Fleming model to show the impact of policy changes and to understand the economic forces at work as the economy moves from one equilibrium to another.

Fiscal Policy

Suppose that the government stimulates domestic spending by increasing government purchases or by cutting taxes. Because such expansionary fiscal policy increases planned expenditure, it shifts the IS^* curve to the right, as in Figure 12-4. As a result, the exchange rate appreciates, while the level of income remains the same.

FIGURE 12-4



A Fiscal Expansion Under Floating Exchange Rates An increase in government purchases or a decrease in taxes shifts the *IS** curve to the right. This raises the exchange rate but has no effect on income.

Notice that fiscal policy has very different effects in a small open economy than it does in a closed economy. In the closed-economy *IS–LM* model, a fiscal expansion raises income, whereas in a small open economy with a floating exchange rate, a fiscal expansion leaves income at the same level. Mechanically, the difference arises because the *LM** curve is vertical, while the *LM* curve we used to study a closed economy is upward sloping. But this explanation is not very satisfying. What are the economic forces that lie behind the different outcomes? To answer this question, we must think through what is happening to the international flow of capital and the implications of these capital flows for the domestic economy.

The interest rate and the exchange rate are the key variables in the story. When income rises in a closed economy, the interest rate rises, because higher income increases the demand for money. That is not possible in a small open economy because, as soon as the interest rate starts to rise above the world interest rate r^*, capital quickly flows in from abroad to take advantage of the higher return. As this capital inflow pushes the interest rate back to r^*, it also has another effect: because foreign investors need to buy the domestic currency to invest in the domestic economy, the capital inflow increases the demand for the domestic currency in the market for foreign-currency exchange, bidding up the value of the domestic currency. The appreciation of the domestic currency makes domestic goods expensive relative to foreign goods, reducing net exports. The fall in net exports exactly offsets the effects of the expansionary fiscal policy on income.

Why is the fall in net exports so great that it renders fiscal policy powerless to influence income? To answer this question, consider the equation that describes the money market:

$$M/P = L(r, Y).$$

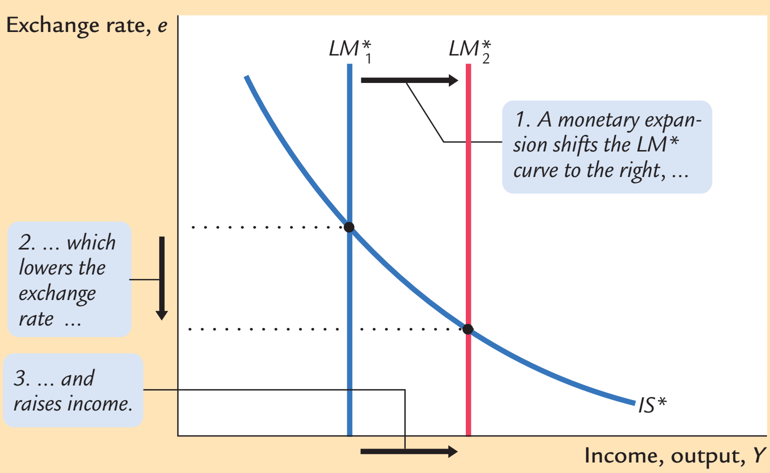
In both closed and open economies, the quantity of real money balances supplied M/P is fixed by the central bank (which sets M) and the assumption of sticky prices (which fixes P). The quantity demanded (determined by r and Y) must equal this fixed supply. In a closed economy, a fiscal expansion causes the equilibrium interest rate to rise. This increase in the interest rate (which reduces the quantity of money demanded) implies an increase in equilibrium income (which raises the quantity of money demanded); these two effects together maintain equilibrium in the money market. By contrast, in a small open economy, r is fixed at r^*, so there is only one level of income that can satisfy this equation, and this level of income does not change when fiscal policy changes. Thus, when the government increases spending or cuts taxes, the appreciation of the currency and the fall in net exports must be large enough to offset fully the expansionary effect of the policy on income.

Monetary Policy

Suppose now that the central bank increases the money supply. Because the price level is assumed to be fixed, the increase in the money supply means an increase in real money balances. The increase in real balances shifts the LM^* curve to the right, as in Figure 12-5. Hence, an increase in the money supply raises income and lowers the exchange rate.

Although monetary policy influences income in an open economy, as it does in a closed economy, the monetary transmission mechanism is different. Recall that in a closed economy an increase in the money supply increases spending because it lowers the interest rate and stimulates investment. In a small open economy, this channel of monetary transmission is not available because the interest rate is fixed by the world interest rate. So how does monetary policy

FIGURE 12-5



A Monetary Expansion Under Floating Exchange Rates An increase in the money supply shifts the LM^* curve to the right, lowering the exchange rate and raising income.

influence spending? To answer this question, we once again need to think about the international flow of capital and its implications for the domestic economy.

The interest rate and the exchange rate are again the key variables. As soon as an increase in the money supply starts putting downward pressure on the domestic interest rate, capital flows out of the economy, as investors seek a higher return elsewhere. This capital outflow prevents the domestic interest rate from falling below the world interest rate r^*. It also has another effect: because investing abroad requires converting domestic currency into foreign currency, the capital outflow increases the supply of the domestic currency in the market for foreign-currency exchange, causing the domestic currency to depreciate in value. This depreciation makes domestic goods inexpensive relative to foreign goods, stimulating net exports and thus total income. Hence, in a small open economy, monetary policy influences income by altering the exchange rate rather than the interest rate.

Trade Policy

Suppose that the government reduces the demand for imported goods by imposing an import quota or a tariff. What happens to aggregate income and the exchange rate? How does the economy reach its new equilibrium?

Because net exports equal exports minus imports, a reduction in imports means an increase in net exports. That is, the net-exports schedule shifts to the right, as in Figure 12-6. This shift in the net-exports schedule increases planned expenditure and thus moves the IS^* curve to the right. Because the LM^* curve is vertical, the trade restriction raises the exchange rate but does not affect income.

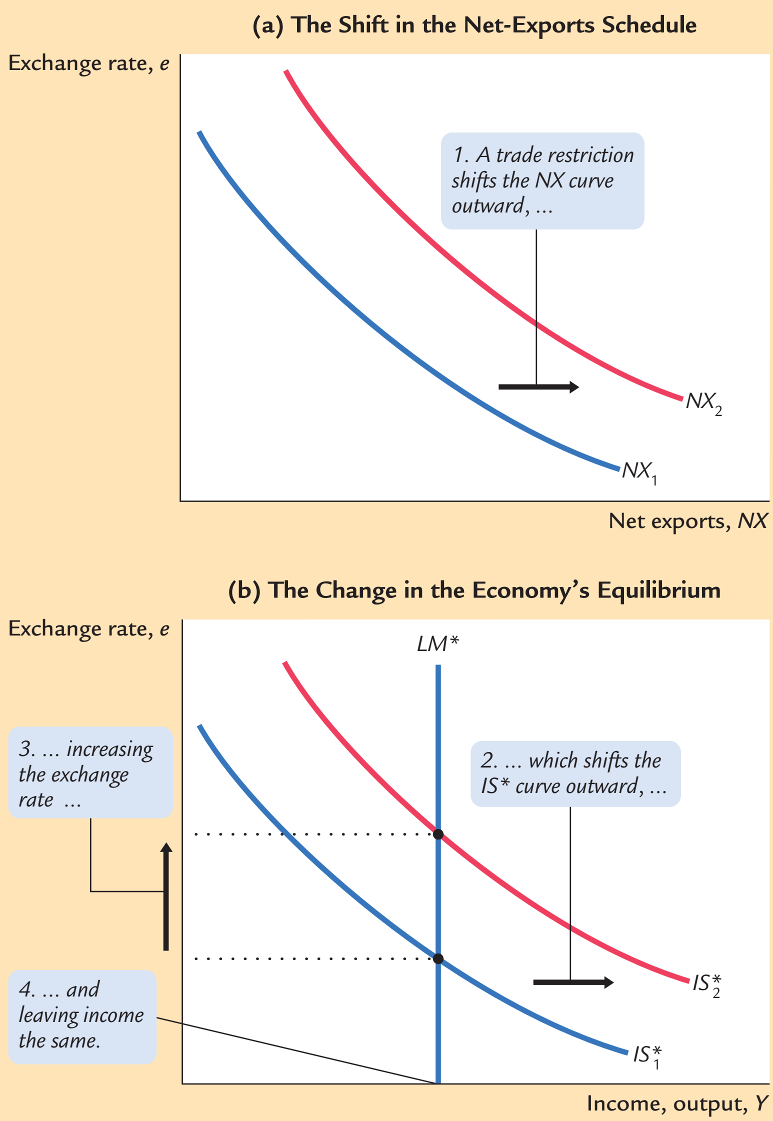
The economic forces behind this transition are similar to the case of expansionary fiscal policy. Because net exports are a component of GDP, the rightward shift in the net-exports schedule, other things equal, puts upward pressure on income Y; an increase in Y, in turn, increases money demand and puts upward pressure on the interest rate r. Foreign capital quickly responds by flowing into the domestic economy, pushing the interest rate back to the world interest rate r^* and causing the domestic currency to appreciate in value. Finally, the appreciation of the currency makes domestic goods more expensive relative to foreign goods, which decreases net exports NX and returns income Y to its initial level.

Often a stated goal of policies to restrict trade is to alter the trade balance NX. Yet, as we first saw in Chapter 5, such policies do not necessarily have that effect. The same conclusion holds in the Mundell–Fleming model under floating exchange rates. Recall that

$$NX(e) = Y - C(Y - T) - I(r^*) - G.$$

Because a trade restriction does not affect income, consumption, investment, or government purchases, it does not affect the trade balance. Although the shift in the net-exports schedule tends to raise NX, the increase in the exchange rate reduces NX by the same amount. The overall effect is simply *less trade.* The domestic economy imports less than it did before the trade restriction, but it exports less as well.

FIGURE 12-6



A Trade Restriction Under Floating Exchange Rates A tariff or an import quota shifts the net-exports schedule in panel (a) to the right. As a result, the IS^* curve in panel (b) shifts to the right, raising the exchange rate and leaving income unchanged.

12-3 The Small Open Economy Under Fixed Exchange Rates

We now turn to the second type of exchange-rate system: **fixed exchange rates.** Under a fixed exchange rate, the central bank announces a value for the exchange rate and stands ready to buy and sell the domestic currency to keep the exchange rate at its announced level. In the 1950s and 1960s, most of the world's major economies, including that of the United States, operated within the Bretton Woods system—an international monetary system under which most governments agreed to fix exchange rates. The world abandoned this system in the early 1970s, and most exchange rates were allowed to float. Yet fixed exchange rates are not merely of historical interest. More recently, China fixed the value of its currency against the U.S. dollar—a policy that, as we will see, was a source of some tension between the two countries.

In this section we discuss how such a system works, and we examine the impact of economic policies on an economy with a fixed exchange rate. Later in the chapter we examine the pros and cons of fixed exchange rates.

How a Fixed-Exchange-Rate System Works

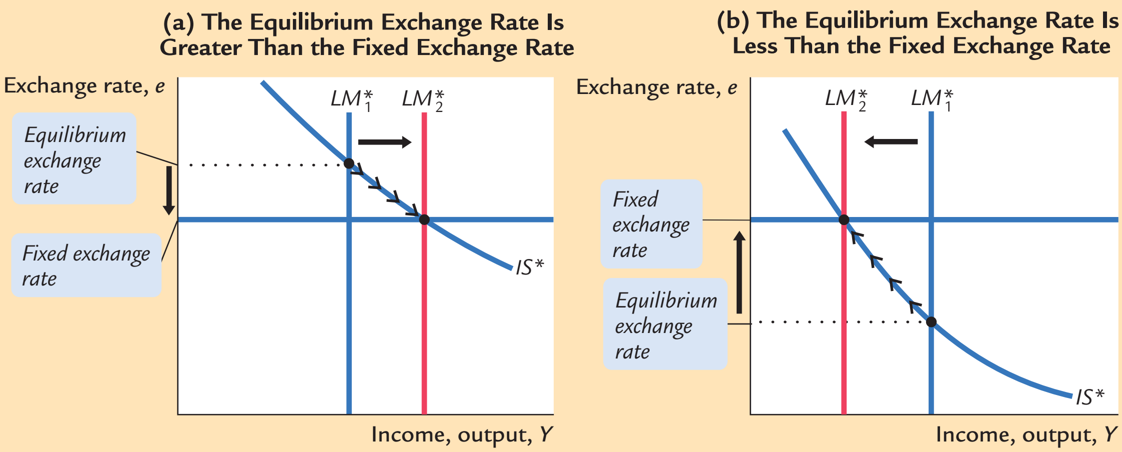
Under a system of fixed exchange rates, a central bank stands ready to buy or sell the domestic currency for foreign currencies at a predetermined price. For example, suppose the Fed announced that it was going to fix the exchange rate at 100 yen per dollar. It would then stand ready to give $1 in exchange for 100 yen or to give 100 yen in exchange for $1. To carry out this policy, the Fed would need a reserve of dollars (which it can print) and a reserve of yen (which it must have purchased previously).

A fixed exchange rate dedicates a country's monetary policy to the single goal of keeping the exchange rate at the announced level. In other words, the essence of a fixed-exchange-rate system is the commitment of the central bank to allow the money supply to adjust to whatever level will ensure that the equilibrium exchange rate in the market for foreign-currency exchange equals the announced exchange rate. Moreover, as long as the central bank stands ready to buy or sell foreign currency at the fixed exchange rate, the money supply adjusts automatically to the necessary level.

To see how fixing the exchange rate determines the money supply, consider the following example. Suppose the Fed announces that it will fix the exchange rate at 100 yen per dollar, but, in the current equilibrium with the current money supply, the market exchange rate is 150 yen per dollar. This situation is illustrated in panel (a) of Figure 12-7. Notice that there is a profit opportunity: an arbitrageur could buy 300 yen in the foreign-exchange market for $2 and then sell the yen to the Fed for $3, making a $1 profit. When the Fed buys these yen from the arbitrageur, the dollars it pays for them automatically increase the money supply. The rise in the money supply shifts the *LM** curve to the right, lowering the equilibrium exchange rate. In this way, the money supply continues to rise until the equilibrium exchange rate falls to the announced level.

Conversely, suppose that when the Fed announces that it will fix the exchange rate at 100 yen per dollar, the equilibrium has a market exchange rate of 50 yen per dollar. Panel (b) of Figure 12-7 shows this situation. In this case, an arbitrageur could make a profit by buying 100 yen from the Fed for $1 and then selling the yen in the marketplace for $2. When the Fed sells these yen, the $1 it receives automatically reduces the money supply. The fall in the money supply shifts the *LM** curve to the left, raising the equilibrium exchange rate. The money supply continues to fall until the equilibrium exchange rate rises to the announced level.

FIGURE 12-7



How a Fixed Exchange Rate Governs the Money Supply In panel (a), the equilibrium exchange rate initially exceeds the fixed level. Arbitrageurs will buy foreign currency in foreign-exchange markets and sell it to the Fed for a profit. This process automatically increases the money supply, shifting the *LM** curve to the right and lowering the exchange rate. In panel (b), the equilibrium exchange rate is initially below the fixed level. Arbitrageurs will buy dollars in foreign-exchange markets and use them to buy foreign currency from the Fed. This process automatically reduces the money supply, shifting the *LM** curve to the left and raising the exchange rate.

It is important to understand that this exchange-rate system fixes the *nominal* exchange rate. Whether it also fixes the real exchange rate depends on the time horizon under consideration. If prices are flexible, as they are in the long run, then the real exchange rate can change even while the nominal exchange rate is fixed. Therefore, in the long run described in Chapter 5, a policy to fix the nominal exchange rate would not influence any real variable, including the real exchange rate. A fixed nominal exchange rate would influence only the money supply and the price level. Yet in the short run described by the Mundell–Fleming model, prices are fixed, so a fixed nominal exchange rate implies a fixed real exchange rate as well.

CASE STUDY

The International Gold Standard

During the late nineteenth and early twentieth centuries, most of the world's major economies operated under the gold standard. Each country maintained a reserve of gold and agreed to exchange one unit of its currency for a specified amount of gold. Through the gold standard, the world's economies maintained a system of fixed exchange rates.

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 7 at the end of this chapter asks you to analyze this issue more fully.)

In Chapter 14 we extend our theory of short-run fluctuations to include explicitly 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.

11-2 *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 9, 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.

From the *IS–LM* Model to the Aggregate Demand Curve

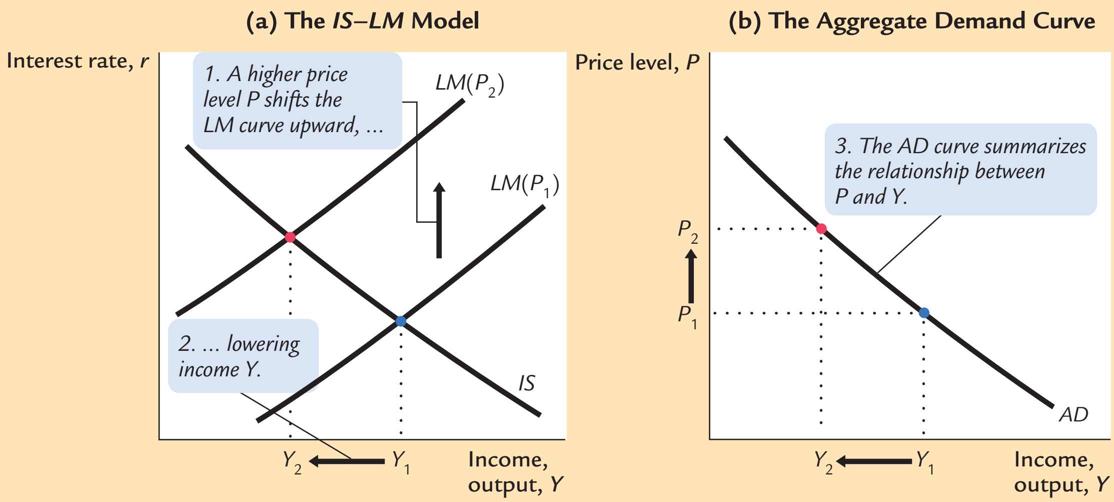
Recall from Chapter 9 that the aggregate demand curve describes a relationship between the price level and the level of national income. In Chapter 9 this relationship was derived from the quantity theory of money. That analysis showed that for a given money supply, a higher price level implies a lower 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 11-5. 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.

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 11-6. Similarly, an increase in government purchases or a decrease in taxes raises income in the *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 11-6. 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

FIGURE 11-5

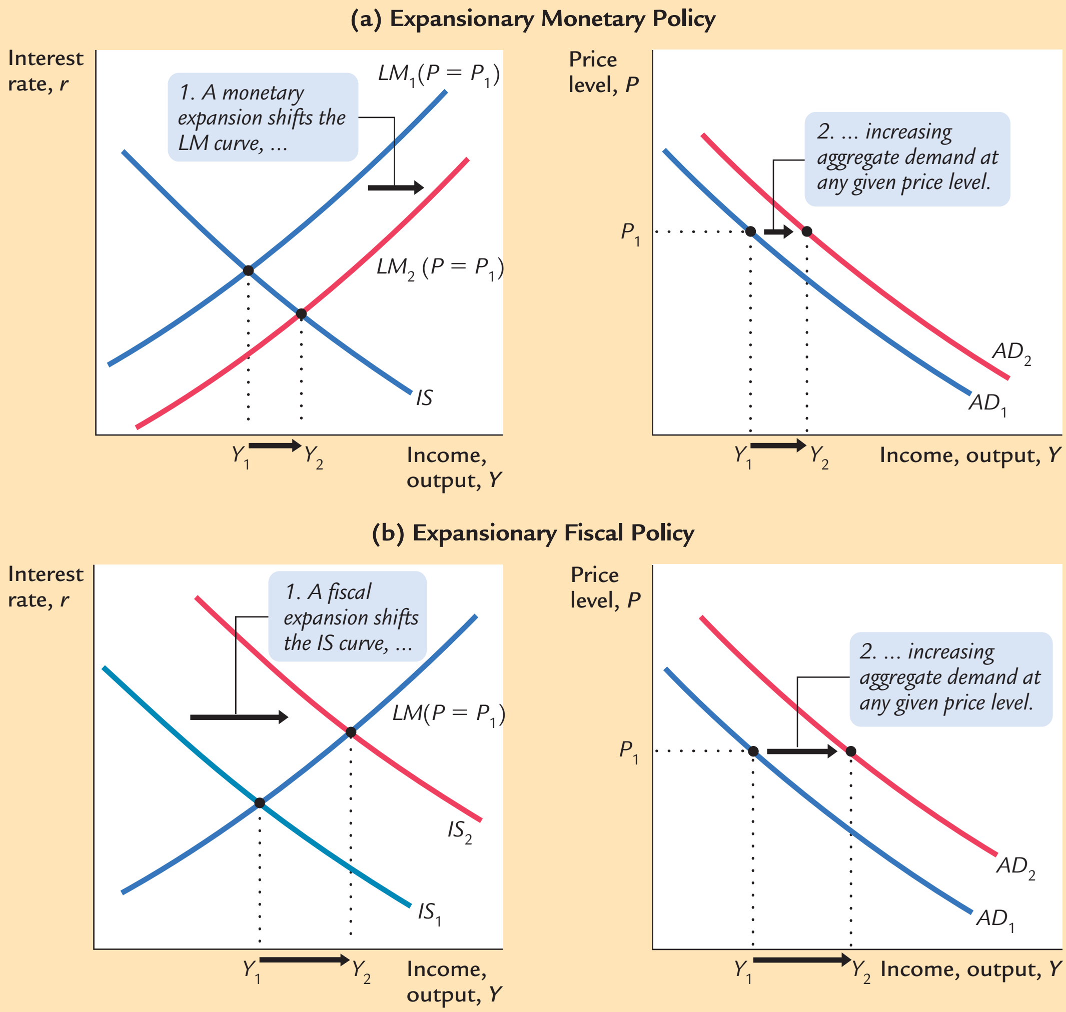


Deriving the Aggregate Demand Curve with the *IS–LM* Model Panel (a) shows the *IS–LM* model: an increase in the price level from P_1 to P_2 lowers real money balances and thus shifts the *LM* curve upward. The shift in the *LM* curve lowers income from Y_1 to Y_2. Panel (b) shows the aggregate demand curve summarizing this relationship between the price level and income: the higher the price level, the lower the level of income.

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.*

FIGURE 11-6



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.

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

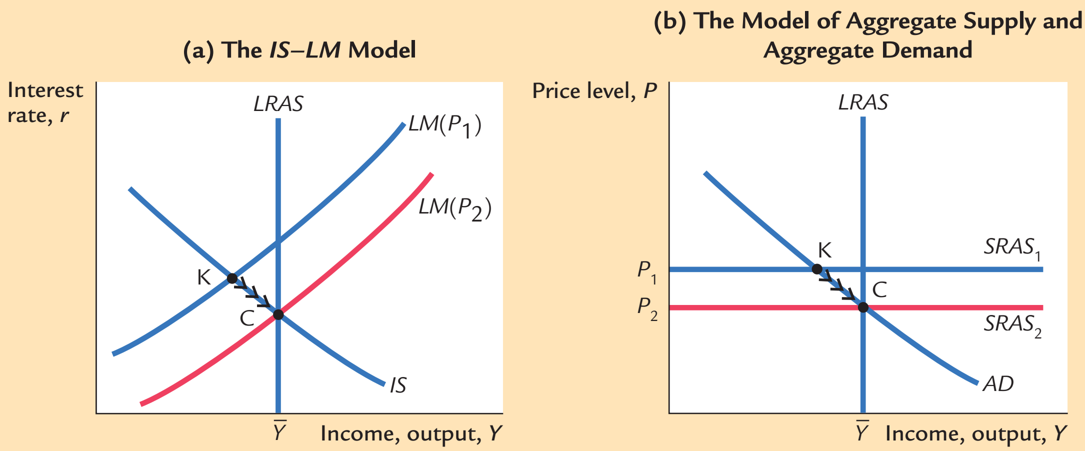
The *IS–LM* model is designed to explain the economy in the short run when the price level is fixed. Yet, now that we have seen how a change in the price level influences the equilibrium in the *IS–LM* model, we can also use the model to describe the economy in the long run when the price level adjusts 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 11-7 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 $\overline{Y}$. 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 11-7 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

FIGURE 11-7



The Short-Run and Long-Run Equilibria We can compare the short-run and long-run equilibria using either the *IS–LM* diagram in panel (a) or the aggregate supply–aggregate demand diagram in panel (b). In the short run, the price level is stuck at P_1. The short-run equilibrium of the economy is therefore point K. In the long run, the price level adjusts so that the economy is at the natural level of output. The long-run equilibrium is therefore point C.

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:

$$Y = C(Y - T) + I(r) + G \qquad IS,$$

$$M/P = L(r, Y) \qquad LM.$$

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

$$Y = \overline{Y}.$$

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 analysis of national income in Chapter 3 and prices in Chapter 4 assumes 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.

of this traumatic economic downturn. And, as we will see throughout this chapter, the model can also be used to shed light on more recent recessions, such as those that began in 2001 and 2008.

11-1 Explaining Fluctuations With the *IS–LM* Model

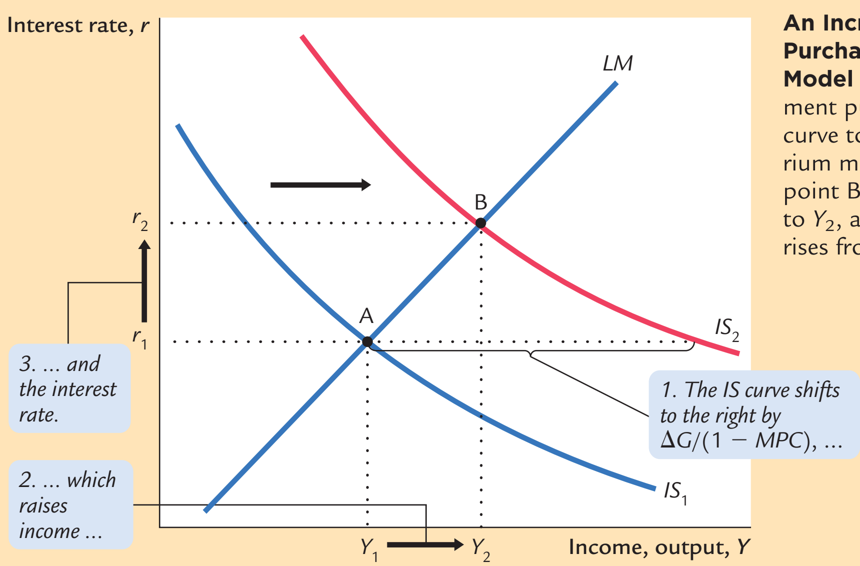
The intersection of the *IS* curve and the *LM* curve determines the level of national income. When one of these curves shifts, the short-run equilibrium of the economy changes, and national income fluctuates. In this section we examine how changes in policy and shocks to the economy can cause these 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 $\Delta G/(1 - MPC)$. Therefore, as Figure 11-1 shows, the *IS* curve shifts to the right

FIGURE 11-1



An Increase in Government Purchases in the *IS–LM* Model An increase in government purchases 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.

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 11-1, 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 has not changed, however, 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 11-1. 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.

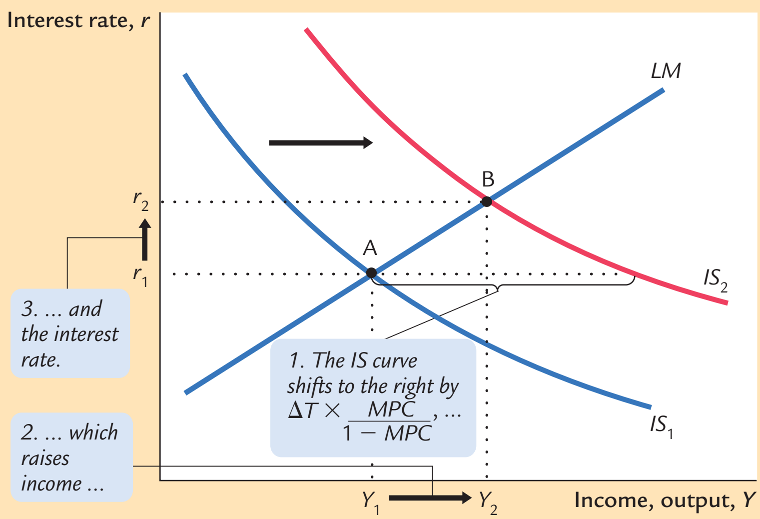
Changes in Taxes In the *IS–LM* model, changes in taxes affect the economy much the same as changes in government purchases do, except that taxes affect expenditure through consumption. Consider, for instance, a decrease in taxes of ΔT. The tax cut encourages consumers to spend more and, therefore, increases 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 11-2 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

FIGURE 11-2

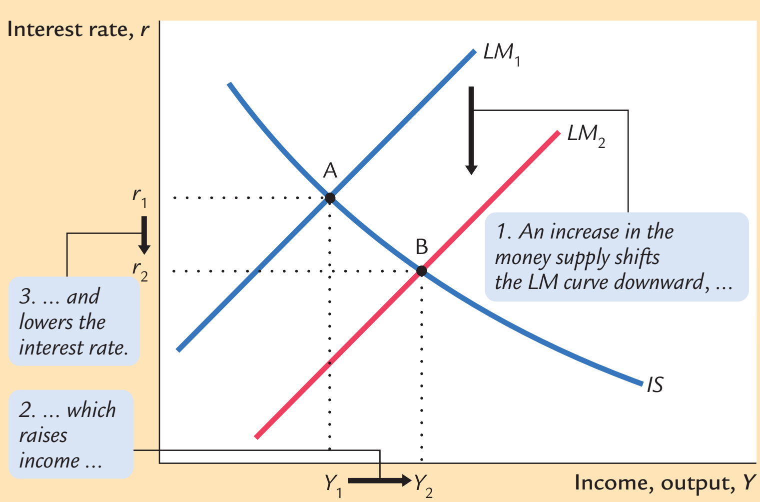


A Decrease in Taxes in the *IS–LM* Model A decrease in taxes shifts the *IS* curve to the right. The equilibrium moves from point A to point B. Income rises from Y_1 to Y_2, and the interest rate rises from r_1 to r_2.

income, an increase in real money balances leads to a lower interest rate. Therefore, the *LM* curve shifts downward, as in Figure 11-3. 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

FIGURE 11-3



An Increase in the Money Supply in the *IS–LM* Model An increase in the money supply shifts the *LM* curve downward. The equilibrium moves from point A to point B. Income rises from Y_1 to Y_2, and the interest rate falls from r_1 to r_2.

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.

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 9. 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.

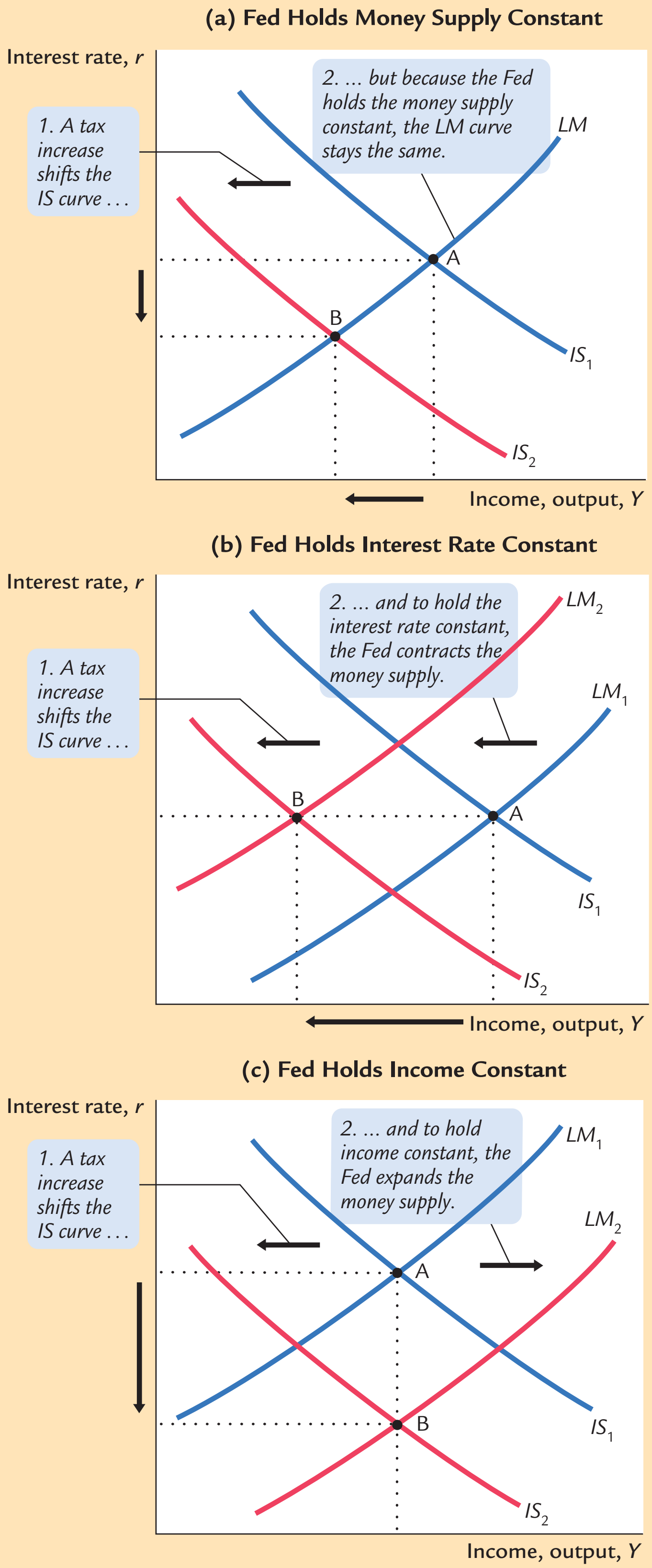
For example, suppose Congress raises taxes. What effect will this policy have on the economy? According to the *IS–LM* model, the answer depends on how the Fed responds to the tax increase.

Figure 11-4 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.

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

FIGURE 11-4



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 raising the money supply. In each case, the economy moves from point A to point B.

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.

CASE STUDY

Policy Analysis With Macroeconometric Models

The *IS–LM* model shows how monetary and fiscal policy influence the equilibrium level of income. The predictions of the model, however, are qualitative, not quantitative. The *IS–LM* model shows that increases in government purchases raise GDP and that increases in taxes lower GDP. But when economists analyze specific policy proposals, they need to know not only the direction of the effect but also the size. For example, if Congress increases taxes by $100 billion and if monetary policy is not altered, how much will GDP fall? To answer this question, economists need to go beyond the graphical representation of the *IS–LM* model.

Macroeconometric models of the economy provide one way to evaluate policy proposals. A *macroeconometric model* is a model that describes the economy quantitatively, rather than just qualitatively. Many of these models are essentially more complicated and more realistic versions of our *IS–LM* model. The economists who build macroeconometric models use historical data to estimate parameters such as the marginal propensity to consume, the sensitivity of investment to the interest rate, and the sensitivity of money demand to the interest rate. Once a model is built, economists can simulate the effects of alternative policies with the help of a computer.

Table 11-1 shows the fiscal-policy multipliers implied by one widely used macroeconometric model, the Data Resources Incorporated (DRI) model, named for the economic forecasting firm that developed it. The multipliers are given for two assumptions about how the Fed might respond to changes in fiscal policy.

One assumption about monetary policy is that the Fed keeps the nominal interest rate constant. That is, when fiscal policy shifts the *IS* curve to the right or to the left, the Fed adjusts the money supply to shift the *LM* curve in the same direction. Because there is no crowding out of investment due to a changing interest rate, the fiscal-policy multipliers are similar to those from the Keynesian cross. The DRI model indicates that, in this case, the government-purchases multiplier is 1.93, and the tax multiplier is −1.19. That is, a $100 billion increase in government purchases raises GDP by $193 billion, and a $100 billion increase in taxes lowers GDP by $119 billion.

The second assumption about monetary policy is that the Fed keeps the money supply constant so that the *LM* curve does not shift. In this case, the interest rate rises, and investment is crowded out, so the multipliers are much smaller. The government-purchases multiplier is only 0.60, and the tax multiplier is only −0.26.