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Olivier Blanchard
Massachusetts Institute of Technology

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Chapter

6

Goods and Financial Markets: The *IS-LM*

We spent Chapters 3 and 4 looking at the goods market, then Chapter 5 looking at financial markets. We now look at goods and financial markets together. By the end of this chapter you will have a conceptual framework to think about how output and the interest rate are determined, and about the effects of monetary and fiscal policies on the economy.

In developing this framework we shall follow a path first traced by two economists, John Hicks and Alvin Hansen, in the late 1930s and the early 1940s. When Keynes's *General Theory* was published in 1936, there was much agreement that the book was both fundamental and nearly impenetrable. (You may want to have a look at it to convince yourself of that.) There were many debates about what Keynes "really meant." In 1937, John Hicks summarized what he saw as one of Keynes's main contributions: the joint description of goods and financial markets. His analysis was later extended by Alvin Hansen. Hicks and Hansen called their formalization the *IS-LM* model. For obvious reasons, it is also called the Hicks–Hansen model.

Macroeconomics has made substantial progress since the early 1940s. This is why the *IS-LM* model is treated in Chapter 6 rather than in Chapter 30 of this book. (Think of it: If you had taken this course 40 years ago, you would be nearly done.) But to most economists, the *IS-LM* model still represents an essential building block—one that, despite its simplicity, captures much of what happens in the economy in the short and medium run. This is why the *IS-LM* model is still taught and used today.

6-1 THE GOODS MARKET AND THE *IS* RELATION

Let's first take stock of what we learned in Chapter 3. We characterized equilibrium in the goods market as the condition that production, Y, be equal to demand, Z. We called this condition the *IS* relation, because it can be reinterpreted as the condition that investment be equal to saving.

We defined demand as the sum of consumption, investment, and government spending. We assumed that consumption was a function of disposable income (income minus taxes), and took investment spending, government spending, and taxes as given. The equilibrium condition was thus given by

$$Y = C(Y - T) + \bar{I} + G$$

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

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

INVESTMENT, SALES, AND THE INTEREST RATE

In our first model of output determination, investment was left unexplained and thus assumed constant in the face of movements in output. Let's now relax this assumption. Investment—spending on new machines and plants by firms—depends primarily on two factors[1]:

[1] *We focus here on nonresidential fixed investment by firms and ignore* residential investment, *the purchase of new housing by people.*

- The first is the level of sales. Firms faced with high sales and the need to increase production will typically want to buy additional machines, to build additional plants. Firms that face low sales will feel no such need and will spend little if anything on investment.
- The second is the interest rate. Consider a firm that is deciding whether or not to buy a new machine. Suppose that to buy the new machine, the firm must borrow, either by taking a loan from a bank or by issuing bonds. The higher the interest rate, the less likely the firm is to borrow and buy the machine. At a high enough interest rate, the additional profits from the new machine will just not cover interest payments and the new machine will not be worth buying.

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

$$I = I(Y, i) \quad (+, -) \tag{6.1}$$

Equation (6.1) states that investment depends on two variables: production, Y, and the interest rate, i. While our discussion suggests that sales may be a more appropriate variable, we shall assume that sales and production are equal—in other words, we shall assume that inventory investment is always equal to zero—and use production instead. The positive sign under Y indicates a positive relation: An increase in production leads to an increase in investment. The negative sign under the interest rate i indicates a negative relation: An increase in the interest rate leads to a decrease in investment.

THE *IS* CURVE

Taking into account the investment relation (6.1), the equilibrium condition in the goods market becomes

$$\underbrace{Y}_{\text{Production}} = \underbrace{C(Y - T) + I(Y, i) + G}_{\text{Demand}} \tag{6.2}$$

This is our expanded *IS relation*. We can now look at what happens to output when the interest rate changes.

The first step is taken in Figure 6-1. Demand—the right-hand side of equation (6.2)—is measured on the vertical axis. Output (equivalently production, or income; remember that production is a synonym for output, and that production and income are always equal) is measured on the horizontal axis.

The curve ZZ plots demand as a function of output for a given value of the interest rate, i. As output, and thus income, increases, so does consumption; we studied this relation at length in Chapter 3. And as output increases, investment increases; this is the relation between investment and production that we have introduced in this chapter. Thus, through its effects on both consumption and investment, an increase in output leads to an increase in demand: ZZ is upward sloping.[2]

[2] *Since we have not assumed that the consumption and investment relations in equation (6.2) are linear,* ZZ *is in general a curve rather than a line. Thus, I draw it as a curve in Figure 6-1. But all the arguments that follow would apply if we assumed instead that the consumption and investment relations were linear and that* ZZ *was a line instead.*

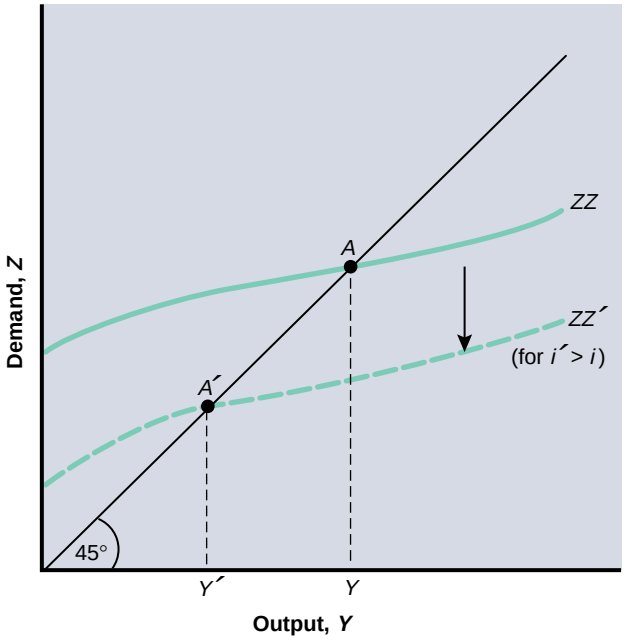


FIGURE 6-1
The Effects of an Increase in the Interest Rate on Output
An increase in the interest rate decreases the demand for goods at any level of output.

Note that I have drawn *ZZ* so that it is flatter than the 45-degree line. Put another way, I have assumed that an increase in output leads to a less than one-for-one increase in demand. In Chapter 3, where investment was constant, this restriction naturally followed from the restriction that consumers spend only part of their additional income on consumption. But now that we allow investment to respond to production, this restriction may no longer hold. When output increases, the sum of the increase in consumption and investment could exceed the initial increase in output. Although this is a theoretical possibility, the empirical evidence suggests, however, that it is not the case in practice. Thus, I shall assume that the response of demand to output is indeed less than one for one and draw *ZZ* flatter than the 45-degree line.

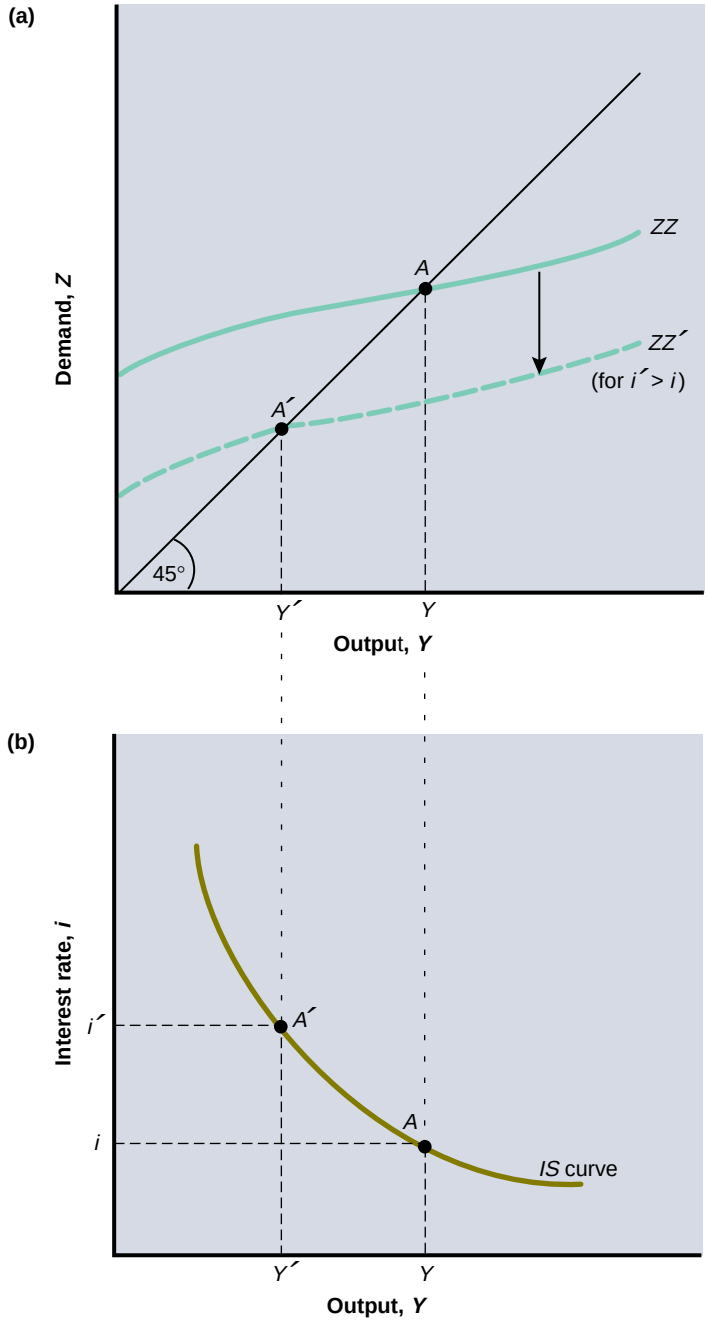
Equilibrium is reached at the point where demand is equal to production—thus at point *A,* the intersection of *ZZ* and the 45-degree line. The equilibrium level of output is given by *Y.*

We have drawn the demand relation, *ZZ,* for a given value of the interest rate. Suppose now that the interest rate increases from its initial value *i* to a new higher value *i′*. At any level of output, investment decreases. Thus, the demand curve *ZZ* shifts down to *ZZ′*. The new equilibrium is at the intersection of the new demand curve *ZZ′* and the 45-degree line, thus at point *A′*. The equilibrium level of output is now given by *Y′*.

Let's explain what happens in words. An increase in the interest rate decreases investment. The decrease in investment leads to a decrease in output, which in turn further decreases consumption and investment. In other words, the initial decrease in investment leads to a larger decrease in output through the multiplier effect.

Using Figure 6-1, we can find the equilibrium value of output associated with *any* value of the interest rate. The relation between equilibrium output and the interest rate is derived in Figure 6-2. Figure 6-2(a) reproduces Figure 6-1. The interest

FIGURE 6-2
The Derivation of the *IS* Curve
Equilibrium in the goods market implies that output is a decreasing function of the interest rate. The *IS* curve is downward sloping.



rate i implies a level of equilibrium output equal to Y. The higher interest rate i' implies a lower equilibrium level of output Y'. Figure 6-2(b) plots equilibrium output Y on the horizontal axis against the interest rate on the vertical axis. Point A in Figure 6-2(a) corresponds to point A in Figure 6-2(b), and point A' in Figure 6-2(a) corresponds to A' in Figure 6-2(b). More generally, equilibrium in the goods market implies that the higher the interest rate, the lower the equilibrium level of output.

This relation between the interest rate and output is represented by the downward-sloping curve in Figure 6-2(b). This curve is called the ***IS* curve.**[3]

Shifts in the *IS* Curve

Note that we have derived the *IS* curve in Figure 6-2 for given values of taxes, *T,* and government spending, *G.* Changes in either *T* or *G* will shift the *IS* curve.

To see how, consider Figure 6-3. The *IS* curve gives the equilibrium level of output as a function of the interest rate. It is drawn for given values of taxes and government spending. Now consider an increase in taxes, from *T* to *T′*. At a given interest rate, say *i,* consumption decreases, leading to a decrease in the demand for goods and, through the multiplier, to a decrease in equilibrium output. The equilibrium level of output decreases, from, say, *Y* to *Y′*. Put another way, the *IS* curve shifts to the left: At any interest rate, the equilibrium level of output is now lower than before the increase in taxes.

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

Let's summarize the main results of this first section. Equilibrium in the goods market implies that output is a decreasing function of the interest rate. This relation

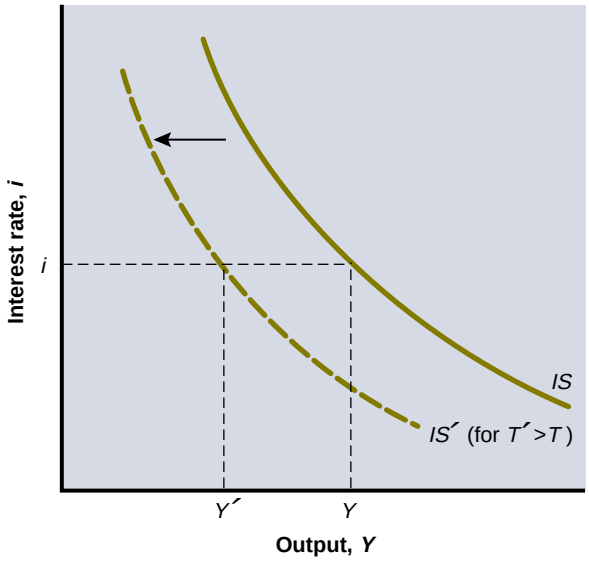


FIGURE 6-3
Shifts in the *IS* Curve
An increase in taxes shifts the *IS* curve to the left.

[3] ***Digging deeper.*** *You may want to think about what happens to investment and saving as we move down the* IS *curve. As we move down, the interest rate decreases and production increases; both factors increase investment. Also, as we move down, income increases, and thus saving increases. Thus, as we move down the* IS *curve, both investment and saving increase; indeed, by the construction of the* IS *curve, they increase by the same amount, so that investment remains equal to saving.*

is represented by the *IS* curve. Changes in factors that decrease or increase the demand for goods given the interest rate shift the *IS* curve to the left or to the right.

6-2 Financial Markets and the *LM* Relation

Let's now turn to financial markets. We saw in Chapter 5 that the interest rate is determined by the equality of the supply of and the demand for money:

$$M = \$YL(i)$$

The variable M on the left-hand side is the nominal money stock. I shall ignore here the details of the money-supply process and simply think of the central bank as controlling M directly. The right-hand side gives the demand for money, which is a function of nominal income, $\$Y$, and of the nominal interest rate, i. An increase in nominal income increases the demand for money. An increase in the interest rate decreases the demand for money. Equilibrium requires that money supply (the left-hand side of the equation) be equal to money demand (the right-hand side of the equation).

Real Money, Real Income, and the Interest Rate

The foregoing equation gives a relation between money, nominal income, and the interest rate. It will prove more convenient here to rewrite it as a relation between real money (that is, money in terms of goods), real income, and the interest rate.

Recall from Chapter 2 that nominal income divided by the price level is equal to real income, Y. Thus, dividing both sides of the equation by the price level P (which we take as given here) gives

$$\frac{M}{P} = YL(i) \tag{6.3}$$

Thus, we can restate our equilibrium condition as the condition that the *real money supply*—that is, the money stock in terms of goods, not dollars—be equal to the *real money demand,* which in turn depends on real income Y and the interest rate i. The notion of a "real" demand for money may feel a bit abstract, so an example may help here. Think not of your demand for money in general but just of your demand for coins. Suppose that you like to have coins in your pocket to buy four cups of coffee during the day. If a cup costs 60 cents, you will want to keep about $2.40 in coins: This is your nominal demand for coins. Equivalently, you want to keep enough in your pocket to buy four cups of coffee. This is your demand for coins in terms of goods, here in terms of cups of coffee.

From now on, I shall refer to equation (6.3) as the *LM relation.* The advantage of writing things this way is that *real income, Y,* now appears on the right-hand side of the equation instead of *nominal income* $\$Y$. And real income is the variable we focus on when looking at equilibrium in the goods market. To make the reading lighter, I shall refer to the right- and left-hand sides of equation (6.3) simply as "money supply" and "money demand" rather than the more accurate but heavier

"real money supply" and "real money demand." Similarly, I shall refer to income rather than "real income."

THE *LM* CURVE

To see the relation between output and the interest rate implied by equation (6.3), let's start with Figure 6-4. Let the interest rate be measured on the vertical axis, and (real) money be measured on the horizontal axis. Money supply is given by the vertical line at M/P, and is denoted M^s. For a given level of income, Y, money demand is a decreasing function of the interest rate. It is drawn as the downward-sloping curve denoted M^d. Except for the fact that we measure real money rather than nominal money on the horizontal axis, the figure is the same as Figure 5-4. The equilibrium is at point A, where money supply is equal to money demand and the interest rate is equal to i.

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

Using Figure 6-4, we can find out what value of the interest rate is associated with *any* value of income for a given money supply. The relation is derived in Figure 6-5. Figure 6-5(a) reproduces Figure 6-4. When income is equal to Y, money demand is given by M^d and the equilibrium interest rate is equal to i. When income is equal to the higher value Y', money demand is given by $M^{d'}$ and the equilibrium interest rate

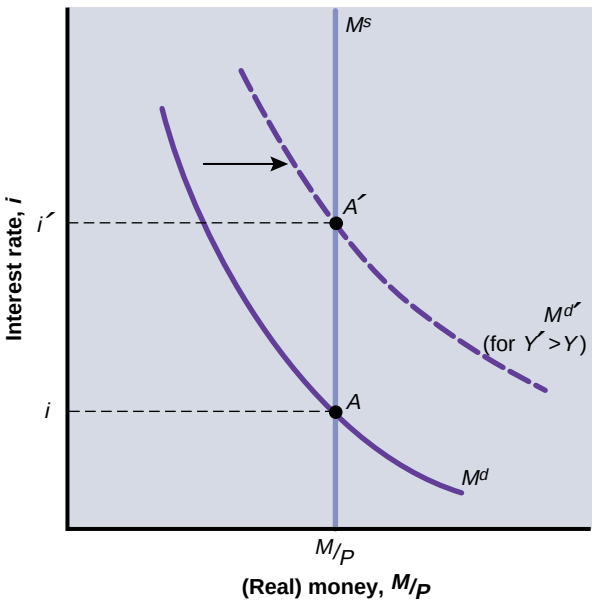


FIGURE 6-4
The Effects of an Increase in Income on the Interest Rate
An increase in income leads, at a given interest rate, to an increase in the demand for money. Given the money supply, this leads to an increase in the equilibrium interest rate.

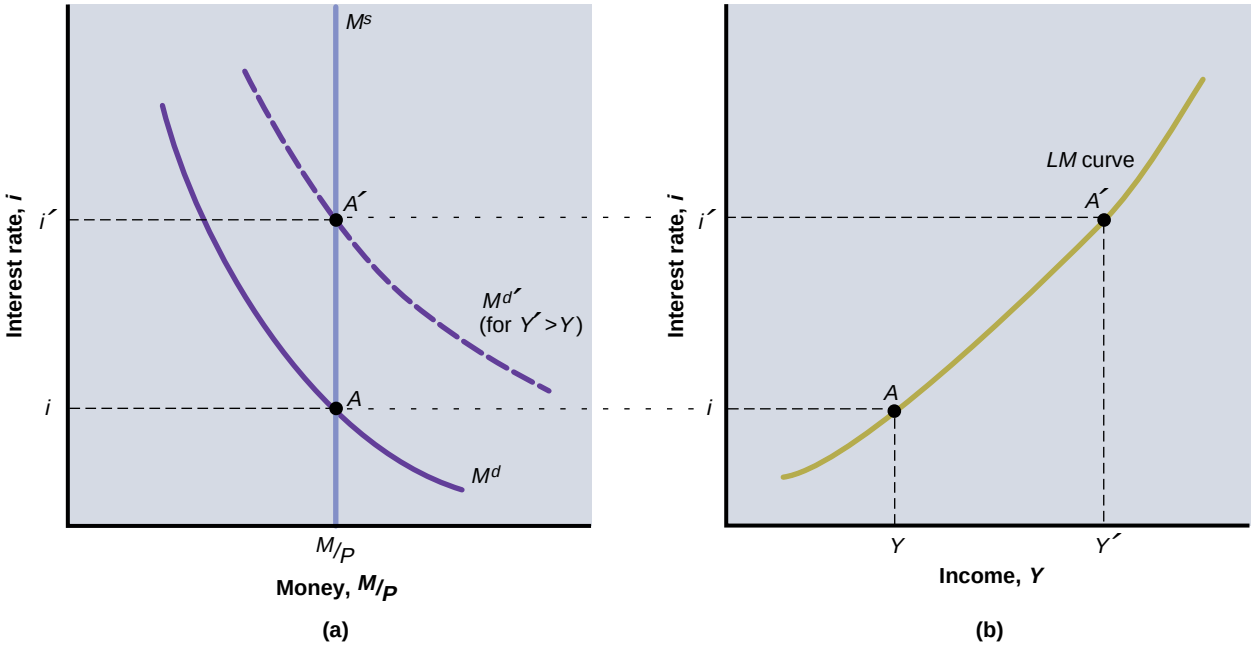


FIGURE 6-5
The Derivation of the *LM* Curve
Equilibrium in financial markets implies that the interest rate is an increasing function of the level of income. The *LM* curve is upward sloping.

is equal to i'. Figure 6-5(b) plots the equilibrium interest rate i on the vertical axis against income on the horizontal axis. Point A in Figure 6-5(b) corresponds to point A in Figure 6-5(a), and point A' in Figure 6-5(b) corresponds to point A' in Figure 6-5(a). More generally, equilibrium in financial markets implies that the higher the level of output, the higher the demand for money, and thus the higher the equilibrium interest rate. This relation between output and the interest rate is represented by the upward-sloping curve in Figure 6-5(b). This curve is called the ***LM* curve.**

Shifts in the *LM* Curve

We have derived the *LM* curve in Figure 6-5 taking both the nominal money stock, M, and the price level, P—and thus the real money stock, M/P—as given. Changes in M/P, whether they come from changes in the nominal money stock, M, or from changes in the price level, P, will shift the *LM* curve.

To see how, consider Figure 6-6. The *LM* curve gives the interest rate as a function of the level of income. It is drawn for a given value of M/P. Now consider an increase in the nominal money supply, from M to M', so that, at an unchanged price level, the real money supply increases from M/P to M'/P. At a given level of income, Y, this increase in money leads to a decrease in the equilibrium interest rate from i to i'. Put another way, the *LM* curve shifts down; at any level of income, an increase in money leads to a decrease in the equilibrium interest rate. By the same reasoning, at any level of income, a decrease in money leads to an increase in the interest rate. Thus, a decrease in money leads the *LM* curve to shift up.

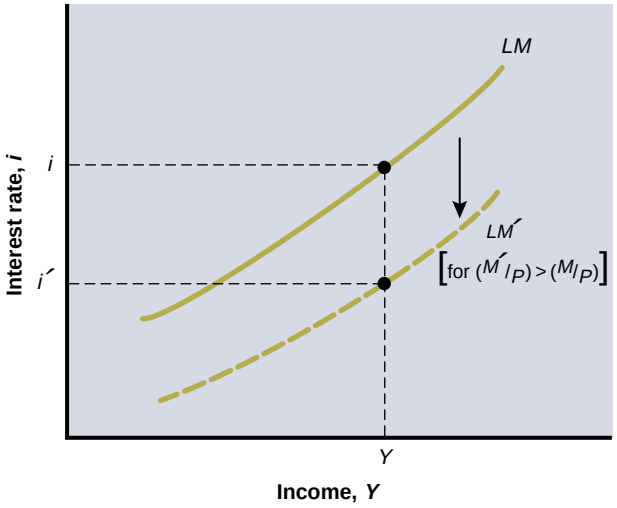


FIGURE 6-6
Shifts in the *LM* Curve
An increase in money leads the *LM* curve to shift down.

Let's summarize what we have learned in this section. Equilibrium in financial markets implies that the interest rate is an increasing function of the level of income. This relation is represented by the *LM* curve. Increases in money shift the *LM* curve down; decreases in money shift the *LM* curve up.

6-3 THE *IS-LM* MODEL: EXERCISES

We can now put the *IS* and *LM* relations together. At any point in time, the supply of and the demand for goods must be equal. And the same must hold for the supply of and the demand for money. Thus, both the *IS* and *LM* relations must hold:

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

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

Figure 6-7 on the next page plots both the *IS* curve and the *LM* curve on one graph. Output—equivalently production or income—is measured on the horizontal axis. The interest rate is measured on the vertical axis.

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

The *IS* and *LM* relations that underlie Figure 6-7 contain a lot of information about consumption, investment, money demand, and equilibrium conditions. But you may well be asking at this point: So what if the equilibrium is at point *A*? How does this fact translate into anything directly useful about the world? Don't despair: Figure 6-7 does in fact hold the answer to many central questions in macroeconomics. Used properly, it allows us to study what happens to output and the interest rate when the central bank decides to increase the money stock, or when the government decides to increase

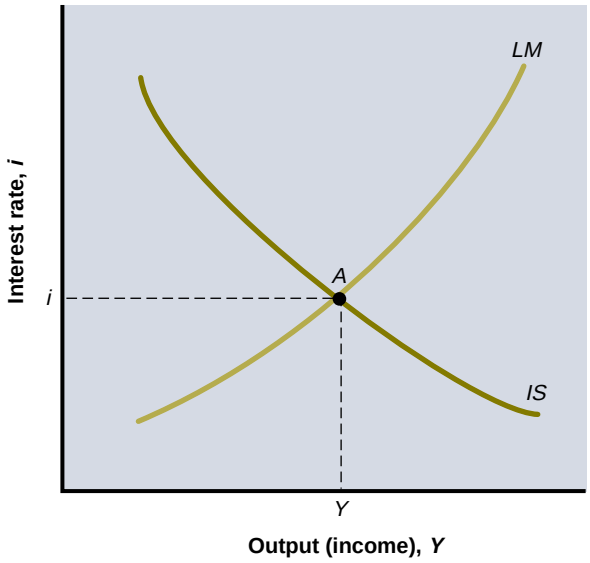


FIGURE 6-7
The *IS-LM* Model
Equilibrium in the goods market implies that output is a decreasing function of the interest rate. Equilibrium in financial markets implies that the interest rate is an increasing function of output. Only at point *A* are both goods and financial markets in equilibrium.

taxes, or when consumers become more pessimistic about the future, and so on. Indeed, there was a point 30 years ago or so when the *IS-LM* model was so dominant in macroeconomics that it led Axel Leijonhufvud, an economist at UCLA, to write a spoof of macroeconomics that is reproduced in part in the Focus box entitled "Life Among the Econ: The *IS-LM* as a Totem." Let's now see what the *IS-LM* model can do.

FOCUS

LIFE AMONG THE ECON: THE IS-LM AS A TOTEM

From the 1950s to the 1970s, the *IS-LM* model was the dominant model in macroeconomics. Nearly every question was recast in terms of whether the *IS* curve or the *LM* curve shifted, and how this shift in turn led to a change in output.

The dominance of the *IS-LM* model led Axel Leijonhufvud to write a satire of macroeconomics. In "Life Among the Econ," he pretended to be an "econologist"—that is, an anthropologist studying a tribe called the Econ. He described the tribe as divided into castes, the "Micros" and the "Macros," each with "elders" and "grads," each making "modls," and each with their own totems. Here is how he describes macro and the *IS-LM*:

> *Consider the totems of the Micro and the Macro. Both could be roughly described as formed by two carved sticks joined together in the middle somewhat in the form of a pair of scissors (see Figure 1 on page 111).*
>
> *Certain ceremonies connected with these totems are of great interest to us. . . . The following account of the "prospecting" ceremony among the Macro brings out several riddles that currently perplex econologists working in the area:*
>
> *The elder grasps the LM with his left hand and the IS with his right hand and, holding the totem out in front of himself, with elbows slightly bent, proceeds in a straight line—gazing neither left nor right, in the words of their ritual—out over the chosen terrain. . . . At long last, the totem vibrates, then oscillates more and more; finally, it points, quivering, straight down. The elder waits for the grads to gather around and then pronounces, with great solemnity: "Behold, the Truth and the Power of Macro." . . .*
>
> *The Macro maintain that they strike gold this way. Some travellers and investigators support the con-*

FOCUS

tention, others dismiss it as mere folklore. The issues are much the same as those connected with attempts to appraise the divining-rod method of finding water. Numerous people argue that it works—but no scientific explanation of why it would has ever been advanced.

Source: Axel Leijonhufvud, "Life Among the Econ," *Western Economic Journal,* 1973, 327–337.

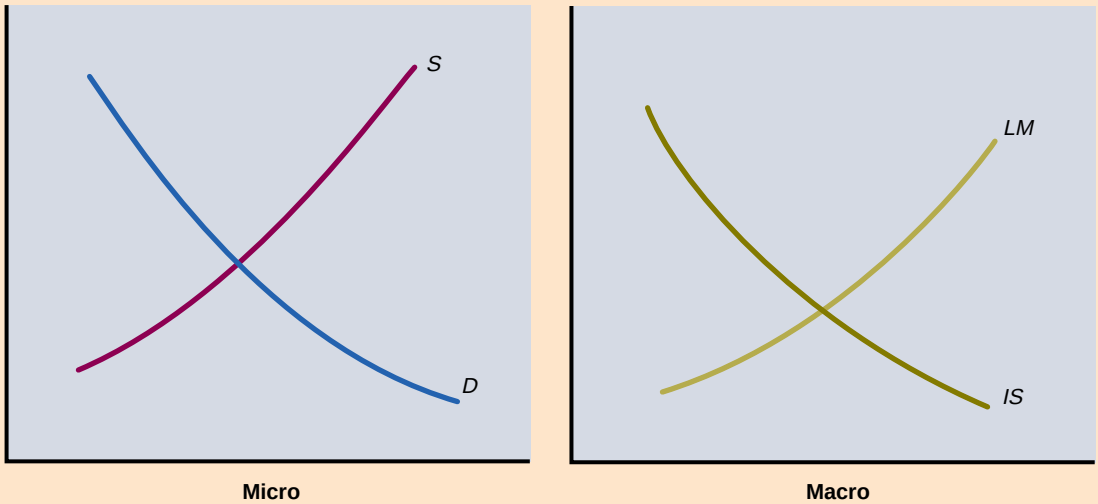


FIGURE 1
Totems of the Micro and the Macro: Demand/Supply and *IS-LM*

Fiscal Policy, Activity, and the Interest Rate

Suppose that the government concludes that the budget deficit is too large. A decision is made to increase taxes while keeping government spending unchanged. Such a policy, aimed at reducing the budget deficit, is often called a **fiscal contraction** or a **fiscal consolidation.** (In contrast, an *increase* in the deficit, either due to an increase in spending or to a decrease in taxes, is called a **fiscal expansion.**) What are the effects of such a fiscal contraction on output, on its components, and on the interest rate?

In answering this or any question about the effects of changes in policy, always go through the following three steps:

- *Step 1:* Ask how this change affects goods and financial markets equilibrium relations, how it shifts the *IS* and/or the *LM* curve.
- *Step 2:* Characterize the effects of these shifts on the equilibrium.
- *Step 3:* Describe the effects in words.

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

Going through step 1, the first question to tackle is how the increase in taxes affects equilibrium in the goods market—that is, how it affects the *IS* curve. Let's draw, in Figure 6-8(a), the *IS* curve corresponding to equilibrium in the goods market before the increase in taxes. Take an arbitrary point, *B,* on this *IS* curve. By construction of the *IS* curve, output Y_B and the corresponding interest rate i_B are such that the supply of goods is equal to the demand for goods.

Now, at the interest rate i_B, ask what happens to output if taxes increase from T to T'. We saw the answer in Section 6-1. Because people have less disposable income, the increase in taxes decreases consumption, and through the multiplier, decreases output. Thus, at interest rate i_B, output decreases from Y_B to Y_C. More generally, at *any* interest rate, higher taxes lead to lower output: The *IS* curve shifts to the left from *IS* to *IS′*.

Next, let's see if anything happens to the *LM* curve. Figure 6-8(b) draws the *LM* curve corresponding to financial-markets equilibrium before the increase in taxes. Take an arbitrary point, *D,* on this *LM* curve. By construction of the *LM* curve, the interest rate i_D and income Y_D are such that the supply of money is equal to the demand for money.

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

Note the general principle here: *A curve shifts in response to a change in an exogenous variable only if this variable appears directly in the equation represented by that curve.* Taxes enter equation (6.2), so the *IS* curve shifts. But taxes do not enter equation (6.3), so the *LM* curve does not shift.

Now let's consider the second step, the determination of the equilibrium. Let the initial equilibrium in Figure 6-8(c) be at point *A,* at the intersection between the initial *IS* curve and the *LM* curve. After the increase in taxes, the *IS* curve shifts to the left, and the new equilibrium is at the intersection of the new *IS* curve and the unchanged *LM* curve, at point *A′*. Output decreases from *Y* to *Y′*. The interest rate decreases from *i* to *i′*. Thus, as the *IS* curve *shifts,* the economy *moves along* the *LM* curve, from *A* to *A′*. The reason these words are italicized is that it is always important to distinguish *shifts in* curves (here the *IS* curve) and *movements along* a curve (here the *LM* curve). Most mistakes and confusion come from not distinguishing between the two.

The third and final step is to tell the story in words. The story goes like this: The increase in taxes leads to lower disposable income, which causes people to consume less. The result through the multiplier effect is a decrease in output and income. The decrease in income reduces the demand for money, leading to a decrease in the interest rate. The decline in the interest rate mitigates but does not completely offset the effect of higher taxes on the demand for goods. (If the interest rate did not decline, the economy would go from point *A* to point *F* in Figure 6-8(c). But as a result

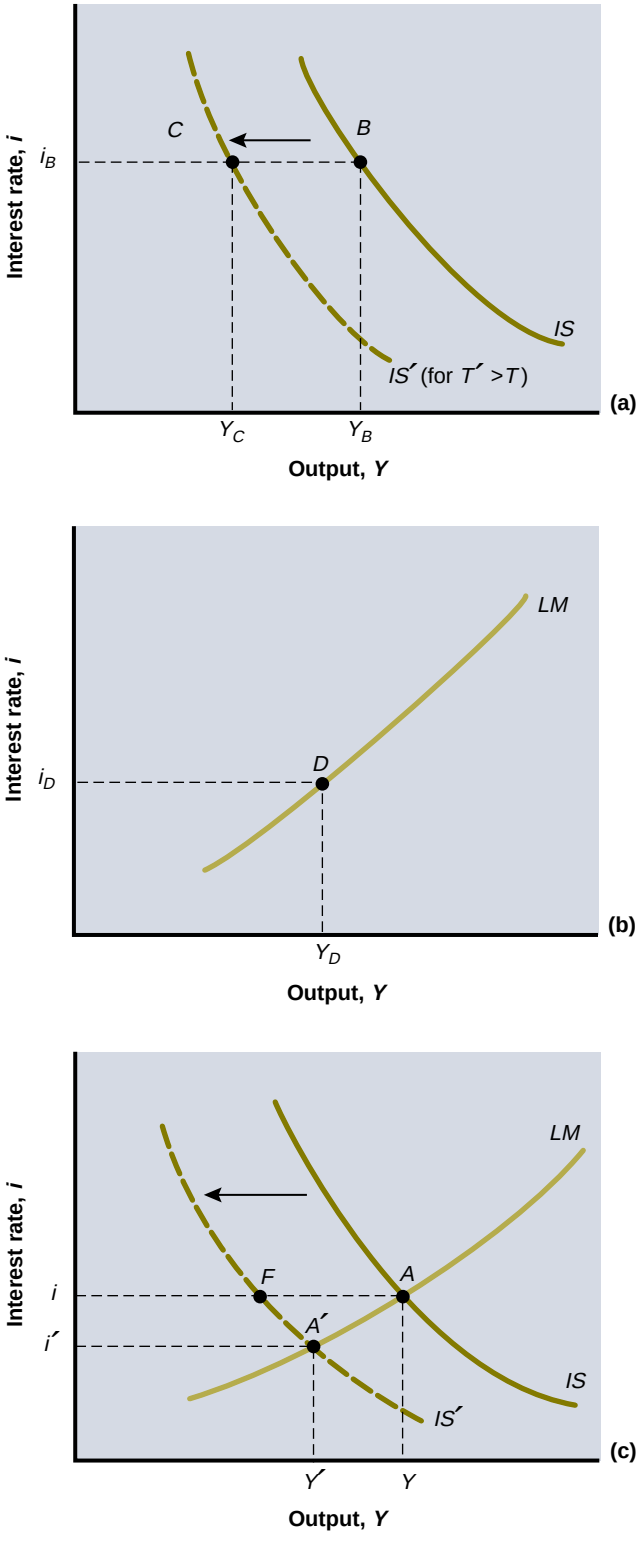


FIGURE 6-8
The Effects of an Increase in Taxes
An increase in taxes shifts the *IS* curve to the left, and leads to a decrease in the equilibrium level of output and the equilibrium interest rate.

of the decline in the interest rate—which stimulates investment—the decline in activity is only to point A'.)

What happens to the components of demand? By assumption, government spending remains unchanged: We have assumed that the fiscal consolidation takes place through an increase in taxes. Consumption surely goes down, both because taxes go up and because income goes down. But what happens to investment? On the one hand, lower output means lower sales and lower investment. On the other, a lower interest rate leads to higher investment. Without knowing more about the exact form of the investment relation, equation (6.1), we cannot tell which effect dominates. If investment depends only on the interest rate, then investment surely increases; if investment depends only on sales, then investment surely decreases. In general, we cannot tell. Contrary to what is often stated by politicians, a reduction in the budget deficit does not necessarily lead to an increase in investment. (The Focus box entitled "Deficit Reduction: Good or Bad for Investment?" discusses this result at more length.) We shall return to the relation between fiscal policy and investment many times in this book, and we shall qualify this first answer in many ways. But the result that *deficit reduction may decrease investment,* at least in the short run, will remain.

FOCUS

DEFICIT REDUCTION: GOOD OR BAD FOR INVESTMENT?

You may have heard the argument before: "Private saving goes toward either financing the budget deficit or financing investment. Thus, it does not take a genius to conclude that reducing the budget deficit leaves more saving available for investment, and thus increases investment."

This argument sounds simple and convincing. How do we reconcile it with what we just saw in the text, that deficit reduction may decrease rather than increase investment?

Remember from Chapter 3 that we can also think of goods-market equilibrium as the condition that

$$\underset{\text{Investment}}{I} = \underset{\text{Private saving}}{S} - \underset{\text{Budget deficit}}{(G - T)}$$

Investment must be equal to total saving—that is, private saving minus the budget deficit (which is just dissaving by the government). And it is indeed true that *given private saving,* if the government reduces its deficit—either by increasing taxes or reducing government spending—investment must go up.

The crucial part of this statement, however, is "given private saving." And a fiscal contraction affects private saving as well: A fiscal contraction leads to lower output, lower income; as consumption goes down by less than income decreases, private saving also goes down. And it may go down by more than the reduction in the budget deficit, leading to a decrease rather than an increase in investment. To sum up, a fiscal contraction may indeed decrease investment. Or, looking at the reverse case, a fiscal expansion—that is, a decrease in taxes or an increase in spending—may actually increase investment.

Monetary Policy, Activity, and the Interest Rate

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

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

The first step is again to see whether and how the *IS* and the *LM* curves shift. Let's look at the *IS* curve first. The money supply does not affect *directly* either the supply of or the demand for goods. In other words, M does not appear in the *IS* relation. Thus, a change in M does not shift the *IS* curve.

Money enters the *LM* relation, however, so that the *LM* curve shifts when the money supply changes. As we saw in Section 6-2, an increase in money shifts the *LM* down: At a given level of income, an increase in money leads to a decrease in the interest rate.

Putting things together, a monetary expansion shifts the *LM* curve down and does not affect the *IS* curve. Thus, in Figure 6-9, the economy moves along the *IS* curve, and the equilibrium changes from point A to point A'. Output increases from Y to Y', and the interest rate decreases from i to i'. In words: The increase in money leads to a lower interest rate. The lower interest rate leads to an increase in investment and, through the multiplier, to an increase in demand and output.

In the case of a monetary expansion, as opposed to the case of fiscal contraction we looked at earlier, we can tell exactly what happens to the various components of demand. With higher income and unchanged taxes, consumption goes up. With higher sales and a lower interest rate, investment also unambiguously goes up. A monetary expansion is thus more investment friendly than a fiscal expansion.

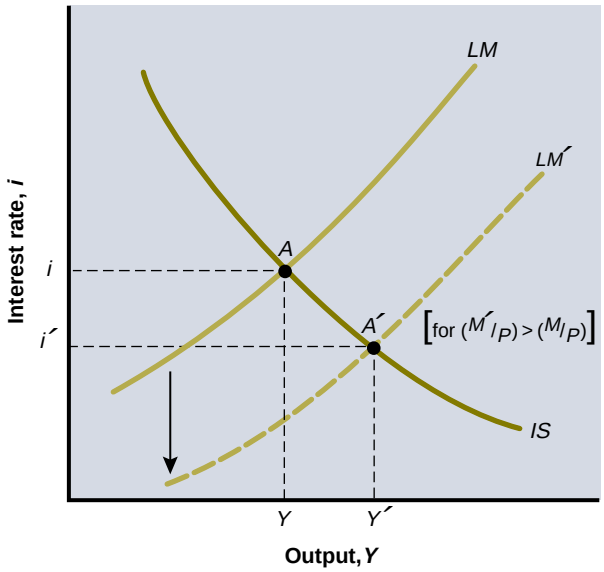


FIGURE 6-9
The Effects of a Monetary Expansion
A monetary expansion leads to higher output and a lower interest rate.

Using a Policy Mix

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

Sometimes monetary and fiscal policies are used for a common goal. For example, in 1993 President Clinton sent a deficit reduction package to Congress. At that time, the Fed very much wanted to see a deficit reduction and indicated that if the package went through, the Fed would partially counteract the adverse effects of a fiscal contraction on economic activity with a more expansionary monetary policy. In terms of the *IS-LM* diagram in Figure 6-10, the Fed implicitly agreed that if the fiscal consolidation package were passed (leading to a leftward shift of the *IS* curve, from *IS* to *IS′*) it would shift the *LM* curve down (from *LM* to *LM′*). It implicitly agreed to reduce the adverse effects of fiscal contraction on activity, thus leading the economy to go from point *A* to a point such as *A′* rather than to a point such as *B*.[4]

Sometimes the fiscal–monetary mix emerges from tensions or even disagreements between the government (which is in charge of fiscal policy) and the central bank (which is in charge of monetary policy). A typical scenario is one in which the central bank, disagreeing with what it considers a dangerous fiscal expansion, embarks on a course of monetary contraction to offset some of the fiscal expansion's effects on activity. A recent example of such a tug of war is that of Germany after unification in the early 1990s. It is described in the In-Depth box entitled "German Unification and the German Fiscal–Monetary Policy Mix."

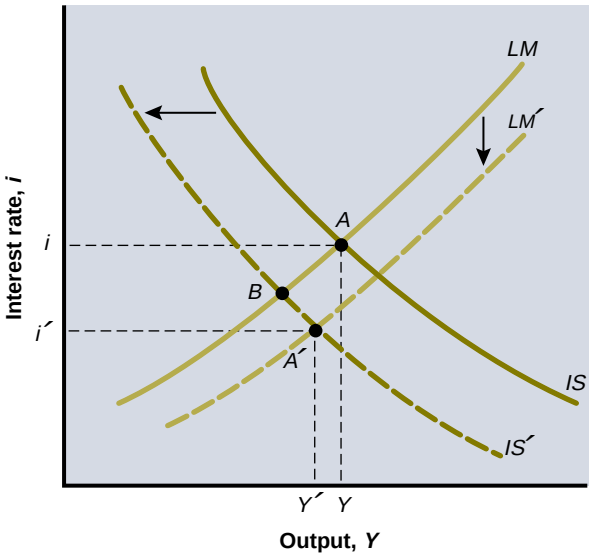


FIGURE 6-10
Fiscal Contraction and Monetary Expansion
Combining a monetary expansion with a fiscal contraction allows for a decrease in the interest rate with little or no decrease in output.

[4] *A detailed description of this episode is given in Chapter 10.*

TABLE 6-1

THE EFFECTS OF FISCAL AND MONETARY POLICY

	SHIFT IN *IS*	SHIFT IN *LM*	MOVEMENT IN OUTPUT	MOVEMENT IN INTEREST RATE
Increase in taxes	left	none	down	down
Decrease in taxes	right	none	up	up
Increase in government spending	right	none	up	up
Decrease in government spending	left	none	down	down
Increase in money	none	down	up	down
Decrease in money	none	up	down	up

You should remember the method we have developed in this section to look at changes in activity and the interest rate. We have used it to look at the effects of changes in policy; Table 6-1 summarizes what we have learned. But you can use it to look at other changes as well. For example, you may want to trace the effects of a decrease in consumer confidence through its effect on consumption demand.

IN DEPTH

GERMAN UNIFICATION AND THE GERMAN FISCAL–MONETARY POLICY MIX

In 1990 East Germany and West Germany became one country again. Whereas the two parts had been at a roughly comparable level of economic development before World War 11, this was no longer the case by 1990. West Germany was far richer and far more productive than East Germany. The economic consequences of unification were many; the focus here will be just on the implications of unification for fiscal and monetary policy. (A full discussion of the transition from central planning to a market economy in East Germany, and Eastern Europe in general, will have to wait until Chapter 26, after we have developed the required tools.)

Upon unification, it became clear that most firms in the Eastern Lander (as the ex-German Democratic Republic is now known) were just not competitive. Many simply had to be closed in part or in total, and the others needed new and more modern equipment. It soon became obvious that transition would require large increases in government spending on new infrastructure, on cleaning up environmental damage, on unemployment benefits to workers losing their jobs, and on transfers to firms to keep them operating until they turned around.

The Berlin Wall, which had separated the two halves of Berlin since 1961, was dismantled in November 1989.

Faced with this large increase in transfers and spending, the German government decided to rely partly on increased taxes and partly on a larger deficit. Table 1 gives basic numbers on some of the major macroeconomic variables from 1988 to 1991 (for West Germany only).

The numbers show that, even before unification, Germany was experiencing a strong expansion. GDP growth in 1988 and 1989 was close to 4 percent. Investment was booming. And, because tax revenues depend on economic activity, the strong growth in GDP was the source of high government revenues in 1989, leading to a fiscal surplus of 0.2% of GDP in 1989.

The effects of unification were to increase demand further. In 1990, the rate of investment growth was even higher than in 1989. Because of the increase in spending and transfers due to unification, West Germany's fiscal position went from a budget surplus in 1989 to a budget deficit of 1.8% of GDP in 1990. In terms of the *IS-LM* model, 1990 was thus characterized by a sharp increase in government spending, a large shift of the *IS* to the right, from *IS* to *IS′* in Figure 1.

Seeing these developments, the German central bank (Bundesbank) worried that growth was too strong, that the economy was operating at too a high a level of activity, and that the result would be inflation (a mechanism we explore later in the book). The central bank concluded that growth should be slowed. Thus, even though the interest rate had already increased from 4.3% in 1988 to 7.1% in 1989, the Bundesbank decided on a policy of tight money; it let the interest rate go even higher, to 9.2% in 1991. In terms of the *IS-LM* in Figure 1, the central bank decided to shift the *LM* up, in order to slow down economic activity.

Thus, one of the effects of German unification was fiscal expansion combined with tight monetary policy. The result was fast growth (from the fiscal expansion) and high interest rates (from tight money). These high interest rates had important implications not only for Germany, but for all of Europe. Indeed, they have been accused of being one of the main causes of the recession in Europe in the early 1990s. We discuss this argument in Chapter 13.

TABLE 1

SELECTED MACRO VARIABLES FOR WEST GERMANY, 1988–1991

	1988	1989	1990	1991
GDP growth (%)	3.7	3.8	4.5	3.1
Investment growth (%)	5.9	8.5	10.5	6.7
Budget surplus (% of GDP) (minus sign: deficit)	–2.1	0.2	–1.8	–2.9
Interest rate (short term)	4.3	7.1	8.5	9.2

"Investment" refers to nonresidential investment.

Source: OECD Economic Outlook, June 1992.

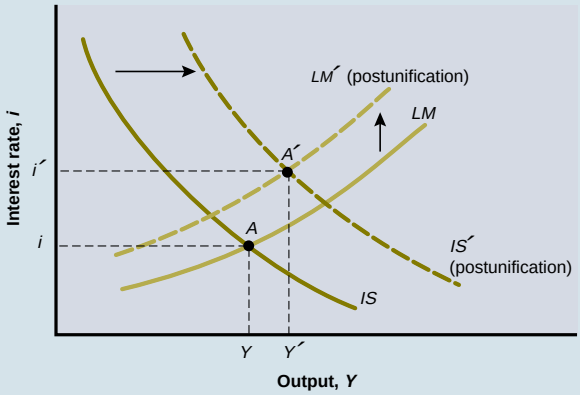


FIGURE 1
The Fiscal–Monetary Policy Mix in Postunification Germany

6-4 ADDING DYNAMICS

In Chapter 4 we added dynamics to our description of the goods market and were able to describe the adjustment of output both more realistically and more intuitively. We do the same here, indeed building on what we learned in Chapter 4.

Let's return first to the *IS* curve and examine the effects of a tax increase. As we have seen, a tax increase shifts the *IS* curve to the left. In Figure 6-11(a), the *IS* curve shifts from *IS* to *IS′*. At a given interest rate, say i_A, the equilibrium level of output decreases from Y_A to Y_B.

Will output really decline instantaneously from Y_A to Y_B? No. We saw some reasons in Chapter 4: It takes a while for production to respond to the decrease in sales and for consumers to respond to the decrease in income. We can now add to that list the fact that it is also likely to take a while for firms to revise their investment plans in light of a decrease in sales. For all these reasons, the decline in output will happen only over time. In terms of Figure 6-11(a), output will decrease slowly from Y_A to Y_B.

More generally, it is reasonable to assume that when output is to the right of the equilibrium curve—which, in our case, after the tax increase, is *IS′*—output decreases slowly; when it is to the left of the equilibrium curve, output increases slowly. This basic conclusion is represented by the two large arrows on each side of *IS′* in Figure 6-11(a).

Now let's look at the *LM* curve and the effects of a monetary contraction. As we have seen, a monetary contraction shifts the *LM* curve up. In Figure 6-11(b) the *LM* curve shifts from *LM* to *LM′*: At a given level of income, say Y_A, the interest rate increases from i_A to i_B. How long does it take for the interest rate to adjust? The answer is: practically no time. Interest rates adjust very quickly to changes in supply and demand in most financial markets. The market

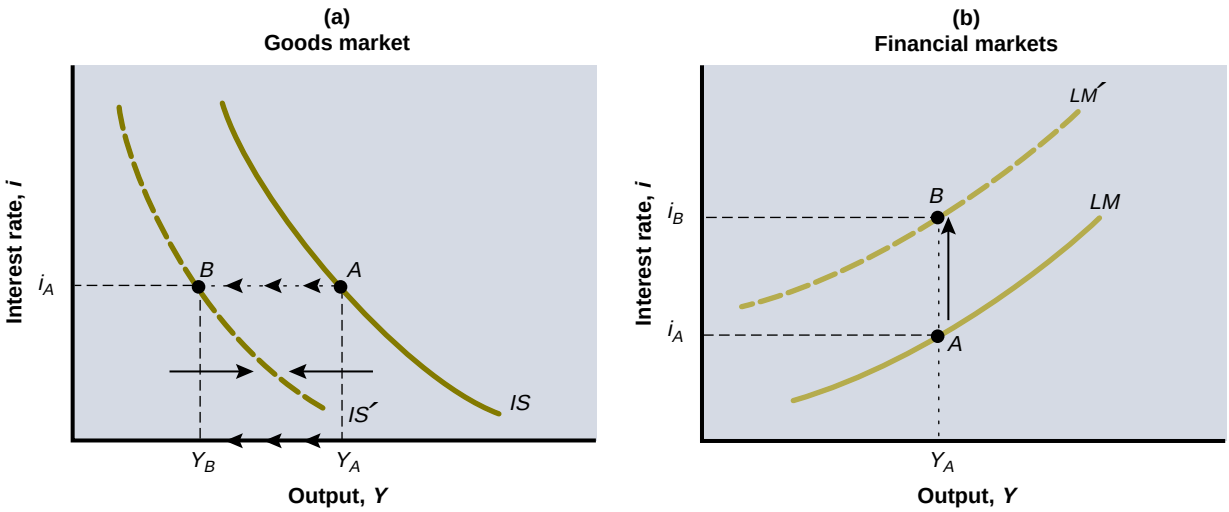


FIGURE 6-11
Introducing Dynamics in the *IS-LM* Model
When output is above the level implied by the *IS* relation, it adjusts slowly to that level. In contrast, interest rates adjust quickly, so that the *LM* relation is always satisfied.

for government bonds (in which the Fed buys and sells bonds in the United States) is one of the most efficient markets in the world and clears within seconds of changes in demand or supply. When the Fed does an open market operation, selling bonds in the bonds market, the interest rate adjusts almost instantaneously. Thus, the right assumption is that the decrease in the money supply causes the interest rate to increase instantaneously from i_A to i_B in Figure 6-11(b).[5] For the rest of the book, I shall assume that the adjustment of the interest rate to any change in the demand or the supply of money is so fast that *the economy is always on the LM curve.*

Equipped with these dynamics, let's reexamine the effects of a monetary contraction on activity and the interest rate. The adjustment is shown in Figure 6-12. Before the decrease in the money supply, the economy is at point *A,* with output *Y* and interest rate *i.* When the central bank decreases the money supply, the *LM* curve shifts from *LM* to *LM′*. The economy jumps to point *A″*: Output does not change right away, and the interest rate must do all the adjustment, increasing from *i* to *i″*. Over time, the higher interest rate leads to lower investment, a lower demand for goods, and lower output, so that output slowly decreases from its initial level. The economy moves along *LM′*, and eventually reaches point *A′*. At *A′*, the interest rate is equal to *i′* and output is equal to *Y′*. Note that the eventual increase in the interest rate is smaller than the initial increase: This is because, as output contracts, so does the demand for money, which puts some pressure on the interest rate to decrease.

It is easy to describe the adjustment in words: The monetary contraction leads initially to a sharp increase in the interest rate. Over time, this increase leads to a decrease in output. This time dimension is important, and there is a general lesson

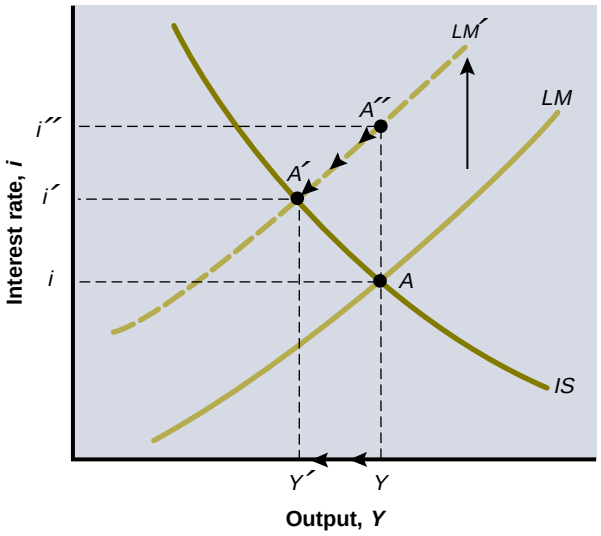


FIGURE 6-12
The Dynamic Effects of a Monetary Contraction
A monetary contraction leads to an increase in the interest rate. The higher interest rate leads, over time, to a decline in output.

[5]***Digging deeper.*** *It is true that an open market operation, which changes the monetary base, affects the interest rate instantaneously. But as we saw in the final section of Chapter 5, this open market operation affects the total money supply (currency and demand deposits) through a money multiplier process, which actually does take time to work itself out. So the adjustment of the interest rate to a change in the monetary base,* H*—the variable directly under the central bank's control—is not instantaneous. But it is sufficiently fast compared to adjustment of output in the goods market that the assumption I make in the text is a good approximation of reality.*

about policy to be drawn from it. Monetary policy can affect the interest rate quickly but cannot affect output right away. Thus, the central bank must be careful not to be fighting the last battle. For example, there is no point in fighting a recession through a lower interest rate if the recession is already over when the lower interest rate starts affecting economic activity.

I shall let you look at the dynamic effects of a change in fiscal policy on your own. And, from now on, I shall often rely on these dynamics to tell more realistic stories of how changes in policy or behavior affect economic activity.

6-5 Does the *IS-LM* Model Actually Capture What Happens in the Economy?

The *IS-LM* model gives us a way of thinking about the determination of output and the interest rate. But it is a model based on many assumptions and many simplifications. How do we know that we have made the right simplifications? How much should we believe the answers given by the *IS-LM* model?

These are the questions facing any theory, whether in macroeconomics or anywhere else. To pass muster, a theory must pass two tests.

- First, the assumptions and the simplifications must be reasonable. But what "reasonable" means is not entirely clear. Surely the assumption we have made that there is only one type of good in the economy is factually wrong, but we may still call it a reasonable simplification of reality if allowing for more than one type of good led to a more complicated model, but roughly the same results about aggregate activity, the interest rate, and so on.
- Second, the major implications of the theory must be roughly consistent with what we actually see in the world. This is easier to check. Using econometrics, we can trace the effects of changes in monetary policy and fiscal policy and see how close the effects correspond to the predictions of the *IS-LM* model. And it turns out that the *IS-LM* model does quite well indeed.

Figure 6-13 on the next page makes this point nicely. It shows the results of a recent econometric study of the effects of changes in monetary policy on activity, using data from the United States from 1960 to 1990.[6] The authors of the study focus on the effects of movements in the **federal funds rate,** a short-term interest rate that is most directly affected by changes in monetary policy. They then trace the typical effects of such a change on activity. These effects are shown in Figure 6-13.

Figure 6-13(a) shows the effects of an increase in the federal funds rate of 1% on output over time. The percentage change in output is plotted on the vertical axis; time, measured in quarters, on the horizontal axis. The figure plots three lines. The best estimate of the effect of the change in the interest rate on output is given by the thick line. But as we saw in Chapter 4, when using econometrics there is no such thing as learning the exact value of a coefficient or the exact effect of one variable

[6] *Lawrence Christiano, Martin Eichenbaum, and Charles Evans, "The Effects of Monetary Policy Shocks: Evidence from the Flow of Funds,"* WP 94-2, *Federal Reserve Bank of Chicago, 1994.*

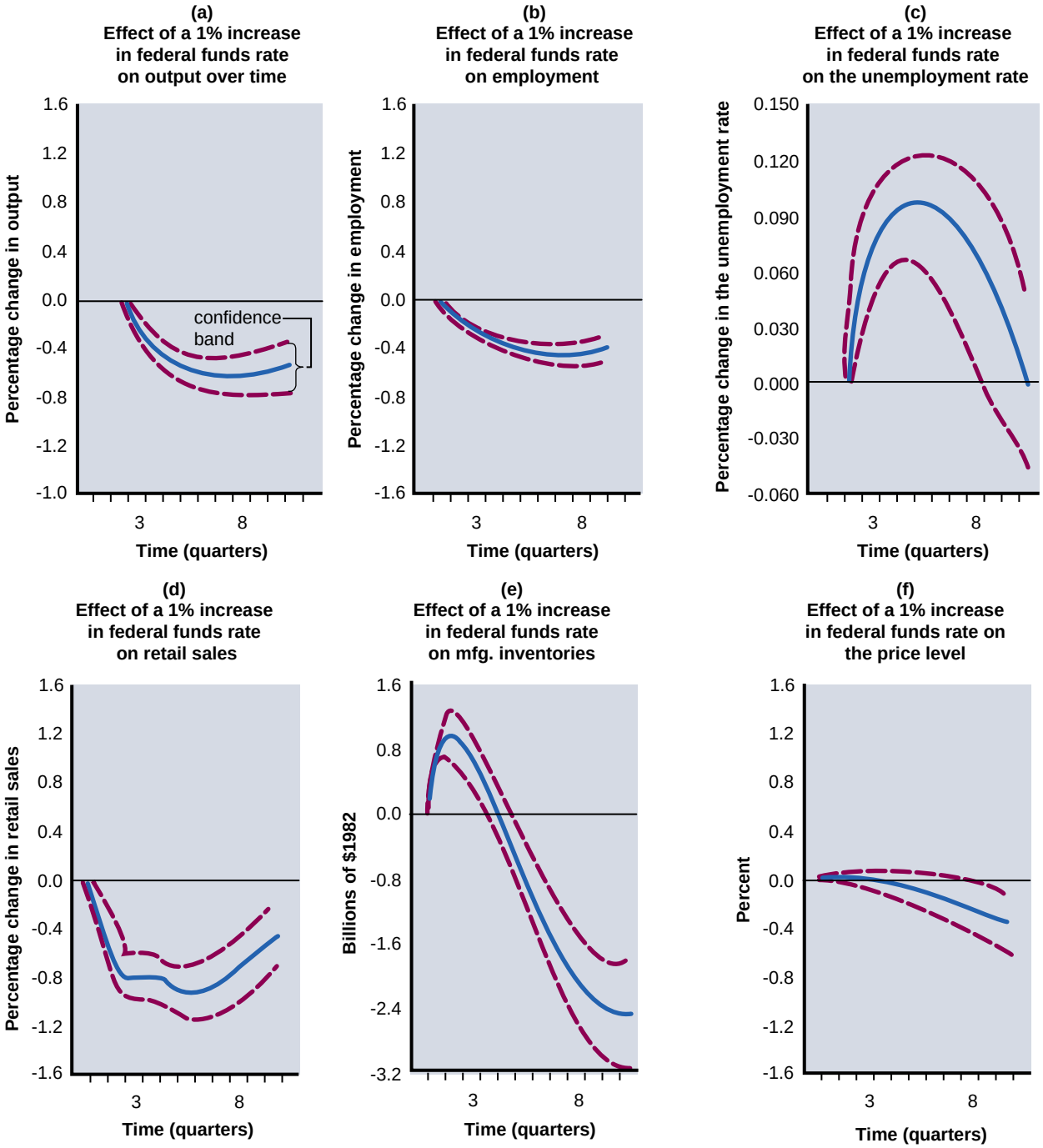


FIGURE 6-13

The Empirical Effects of an Increase in the Federal Funds Rate

An increase in the federal funds rate leads, over time, to a decrease in output and to an increase in unemployment, but has little effect on the price level.

Source: Lawrence Christiano, Martin Eichenbaum, and Charles Evans, "The Effects of Monetary Policy Shocks: Evidence from the Flow of Funds," *WP 94-2,* Federal Reserve Bank of Chicago, 1994.

on another. Rather, econometrics provides a best estimate—here, the thick line—and a measure of confidence we should have in the estimate. The true value of the effect lies within the two dashed lines with 60% probability. For this reason, the space between the two lines is called a **confidence band.**

Focusing on the best estimate—the thick line—we see that, following an increase in the federal funds rate of 1%, output slowly declines over time. The largest decrease, –0.7%, is achieved after eight quarters. This slow decline is very much consistent with the result predicted by our dynamic version of the *IS-LM* model in Figure 6-12.

The other parts of Figure 6-13 give more detail. Figure 6-13(b) shows how the increase in the Federal funds rate leads to lower employment: As firms cut production, they also cut employment. As with output, the decline in employment is slow and steady, reaching –0.5% after eight quarters. The decline in employment is reflected in an increase in unemployment, shown in Figure 6-13(c).

Figures 6-13(d) and (e) show that the lagged response of production to sales—which we looked at in Chapter 4—is indeed present in the data. Figure 6-13(d) shows that sales decrease more quickly than production, and Figure 6-13(e) shows the implication for the behavior of inventories. As sales decline faster than production, inventories initially increase. After three quarters, however, firms cut production by more than sales, and inventories start decreasing. Over time, inventories not only go back to normal but actually keep declining. The fact that eventually production declines more than sales—so that inventories decline—was not present in the model of Chapter 4, and suggests the need for a richer model than the one we developed in that chapter.

Finally, Figure 6-13(f) looks at the behavior of the price level. Remember that one of the assumptions of the *IS-LM* model is that the price level is given and thus does not change in response to changes in demand. Figure 6-13(f) shows that the assumption is not a bad approximation of reality in the short run. The price level is nearly unchanged for the first five quarters or so. Only after the first five quarters does the price level appear to decline. This gives a strong hint as to why the *IS-LM* model becomes less reliable as we look at the medium run: One can no longer assume that the price level is given, and movements in the price level become important.

Figure 6-13 is comforting. It shows that the implications of the *IS-LM* model are consistent with what we observe in the economy. This does not *prove* that the *IS-LM* model is right. It may be that what we observe in the economy is the result of a completely different mechanism, and that the fact that the *IS-LM* model fits well is a coincidence. But this seems unlikely. The *IS-LM* model looks like a solid basis on which to build. In the next four chapters, we build by looking at the role of expectations in determining activity.

Summary

- The *IS-LM* model characterizes the implications of simultaneous equilibrium in the goods and in the financial markets.
- The *IS* relation and the *IS* curve show the combinations of the interest rate and the level of output that are consistent with equilibrium in the goods market. An increase in the interest rate leads to a decline in output.
- The *LM* relation and the *LM* curve show the combinations of the interest rate and the level of output consistent with equilibrium in financial markets. Given the real

money supply, an increase in output leads to an increase in the interest rate.

- A fiscal expansion shifts the *IS* curve to the right, leading to an increase in output and an increase in the interest rate. A monetary expansion shifts the *LM* curve down, leading to an increase in output and a decrease in the interest rate.
- The combination of monetary and fiscal policies is known as the monetary–fiscal policy mix, or simply as the policy mix. Sometimes monetary and fiscal policies are used for a common goal. But the fiscal–monetary mix occasionally emerges from tensions or even disagreements between the government (which is in charge of fiscal policy) and the central bank (which is in charge of monetary policy).
- The *IS-LM* model appears to describe well the behavior of the economy in the short run. In particular, the effects of monetary policy appear to be similar to those implied by the *IS-LM* model once dynamics are introduced in the model. An increase in the interest rate due to a monetary contraction leads to a steady decrease in output, with the maximum effect taking place after about eight quarters.

Key Terms

- *IS* curve, 105
- *LM* curve, 108
- fiscal contraction, or fiscal consolidation, 111
- fiscal expansion, 111
- monetary expansion, 114
- monetary contraction, or monetary tightening, 114
- monetary–fiscal policy mix, or policy mix, 116
- federal funds rate, 121
- confidence band, 123

Questions and Problems

1. One reason why higher interest rates discourage investment is that many firms must borrow funds to purchase plant and equipment. But what about investment projects financed from a firm's own *retained earnings*—income from profits that is kept within the firm? Since no borrowing occurs, will higher interest rates discourage investment in this case? Why or why not?

2. As discussed in the text, a decrease in the budget deficit may cause investment spending to increase or decrease. If you were asked by the president to determine which way investment would change after a deficit reduction, what specific information would you need to give him an answer?

3. Consider the following numerical version of the *IS-LM* model:

$$C = 400 + .5Y_D$$
$$I = 700 - 4{,}000i + .1Y$$
$$G = 200$$
$$T = 200$$
$$\text{Real money demand: } (M/P)^d = .5Y - 7{,}500i$$
$$\text{Real money supply: } (M/P)^s = 500$$

(Note that in this problem, money demand is assumed to be linear to make the mathematics easier.)
Try to keep decimal fractions (like .0667) in the form of simple fractions (2/30) until calculating your final values for *Y, i,* and so forth.

a. Find the equation for the *IS* curve. [*Hint:* Goods-market equilibrium. You want an equation with *Y* on the left-hand side, all else on the right.]

b. Find the equation for the *LM* curve. [*Hint:* It will be convenient for later use to write the equation with *i* on the left-hand side, all else on the right.]

c. Solve for equilibrium real output (*Y*). [*Hint:* Substitute the expression for the interest rate (given in the *LM* equation) into the *IS* equation, and solve for *Y.*]

d. Solve for the equilibrium interest rate (*i*). [*Hint:* Substitute the value you obtained for *Y* above into either the *LM* equation or the *IS* equation, and solve for *i.* You can substitute into both equations to check your work.]

e. Solve for the equilibrium values of consumption spending and investment spending, and verify the value you obtained for *Y* by adding up *C, I,* and *G.*

f. Now suppose that government spending increases by 500 to 700. Solve again for *Y, i, C,* and *I,* and once again verify that $Y = C + I + G$ in equilibrium.

g. Summarize the effects of the expansionary fiscal policy in part f by stating what has happened to *Y, i, C,* and *I.*

h. Set all variables back to their initial values. Now, suppose that the money supply increases by 500. Solve again for *Y, i, C,* and *I.* Once again, verify that $Y = C + I + G$ in equilibrium.

i. Summarize the effects of the expansionary monetary policy in part h by stating what has happened to *Y, i, C,* and *I.*

4. Suppose that policy makers want to decrease the deficit while guaranteeing that there will be no decrease in either output or investment spending. Is there any fiscal–monetary policy mix that can achieve this goal?

5. Using the dynamic assumptions of the text, what sequence of events can we expect after an expansionary fiscal policy?