CHAPTER 10 TEN

# Aggregate Demand I

*I shall argue that the postulates of the classical theory are applicable to a special case only and not to the general case. . . . Moreover, the characteristics of the special case assumed by the classical theory happen not to be those of the economic society in which we actually live, with the result that its teaching is misleading and disastrous if we attempt to apply it to the facts of experience.*

— *John Maynard Keynes,* The General Theory

Of all the economic fluctuations in world history, the one that stands out as particularly large, painful, and intellectually significant is the Great Depression of the 1930s. During this time, the United States and many other countries experienced massive unemployment and greatly reduced incomes. In the worst year, 1933, one-fourth of the U.S. labor force was unemployed, and real GDP was 30 percent below its 1929 level.

This devastating episode caused many economists to question the validity of classical economic theory—the theory we examined in Chapters 3 through 6. Classical theory seemed incapable of explaining the Depression. According to that theory, national income depends on factor supplies and the available technology, neither of which changed substantially from 1929 to 1933. After the onset of the Depression, many economists believed that a new model was needed to explain such a large and sudden economic downturn and to suggest government policies that might reduce the economic hardship so many people faced.

In 1936 the British economist John Maynard Keynes revolutionized economics with his book *The General Theory of Employment, Interest, and Money*. Keynes proposed a new way to analyze the economy, which he presented as an alternative to classical theory. His vision of how the economy works quickly became a center of controversy. Yet, as economists debated *The General Theory*, a new understanding of economic fluctuations gradually developed.

Keynes proposed that low aggregate demand is responsible for the low income and high unemployment that characterize economic downturns. He criticized classical theory for assuming that aggregate supply alone—capital, labor, and technology—determines national income. Economists today reconcile these two views

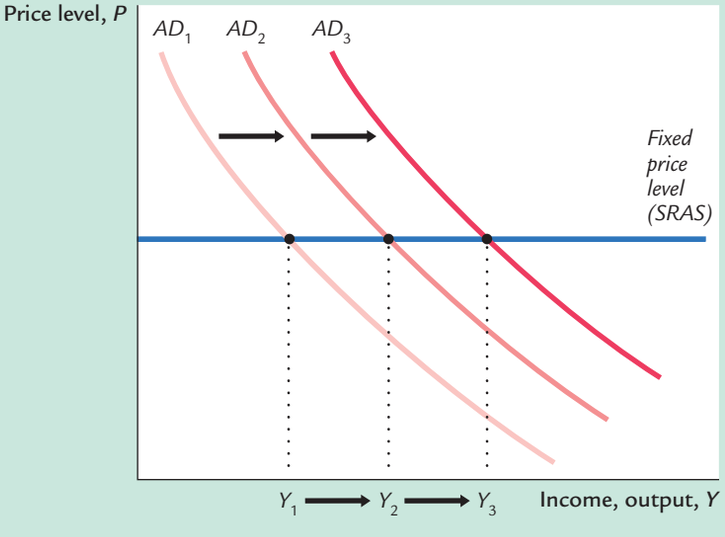
with the model of aggregate demand and aggregate supply introduced in Chapter 9. In the long run, prices are flexible, and aggregate supply determines income. But in the short run, prices are sticky, so changes in aggregate demand influence income.

In this chapter and the next, we continue our study of economic fluctuations by looking more closely at aggregate demand. Our goal is to identify the variables that shift the aggregate demand curve, causing fluctuations in national income. We also examine more fully the tools policymakers can use to influence aggregate demand. In Chapter 9 we derived the aggregate demand curve from the quantity theory of money, and we showed that monetary policy can shift the aggregate demand curve. In this chapter we see that the government can influence aggregate demand with both monetary and fiscal policy.

The model of aggregate demand developed in this chapter, called the ***IS–LM* model**, is the leading interpretation of Keynes's theory. The goal of the model is to show what determines national income for any given price level. There are two ways to view this exercise. We can view the *IS–LM* model as showing what causes income to change in the short run when the price level is fixed. Or we can view the model as showing what causes the aggregate demand curve to shift. These two views of the model are equivalent: as Figure 10-1 shows, in the short run when the price level is fixed, shifts in the aggregate demand curve lead to changes in national income.

The two parts of the *IS–LM* model are, not surprisingly, the ***IS* curve** and the ***LM* curve**. *IS* stands for "investment" and "saving," and the *IS* curve represents what's going on in the market for goods and services (which we first discussed in Chapter 3). *LM* stands for "liquidity" and "money," and the *LM* curve represents what's happening to the supply and demand for money (which we first discussed in Chapter 4). Because the interest rate influences both investment and money

figure 10-1




**Shifts in Aggregate Demand** For a given price level, national income fluctuates because of shifts in the aggregate demand curve. The *IS–LM* model takes the price level as given and shows what causes income to change. The model therefore shows what causes aggregate demand to shift.

demand, it is the variable that links the two halves of the *IS–LM* model. The model shows how interactions between these markets determine the position and slope of the aggregate demand curve and, therefore, the level of national income in the short run.[1]

## 10-1 The Goods Market and the *IS* Curve

The *IS* curve plots the relationship between the interest rate and the level of income that arises in the market for goods and services. To develop this relationship, we start with a basic model called the **Keynesian cross**. This model is the simplest interpretation of Keynes's theory of national income and is a building block for the more complex and realistic *IS–LM* model.

### The Keynesian Cross

In *The General Theory,* Keynes proposed that an economy's total income was, in the short run, determined largely by the desire to spend by households, firms, and the government. The more people want to spend, the more goods and services firms can sell. The more firms can sell, the more output they will choose to produce and the more workers they will choose to hire. Thus, the problem during recessions and depressions, according to Keynes, was inadequate spending. The Keynesian cross is an attempt to model this insight.

**Planned Expenditure** We begin our derivation of the Keynesian cross by drawing a distinction between actual and planned expenditure. *Actual expenditure* is the amount households, firms, and the government spend on goods and services, and as we first saw in Chapter 2, it equals the economy's gross domestic product (GDP). *Planned expenditure* is the amount households, firms, and the government would like to spend on goods and services.

Why would actual expenditure ever differ from planned expenditure? The answer is that firms might engage in unplanned inventory investment because their sales do not meet their expectations. When firms sell less of their product than they planned, their stock of inventories automatically rises; conversely, when firms sell more than planned, their stock of inventories falls. Because these unplanned changes in inventory are counted as investment spending by firms, actual expenditure can be either above or below planned expenditure.

Now consider the determinants of planned expenditure. Assuming that the economy is closed, so that net exports are zero, we write planned expenditure $E$ as the sum of consumption $C$, planned investment $I$, and government purchases $G$:

$$E = C + I + G.$$

[1] The *IS–LM* model was introduced in a classic article by the Nobel-Prize-winning economist John R. Hicks, "Mr. Keynes and the Classics: A Suggested Interpretation," *Econometrica* 5 (1937): 147–159.

To this equation, we add the consumption function

$$C = C(Y - T).$$

This equation states that consumption depends on disposable income $(Y - T)$, which is total income $Y$ minus taxes $T$. To keep things simple, for now we take planned investment as exogenously fixed:

$$I = \bar{I}.$$

And as in Chapter 3, we assume that fiscal policy—the levels of government purchases and taxes—is fixed:

$$G = \overline{G},$$
$$T = \overline{T}.$$

Combining these five equations, we obtain

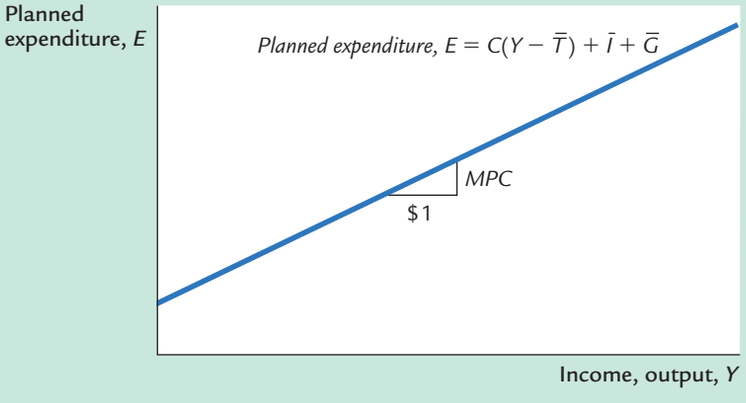
$$E = C(Y - \overline{T}) + \bar{I} + \overline{G}.$$

This equation shows that planned expenditure is a function of income $Y$, the level of planned investment $\bar{I}$, and the fiscal policy variables $\overline{G}$ and $\overline{T}$.

Figure 10-2 graphs planned expenditure as a function of the level of income. This line slopes upward because higher income leads to higher consumption and thus higher planned expenditure. The slope of this line is the marginal propensity to consume, the *MPC:* it shows how much planned expenditure increases when income rises by \$1. This planned-expenditure function is the first piece of the model called the Keynesian cross.

**The Economy in Equilibrium** The next piece of the Keynesian cross is the assumption that the economy is in equilibrium when actual expenditure equals planned expenditure. This assumption is based on the idea that when people's plans have been realized, they have no reason to change what they are doing.

**figure 10-2**




**Planned Expenditure as a Function of Income** Planned expenditure depends on income because higher income leads to higher consumption, which is part of planned expenditure. The slope of this planned-expenditure function is the marginal propensity to consume, *MPC*.

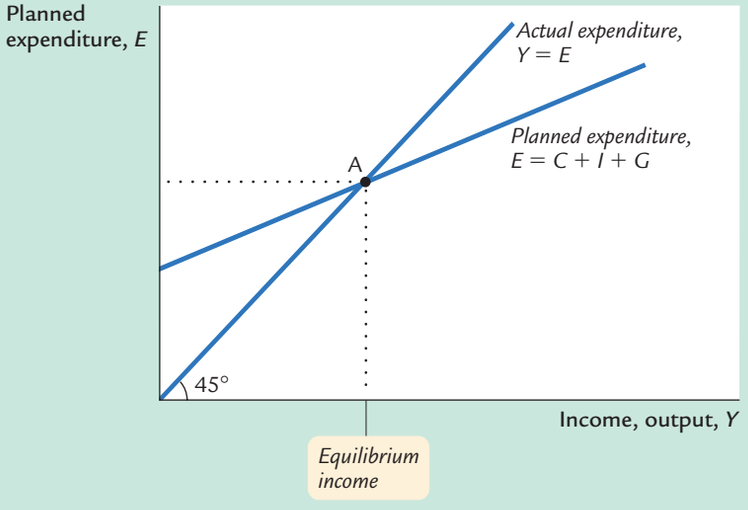
Recalling that $Y$ as GDP equals not only total income but also total actual expenditure on goods and services, we can write this equilibrium condition as

$$\text{Actual Expenditure} = \text{Planned Expenditure}$$
$$Y = E.$$

The 45-degree line in Figure 10-3 plots the points where this condition holds. With the addition of the planned-expenditure function, this diagram becomes the Keynesian cross. The equilibrium of this economy is at point A, where the planned-expenditure function crosses the 45-degree line.

How does the economy get to the equilibrium? In this model, inventories play an important role in the adjustment process. Whenever the economy is not in equilibrium, firms experience unplanned changes in inventories, and this induces them to change production levels. Changes in production in turn influence total income and expenditure, moving the economy toward equilibrium.

**figure 10-3**

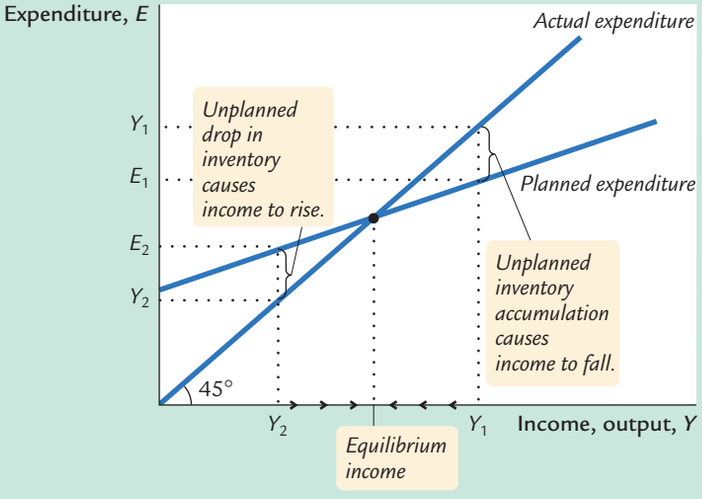



**The Keynesian Cross** The equilibrium in the Keynesian cross is at point A, where income (actual expenditure) equals planned expenditure.

For example, suppose the economy were ever to find itself with GDP at a level greater than the equilibrium level, such as the level $Y_1$ in Figure 10-4. In this case, planned expenditure $E_1$ is less than production $Y_1$, so firms are selling less than they are producing. Firms add the unsold goods to their stock of inventories. This unplanned rise in inventories induces firms to lay off workers and reduce production, and these actions in turn reduce GDP. This process of unintended inventory accumulation and falling income continues until income $Y$ falls to the equilibrium level.

Similarly, suppose GDP were at a level lower than the equilibrium level, such as the level $Y_2$ in Figure 10-4. In this case, planned expenditure $E_2$ is greater than production $Y_2$. Firms meet the high level of sales by drawing down their inventories.

figure 10-4

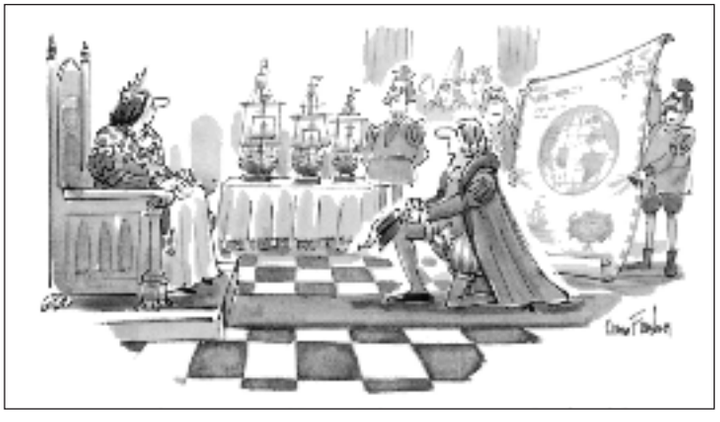



**The Adjustment to Equilibrium in the Keynesian Cross** If firms were producing at level $Y_1$, then planned expenditure $E_1$ would fall short of production, and firms would accumulate inventories. This inventory accumulation would induce firms to reduce production. Similarly, if firms were producing at level $Y_2$, then planned expenditure $E_2$ would exceed production, and firms would run down their inventories. This fall in inventories would induce firms to raise production. In both cases, the firms' decisions drive the economy toward equilibrium.

But when firms see their stock of inventories dwindle, they hire more workers and increase production. GDP rises, and the economy approaches the equilibrium.

In summary, the Keynesian cross shows how income $Y$ is determined for given levels of planned investment $I$ and fiscal policy $G$ and $T$. We can use this model to show how income changes when one of these exogenous variables changes.

**Fiscal Policy and the Multiplier: Government Purchases** Consider how changes in government purchases affect the economy. Because government purchases are one component of expenditure, higher government purchases result in higher planned expenditure for any given level of income. If government purchases rise by $\Delta G$, then the planned-expenditure schedule shifts upward by $\Delta G$, as in Figure 10-5. The equilibrium of the economy moves from point A to point B.



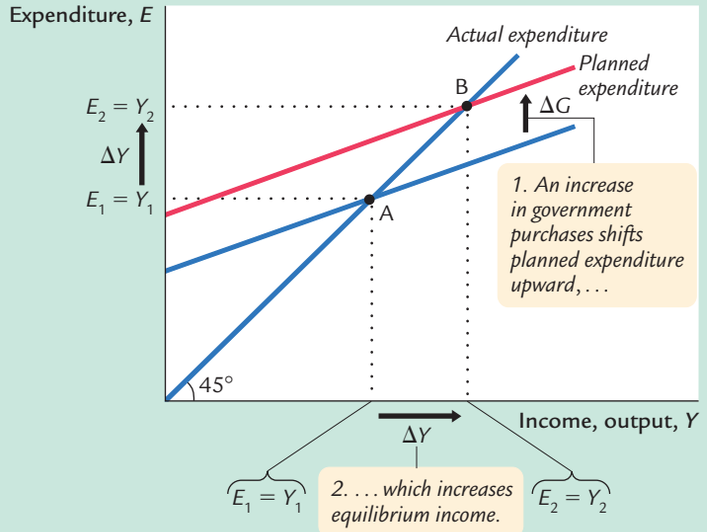


"Your Majesty, my voyage will not only forge a new route to the spices of the East but also create over three thousand new jobs."

This graph shows that an increase in government purchases leads to an even greater increase in income. That is, $\Delta Y$ is larger than $\Delta G$. The ratio $\Delta Y/\Delta G$ is called the **government-purchases multiplier**; it tells us how much income rises in response to a $1 increase in government purchases. An implication of the Keynesian cross is that the government-purchases multiplier is larger than 1.

Why does fiscal policy have a multiplied effect on income?

figure 10-5




**An Increase in Government Purchases in the Keynesian Cross** An increase in government purchases of $\Delta G$ raises planned expenditure by that amount for any given level of income. The equilibrium moves from point A to point B, and income rises from $Y_1$ to $Y_2$. Note that the increase in income $\Delta Y$ exceeds the increase in government purchases $\Delta G$. Thus, fiscal policy has a multiplied effect on income.

The reason is that, according to the consumption function $C = C(Y - T)$, higher income causes higher consumption. When an increase in government purchases raises income, it also raises consumption, which further raises income, which further raises consumption, and so on. Therefore, in this model, an increase in government purchases causes a greater increase in income.

How big is the multiplier? To answer this question, we trace through each step of the change in income. The process begins when expenditure rises by $\Delta G$, which implies that income rises by $\Delta G$ as well. This increase in income in turn raises consumption by $MPC \times \Delta G$, where $MPC$ is the marginal propensity to consume. This increase in consumption raises expenditure and income once again. This second increase in income of $MPC \times \Delta G$ again raises consumption, this time by $MPC \times (MPC \times \Delta G)$, which again raises expenditure and income, and so on. This feedback from consumption to income to consumption continues indefinitely. The total effect on income is

$$\begin{aligned}
\text{Initial Change in Government Purchases} &= \Delta G \\
\text{First Change in Consumption} &= MPC \times \Delta G \\
\text{Second Change in Consumption} &= MPC^2 \times \Delta G \\
\text{Third Change in Consumption} &= MPC^3 \times \Delta G \\
&\vdots \qquad\qquad \vdots \\
\hline
\Delta Y &= (1 + MPC + MPC^2 + MPC^3 + \cdots)\Delta G.
\end{aligned}$$

The government-purchases multiplier is

$$\Delta Y/\Delta G = 1 + MPC + MPC^2 + MPC^3 + \cdots$$

This expression for the multiplier is an example of an *infinite geometric series*. A result from algebra allows us to write the multiplier as[2]

$$\Delta Y/\Delta G = 1/(1 - MPC).$$

For example, if the marginal propensity to consume is 0.6, the multiplier is

$$\begin{aligned}\Delta Y/\Delta G &= 1 + 0.6 + 0.6^2 + 0.6^3 + \cdots \\ &= 1/(1 - 0.6) \\ &= 2.5.\end{aligned}$$

In this case, a \$1.00 increase in government purchases raises equilibrium income by \$2.50.[3]

**Fiscal Policy and the Multiplier: Taxes** Consider now how changes in taxes affect equilibrium income. A decrease in taxes of $\Delta T$ immediately raises disposable income $Y - T$ by $\Delta T$ and, therefore, increases consumption by $MPC \times \Delta T$. For any given level of income $Y$, planned expenditure is now higher. As Figure 10-6 shows, the planned-expenditure schedule shifts upward by $MPC \times \Delta T$. The equilibrium of the economy moves from point A to point B.

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[2] *Mathematical note:* We prove this algebraic result as follows. Let

$$z = 1 + x + x^2 + \cdots.$$

Multiply both sides of this equation by $x$:

$$xz = x + x^2 + x^3 + \cdots.$$

Subtract the second equation from the first:

$$z - xz = 1.$$

Rearrange this last equation to obtain

$$z(1 - x) = 1,$$

which implies

$$z = 1/(1 - x).$$

This completes the proof.

[3] *Mathematical note:* The government-purchases multiplier is most easily derived using a little calculus. Begin with the equation

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

Holding $T$ and $I$ fixed, differentiate to obtain

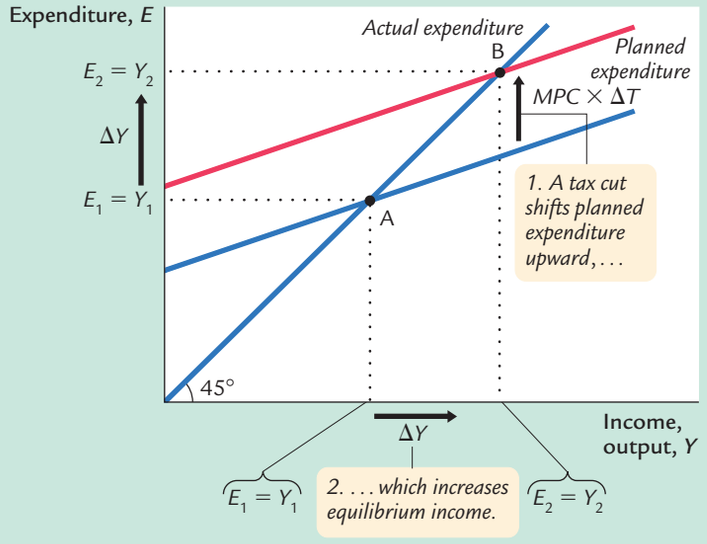
$$dY = C'dY + dG,$$

and then rearrange to find

$$dY/dG = 1/(1 - C').$$

This is the same as the equation in the text.

figure 10-6




**A Decrease in Taxes in the Keynesian Cross** A decrease in taxes of $\Delta T$ raises planned expenditure by $MPC \times \Delta T$ for any given level of income. The equilibrium moves from point A to point B, and income rises from $Y_1$ to $Y_2$. Again, fiscal policy has a multiplied effect on income.

Just as an increase in government purchases has a multiplied effect on income, so does a decrease in taxes. As before, the initial change in expenditure, now $MPC \times \Delta T$, is multiplied by $1/(1 - MPC)$. The overall effect on income of the change in taxes is

$$\Delta Y/\Delta T = -MPC/(1 - MPC).$$

This expression is the **tax multiplier**, the amount income changes in response to a \$1 change in taxes. For example, if the marginal propensity to consume is 0.6, then the tax multiplier is

$$\Delta Y/\Delta T = -0.6/(1 - 0.6) = -1.5.$$

In this example, a \$1.00 cut in taxes raises equilibrium income by \$1.50.[4]

[4] *Mathematical note:* As before, the multiplier is most easily derived using a little calculus. Begin with the equation

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

Holding $I$ and $G$ fixed, differentiate to obtain

$$dY = C'(dY - dT),$$

and then rearrange to find

$$dY/dT = -C'/(1 - C').$$

This is the same as the equation in the text.

CASE STUDY

## Cutting Taxes to Stimulate the Economy

When John F. Kennedy became president of the United States in 1961, he brought to Washington some of the brightest young economists of the day to work on his Council of Economic Advisers. These economists, who had been schooled in the economics of Keynes, brought Keynesian ideas to discussions of economic policy at the highest level.

One of the council's first proposals was to expand national income by reducing taxes. This eventually led to a substantial cut in personal and corporate income taxes in 1964. The tax cut was intended to stimulate expenditure on consumption and investment and thus lead to higher levels of income and employment. When a reporter asked Kennedy why he advocated a tax cut, Kennedy replied, "To stimulate the economy. Don't you remember your Economics 101?"

As Kennedy's economic advisers predicted, the passage of the tax cut was followed by an economic boom. Growth in real GDP was 5.3 percent in 1964 and 6.0 percent in 1965. The unemployment rate fell from 5.7 percent in 1963 to 5.2 percent in 1964 and then to 4.5 percent in 1965.[5]

Economists continue to debate the source of this rapid growth in the early 1960s. A group called *supply-siders* argues that the economic boom resulted from the incentive effects of the cut in income tax rates. According to supply-siders, when workers are allowed to keep a higher fraction of their earnings, they supply substantially more labor and expand the aggregate supply of goods and services. Keynesians, however, emphasize the impact of tax cuts on aggregate demand. Most likely, both views have some truth: *Tax cuts stimuate aggregate supply by improving workers' incentives and expand aggregate demand by raising households' disposable income.*

When George W. Bush was elected president in 2001, a major element of his platform was a cut in income taxes. Bush and his advisers used both supply-side and Keynesian rhetoric to make the case for their policy. During the campaign, when the economy was doing fine, they argued that lower marginal tax rates would improve work incentives. But then the economy started to slow: unemployment rose from 3.9 percent in October 2000 to 4.5 percent in April 2001. The argument shifted to emphasize that the tax cut would stimulate spending and reduce the risk of recession.

Congress passed the tax cut in May 2001. Compared to the original Bush proposal, the bill cut tax rates less in the long run. But it added an immediate tax rebate of $600 per family ($300 for single taxpayers) that was mailed out in the summer of 2001. Consistent with Keynesian theory, the goal of the rebate was to provide an immediate stimulus to aggregate demand.

[5] For an analysis of the 1964 tax cut by one of Kennedy's economists, see Arthur Okun, "Measuring the Impact of the 1964 Tax Reduction," in W. W. Heller, ed., *Perspectives on Economic Growth* (New York: Random House, 1968); reprinted in Arthur M. Okun, *Economics for Policymaking* (Cambridge, MA: MIT Press, 1983), 405–423.

## The Interest Rate, Investment, and the *IS* Curve

The Keynesian cross is only a steppingstone on our path to the *IS*–*LM* model. The Keynesian cross is useful because it shows how the spending plans of households, firms, and the government determine the economy's income. Yet it makes the simplifying assumption that the level of planned investment $I$ is fixed. As we discussed in Chapter 3, an important macroeconomic relationship is that planned investment depends on the interest rate $r$.

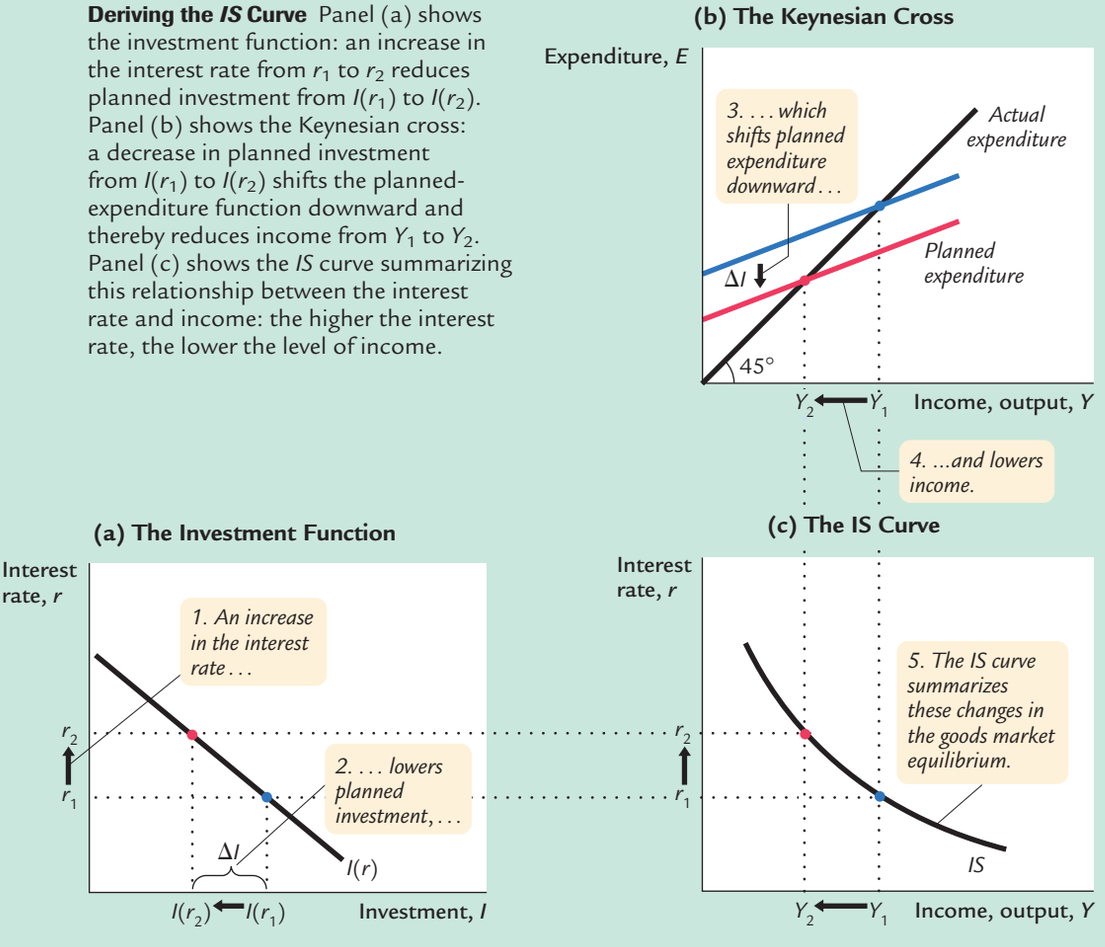
To add this relationship between the interest rate and investment to our model, we write the level of planned investment as

$$I = I(r).$$

This investment function is graphed in panel (a) of Figure 10-7. Because the interest rate is the cost of borrowing to finance investment projects, an increase in

figure 10-7

**Deriving the *IS* Curve** Panel (a) shows the investment function: an increase in the interest rate from $r_1$ to $r_2$ reduces planned investment from $I(r_1)$ to $I(r_2)$. Panel (b) shows the Keynesian cross: a decrease in planned investment from $I(r_1)$ to $I(r_2)$ shifts the planned-expenditure function downward and thereby reduces income from $Y_1$ to $Y_2$. Panel (c) shows the *IS* curve summarizing this relationship between the interest rate and income: the higher the interest rate, the lower the level of income.



the interest rate reduces planned investment. As a result, the investment function slopes downward.

To determine how income changes when the interest rate changes, we can combine the investment function with the Keynesian-cross diagram. Because investment is inversely related to the interest rate, an increase in the interest rate from $r_1$ to $r_2$ reduces the quantity of investment from $I(r_1)$ to $I(r_2)$. The reduction in planned investment, in turn, shifts the planned-expenditure function downward, as in panel (b) of Figure 10-7. The shift in the planned-expenditure function causes the level of income to fall from $Y_1$ to $Y_2$. Hence, an increase in the interest rate lowers income.

The *IS* curve, shown in panel (c) of Figure 10-7, summarizes this relationship between the interest rate and the level of income. In essence, the *IS* curve combines the interaction between $r$ and $I$ expressed by the investment function and the interaction between $I$ and $Y$ demonstrated by the Keynesian cross. Because an increase in the interest rate causes planned investment to fall, which in turn causes income to fall, the *IS* curve slopes downward.

## How Fiscal Policy Shifts the *IS* Curve

The *IS* curve shows us, for any given interest rate, the level of income that brings the goods market into equilibrium. As we learned from the Keynesian cross, the level of income also depends on fiscal policy. The *IS* curve is drawn for a given fiscal policy; that is, when we construct the *IS* curve, we hold $G$ and $T$ fixed. When fiscal policy changes, the *IS* curve shifts.

Figure 10-8 uses the Keynesian cross to show how an increase in government purchases by $\Delta G$ shifts the *IS* curve. This figure is drawn for a given interest rate $\bar{r}$ and thus for a given level of planned investment. The Keynesian cross shows that this change in fiscal policy raises planned expenditure and thereby increases equilibrium income from $Y_1$ to $Y_2$. Therefore, an increase in government purchases shifts the *IS* curve outward.

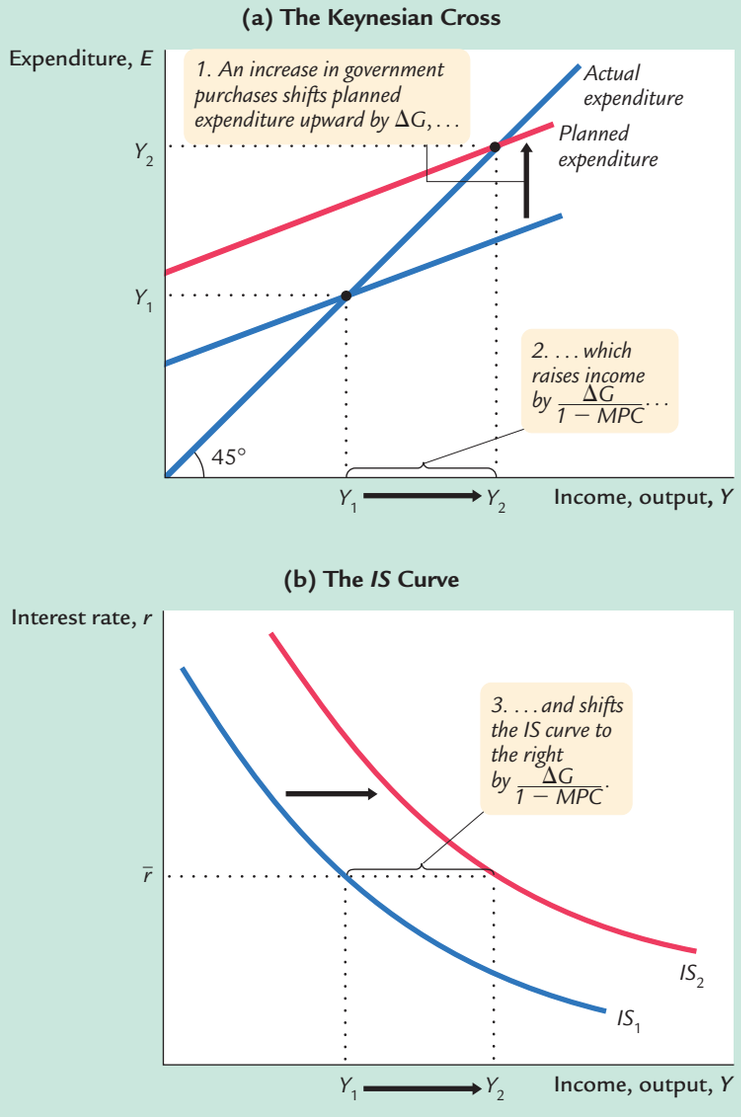
We can use the Keynesian cross to see how other changes in fiscal policy shift the *IS* curve. Because a decrease in taxes also expands expenditure and income, it too shifts the *IS* curve outward. A decrease in government purchases or an increase in taxes reduces income; therefore, such a change in fiscal policy shifts the *IS* curve inward.

*In summary, the IS curve shows the combinations of the interest rate and the level of income that are consistent with equilibrium in the market for goods and services. The IS curve is drawn for a given fiscal policy. Changes in fiscal policy that raise the demand for goods and services shift the IS curve to the right. Changes in fiscal policy that reduce the demand for goods and services shift the IS curve to the left.*

## A Loanable-Funds Interpretation of the *IS* Curve

When we first studied the market for goods and services in Chapter 3, we noted an equivalence between the supply and demand for goods and services and the supply and demand for loanable funds. This equivalence provides another way to interpret the *IS* curve.

figure 10-8




**An Increase in Government Purchases Shifts the *IS* Curve Outward** Panel (a) shows that an increase in government purchases raises planned expenditure. For any given interest rate, the upward shift in planned expenditure of $\Delta G$ leads to an increase in income $Y$ of $\Delta G/(1 - MPC)$. Therefore, in panel (b), the *IS* curve shifts to the right by this amount.

Recall that the national income accounts identity can be written as

$$Y - C - G = I$$
$$S = I.$$

The left-hand side of this equation is national saving $S$, and the right-hand side is investment $I$. National saving represents the supply of loanable funds, and investment represents the demand for these funds.

To see how the market for loanable funds produces the *IS* curve, substitute the consumption function for $C$ and the investment function for $I$:

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

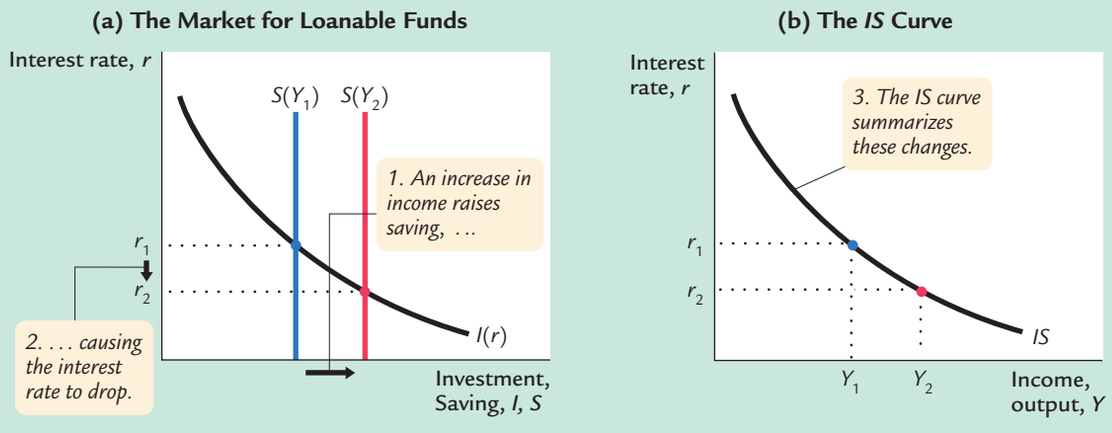
The left-hand side of this equation shows that the supply of loanable funds depends on income and fiscal policy. The right-hand side shows that the demand for loanable funds depends on the interest rate. The interest rate adjusts to equilibrate the supply and demand for loans.

As Figure 10-9 illustrates, we can interpret the *IS* curve as showing the interest rate that equilibrates the market for loanable funds for any given level of income. When income rises from $Y_1$ to $Y_2$, national saving, which equals $Y - C - G$, increases. (Consumption rises by less than income, because the marginal propensity to consume is less than 1.) As panel (a) shows, the increased supply of loanable funds drives down the interest rate from $r_1$ to $r_2$. The *IS* curve in panel (b) summarizes this relationship: higher income implies higher saving, which in turn implies a lower equilibrium interest rate. For this reason, the *IS* curve slopes downward.

This alternative interpretation of the *IS* curve also explains why a change in fiscal policy shifts the *IS* curve. An increase in government purchases or a decrease in taxes reduces national saving for any given level of income. The reduced supply of loanable funds raises the interest rate that equilibrates the market. Because the interest rate is now higher for any given level of income, the *IS* curve shifts upward in response to the expansionary change in fiscal policy.

Finally, note that the *IS* curve does not determine either income $Y$ or the interest rate $r$. Instead, the *IS* curve is a relationship between $Y$ and $r$ arising in the

figure 10-9




**A Loanable-Funds Interpretation of the *IS* Curve** Panel (a) shows that an increase in income from $Y_1$ to $Y_2$ raises saving and thus lowers the interest rate that equilibrates the supply and demand for loanable funds. The *IS* curve in panel (b) expresses this negative relationship between income and the interest rate.

market for goods and services or, equivalently, the market for loanable funds. To determine the equilibrium of the economy, we need another relationship between these two variables, to which we now turn.

## 10-2 The Money Market and the *LM* Curve

The *LM* curve plots the relationship between the interest rate and the level of income that arises in the market for money balances. To understand this relationship, we begin by looking at a theory of the interest rate, called the **theory of liquidity preference.**

### The Theory of Liquidity Preference

In his classic work *The General Theory*, Keynes offered his view of how the interest rate is determined in the short run. That explanation is called the theory of liquidity preference, because it posits that the interest rate adjusts to balance the supply and demand for the economy's most liquid asset—money. Just as the Keynesian cross is a building block for the *IS* curve, the theory of liquidity preference is a building block for the *LM* curve.

To develop this theory, we begin with the supply of real money balances. If $M$ stands for the supply of money and $P$ stands for the price level, then $M/P$ is the supply of real money balances. The theory of liquidity preference assumes there is a fixed supply of real money balances. That is,

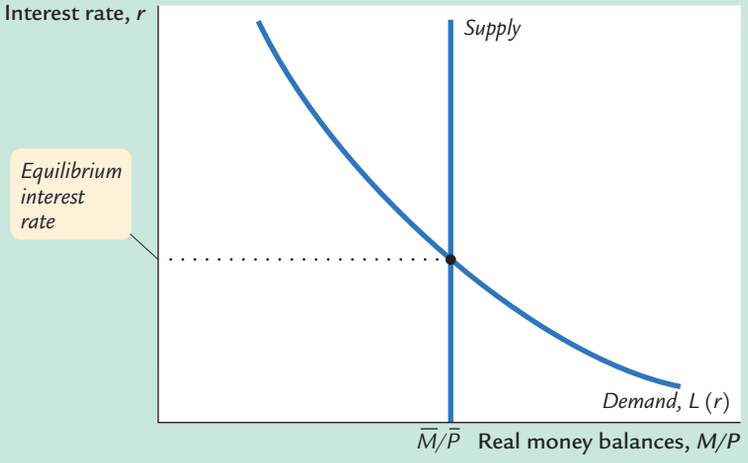
$$(M/P)^s = \overline{M}/\overline{P}.$$

The money supply $M$ is an exogenous policy variable chosen by a central bank, such as the Federal Reserve. The price level $P$ is also an exogenous variable in this model. (We take the price level as given because the *IS*–*LM* model—our ultimate goal in this chapter—explains the short run when the price level is fixed.) These assumptions imply that the supply of real money balances is fixed and, in particular, does not depend on the interest rate. Thus, when we plot the supply of real money balances against the interest rate in Figure 10-10, we obtain a vertical supply curve.

Next, consider the demand for real money balances. The theory of liquidity preference posits that the interest rate is one determinant of how much money people choose to hold. The reason is that the interest rate is the opportunity cost of holding money: it is what you forgo by holding some of your assets as money, which does not bear interest, instead of as interest-bearing bank deposits or bonds. When the interest rate rises, people want to hold less of their wealth in the form of money. We can write the demand for real money balances as

$$(M/P)^d = L(r),$$

figure 10-10




**The Theory of Liquidity Preference** The supply and demand for real money balances determine the interest rate. The supply curve for real money balances is vertical because the supply does not depend on the interest rate. The demand curve is downward sloping because a higher interest rate raises the cost of holding money and thus lowers the quantity demanded. At the equilibrium interest rate, the quantity of real money balances demanded equals the quantity supplied.

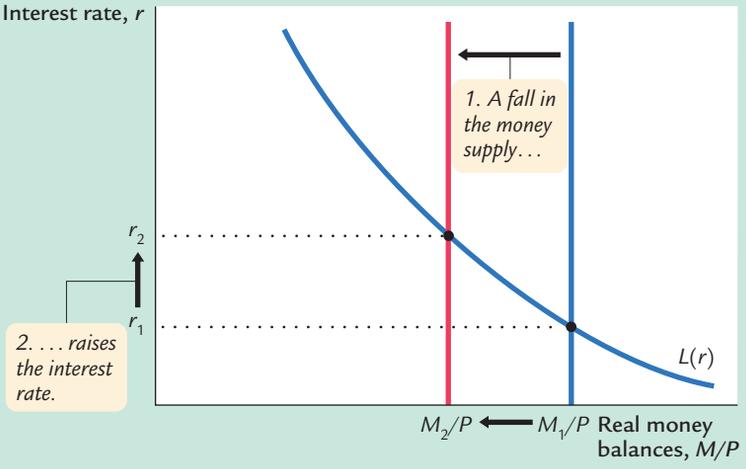
where the function $L(\ )$ shows that the quantity of money demanded depends on the interest rate. Thus, the demand curve in Figure 10-10 slopes downward because higher interest rates reduce the quantity of real money balances demanded.[6]

According to the theory of liquidity preference, the supply and demand for real money balances determine what interest rate prevails in the economy. That is, the interest rate adjusts to equilibrate the money market. As the figure shows, at the equilibrium interest rate, the quantity of real money balances demanded equals the quantity supplied.

How does the interest rate get to this equilibrium of money supply and money demand? The adjustment occurs because whenever the money market is not in equilibrium, people try to adjust their portfolios of assets and, in the process, alter the interest rate. For instance, if the interest rate is above the equilibrium level, the quantity of real money balances supplied exceeds the quantity demanded. Individuals holding the excess supply of money try to convert some of their non-interest-bearing money into interest-bearing bank deposits or bonds. Banks and bond issuers, who prefer to pay lower interest rates, respond to this excess supply of money by lowering the interest rates they offer. Conversely, if the interest rate is below the equilibrium level, so that the quantity of money demanded exceeds the quantity supplied, individuals try to obtain money by selling bonds or making bank withdrawals. To attract now-scarcer funds, banks and bond issuers respond by increasing the interest rates they offer. Eventually, the

[6] Note that $r$ is being used to denote the interest rate here, as it was in our discussion of the *IS* curve. More accurately, it is the nominal interest rate that determines money demand and the real interest rate that determines investment. To keep things simple, we are ignoring expected inflation, which creates the difference between the real and nominal interest rates. The role of expected inflation in the *IS–LM* model is explored in Chapter 11.

figure 10-11




**A Reduction in the Money Supply in the Theory of Liquidity Preference** If the price level is fixed, a reduction in the money supply from $M_1$ to $M_2$ reduces the supply of real money balances. The equilibrium interest rate therefore rises from $r_1$ to $r_2$.

interest rate reaches the equilibrium level, at which people are content with their portfolios of monetary and nonmonetary assets.

Now that we have seen how the interest rate is determined, we can use the theory of liquidity preference to show how the interest rate responds to changes in the supply of money. Suppose, for instance, that the Fed suddenly decreases the money supply. A fall in $M$ reduces $M/P$, because $P$ is fixed in the model. The supply of real money balances shifts to the left, as in Figure 10-11. The equilibrium interest rate rises from $r_1$ to $r_2$, and the higher interest rate makes people satisfied to hold the smaller quantity of real money balances. The opposite would occur if the Fed had suddenly increased the money supply. Thus, according to the theory of liquidity preference, a decrease in the money supply raises the interest rate, and an increase in the money supply lowers the interest rate.

CASE STUDY

## Did Paul Volcker's Monetary Tightening Raise or Lower Interest Rates?

The early 1980s saw the largest and quickest reduction in inflation in recent U.S. history. By the late 1970s inflation had reached the double-digit range; in 1979, consumer prices were rising at a rate of 11.3 percent per year. In October 1979, only two months after becoming the chairman of the Federal Reserve, Paul Volcker announced that monetary policy would aim to reduce the rate of inflation. This announcement began a period of tight money that, by 1983, brought the inflation rate down to about 3 percent.

How does such a monetary tightening influence interest rates? According to the theories we have been developing, the answer depends on the time horizon. Our analysis of the Fisher effect in Chapter 4 suggests that in the long run

Volcker's change in monetary policy would lower inflation, and this in turn would lead to lower nominal interest rates. Yet the theory of liquidity preference predicts that, in the short run when prices are sticky, anti-inflationary monetary policy would lead to falling real money balances and higher nominal interest rates.

Both conclusions are consistent with experience. Nominal interest rates did fall in the 1980s as inflation fell. But comparing the year before the October 1979 announcement and the year after, we find that real money balances ($M1$ divided by the CPI) fell 8.3 percent and the nominal interest rate (on short-term commercial loans) rose from 10.1 percent to 11.9 percent. Hence, although a monetary tightening leads to lower nominal interest rates in the long run, it leads to higher nominal interest rates in the short run.

## Income, Money Demand, and the *LM* Curve

Having developed the theory of liquidity preference as an explanation for what determines the interest rate, we can now use the theory to derive the *LM* curve. We begin by considering the following question: How does a change in the economy's level of income $Y$ affect the market for real money balances? The answer (which should be familiar from Chapter 4) is that the level of income affects the demand for money. When income is high, expenditure is high, so people engage in more transactions that require the use of money. Thus, greater income implies greater money demand. We can express these ideas by writing the money demand function as

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

The quantity of real money balances demanded is negatively related to the interest rate and positively related to income.

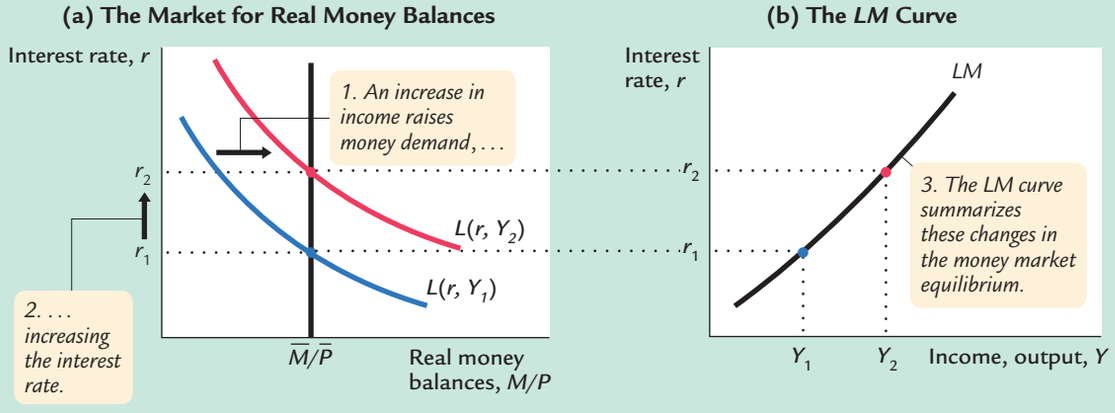
Using the theory of liquidity preference, we can figure out what happens to the equilibrium interest rate when the level of income changes. For example, consider what happens in Figure 10-12 when income increases from $Y_1$ to $Y_2$. As panel (a) illustrates, this increase in income shifts the money demand curve to the right. With the supply of real money balances unchanged, the interest rate must rise from $r_1$ to $r_2$ to equilibrate the money market. Therefore, according to the theory of liquidity preference, higher income leads to a higher interest rate.

The *LM* curve plots this relationship between the level of income and the interest rate. The higher the level of income, the higher the demand for real money balances, and the higher the equilibrium interest rate. For this reason, the *LM* curve slopes upward, as in panel (b) of Figure 10-12.

## How Monetary Policy Shifts the *LM* Curve

The *LM* curve tells us the interest rate that equilibrates the money market at any level of income. Yet, as we saw earlier, the equilibrium interest rate also depends on the supply of real money balances, $M/P$. This means that the *LM* curve is

figure 10-12




**Deriving the *LM* Curve** Panel (a) shows the market for real money balances: an increase in income from $Y_1$ to $Y_2$ raises the demand for money and thus raises the interest rate from $r_1$ to $r_2$. Panel (b) shows the *LM* curve summarizing this relationship between the interest rate and income: the higher the level of income, the higher the interest rate.

drawn for a *given* supply of real money balances. If real money balances change—for example, if the Fed alters the money supply—the *LM* curve shifts.

We can use the theory of liquidity preference to understand how monetary policy shifts the *LM* curve. Suppose that the Fed decreases the money supply from $M_1$ to $M_2$, which causes the supply of real money balances to fall from $M_1/P$ to $M_2/P$. Figure 10-13 shows what happens. Holding constant the amount of income and thus the demand curve for real money balances, we see that a reduction in the supply of real money balances raises the interest rate that equilibrates the money market. Hence, a decrease in the money supply shifts the *LM* curve upward.

*In summary, the LM curve shows the combinations of the interest rate and the level of income that are consistent with equilibrium in the market for real money balances. The LM curve is drawn for a given supply of real money balances. Decreases in the supply of real money balances shift the LM curve upward. Increases in the supply of real money balances shift the LM curve downward.*

## A Quantity-Equation Interpretation of the *LM* Curve

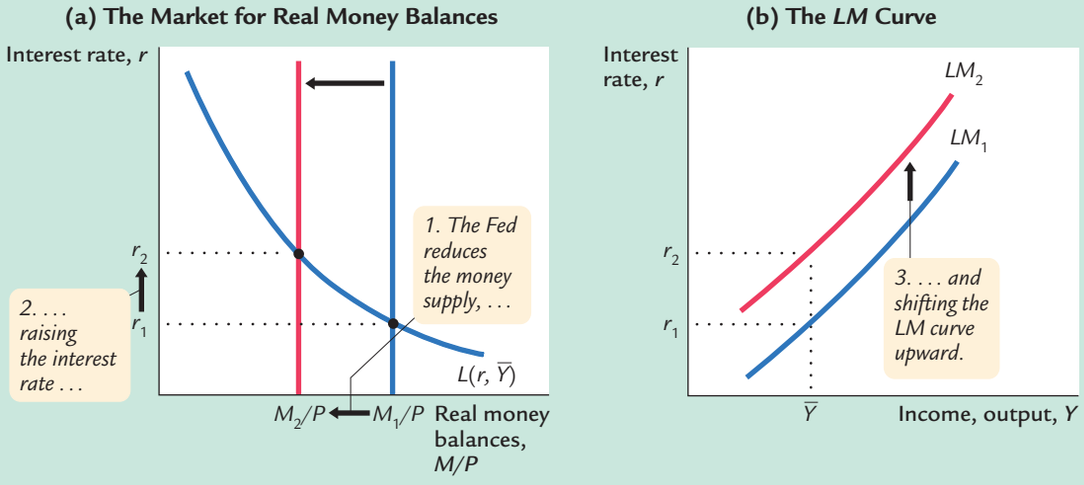
When we first discussed aggregate demand and the short-run determination of income in Chapter 9, we derived the aggregate demand curve from the quantity theory of money. We described the money market with the quantity equation,

$$MV = PY,$$

and assumed that velocity $V$ is constant. This assumption implies that, for any given price level $P$, the supply of money $M$ by itself determines the level of



figure 10-13




**A Reduction in the Money Supply Shifts the *LM* Curve Upward** Panel (a) shows that for any given level of income $\bar{Y}$, a reduction in the money supply raises the interest rate that equilibrates the money market. Therefore, the *LM* curve in panel (b) shifts upward.

income $Y$. Because the level of income does not depend on the interest rate, the quantity theory is equivalent to a vertical *LM* curve.

We can derive the more realistic upward-sloping *LM* curve from the quantity equation by relaxing the assumption that velocity is constant. The assumption of constant velocity is based on the assumption that the demand for real money balances depends only on the level of income. Yet, as we have noted in our discussion of the liquidity-preference model, the demand for real money balances also depends on the interest rate: a higher interest rate raises the cost of holding money and reduces money demand. When people respond to a higher interest rate by holding less money, each dollar they do hold must be used more often to support a given volume of transactions—that is, the velocity of money must increase. We can write this as

$$MV(r) = PY.$$

The velocity function $V(r)$ indicates that velocity is positively related to the interest rate.

This form of the quantity equation yields an *LM* curve that slopes upward. Because an increase in the interest rate raises the velocity of money, it raises the level of income for any given money supply and price level. The *LM* curve expresses this positive relationship between the interest rate and income.

This equation also shows why changes in the money supply shift the *LM* curve. For any given interest rate and price level, the money supply and the level of income must move together. Thus, increases in the money supply shift the *LM* curve to the right, and decreases in the money supply shift the *LM* curve to the left.

Keep in mind that the quantity equation is merely another way to express the theory behind the *LM* curve. This quantity-theory interpretation of the *LM* curve is substantively the same as that provided by the theory of liquidity preference. In both cases, the *LM* curve represents a positive relationship between income and the interest rate that arises from the money market.

Finally, remember that the *LM* curve by itself does not determine either income $Y$ or the interest rate $r$ that will prevail in the economy. Like the *IS* curve, the *LM* curve is only a relationship between these two endogenous variables. The *IS* and *LM* curves together determine the economy's equilibrium.

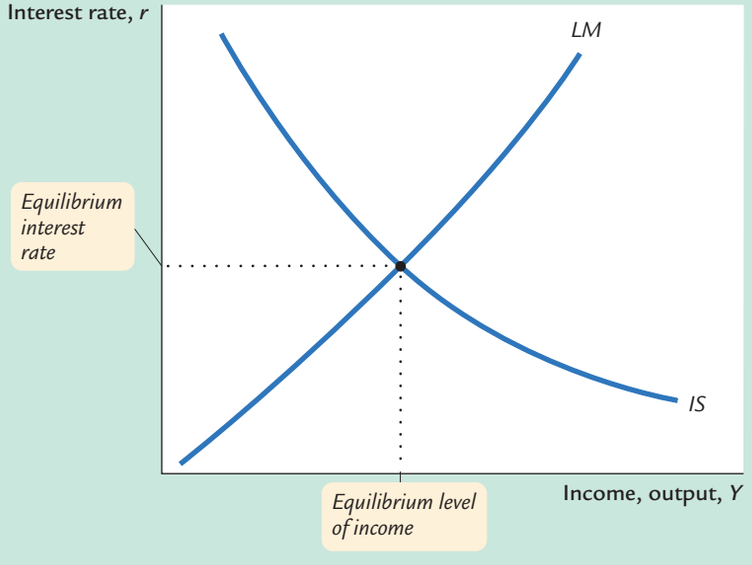
## 10-3 Conclusion: The Short-Run Equilibrium

We now have all the pieces of the *IS–LM* model. The two equations of this model are

$$Y = C(Y - T) + I(r) + G \qquad IS,$$
$$M/P = L(r, Y) \qquad LM.$$

The model takes fiscal policy, $G$ and $T$, monetary policy $M$, and the price level $P$ as exogenous. Given these exogenous variables, the *IS* curve provides the combinations of $r$ and $Y$ that satisfy the equation representing the goods market, and the *LM* curve provides the combinations of $r$ and $Y$ that satisfy the equation representing the money market. These two curves are shown together in Figure 10-14.

figure 10-14

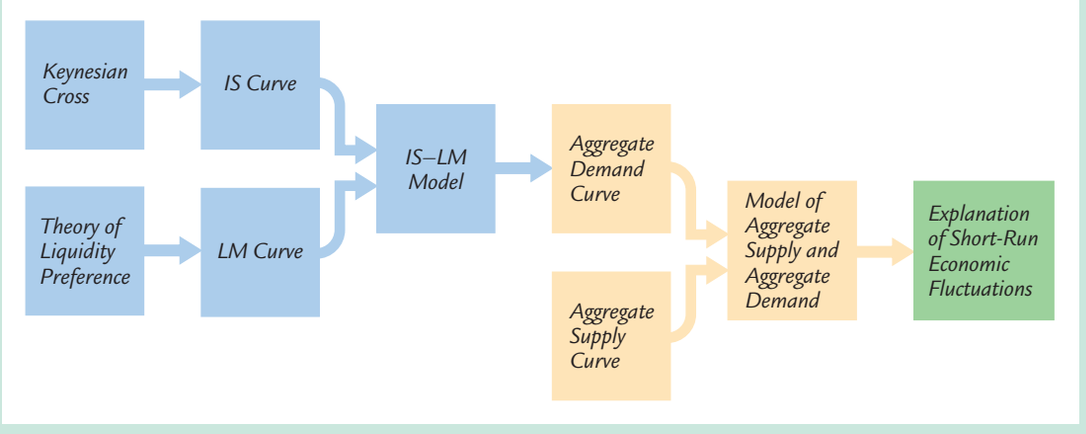



**Equilibrium in the *IS–LM* Model** The intersection of the *IS* and *LM* curves represents simultaneous equilibrium in the market for goods and services and in the market for real money balances for given values of government spending, taxes, the money supply, and the price level.

The equilibrium of the economy is the point at which the *IS* curve and the *LM* curve cross. This point gives the interest rate *r* and the level of income *Y* that satisfy conditions for equilibrium in both the goods market and the money market. In other words, at this intersection, actual expenditure equals planned expenditure, and the demand for real money balances equals the supply.

As we conclude this chapter, let's recall that our ultimate goal in developing the *IS–LM* model is to analyze short-run fluctuations in economic activity. Figure 10-15 illustrates how the different pieces of our theory fit together. In this chapter we developed the Keynesian cross and the theory of liquidity preference as building blocks for the *IS–LM* model. As we see more fully in the next chapter, the *IS–LM* model helps explain the position and slope of the aggregate demand curve. The aggregate demand curve, in turn, is a piece of the model of aggregate supply and aggregate demand, which economists use to explain the short-run effects of policy changes and other events on national income.

figure 10-15




**The Theory of Short-Run Fluctuations** This schematic diagram shows how the different pieces of the theory of short-run fluctuations fit together. The Keynesian cross explains the *IS* curve, and the theory of liquidity preference explains the *LM* curve. The *IS* and *LM* curves together yield the *IS–LM* model, which explains the aggregate demand curve. The aggregate demand curve is part of the model of aggregate supply and aggregate demand, which economists use to explain short-run fluctuations in economic activity.

## Summary

1. The Keynesian cross is a basic model of income determination. It takes fiscal policy and planned investment as exogenous and then shows that there is one level of national income at which actual expenditure equals planned expenditure. It shows that changes in fiscal policy have a multiplied impact on income.

2. Once we allow planned investment to depend on the interest rate, the Keynesian cross yields a relationship between the interest rate and national income. A higher interest rate lowers planned investment, and this in turn lowers national income. The downward-sloping *IS* curve summarizes this negative relationship between the interest rate and income.
3. The theory of liquidity preference is a basic model of the determination of the interest rate. It takes the money supply and the price level as exogenous and assumes that the interest rate adjusts to equilibrate the supply and demand for real money balances. The theory implies that increases in the money supply lower the interest rate.
4. Once we allow the demand for real money balances to depend on national income, the theory of liquidity preference yields a relationship between income and the interest rate. A higher level of income raises the demand for real money balances, and this in turn raises the interest rate. The upward-sloping *LM* curve summarizes this positive relationship between income and the interest rate.
5. The *IS*–*LM* model combines the elements of the Keynesian cross and the elements of the theory of liquidity preference. The *IS* curve shows the points that satisfy equilibrium in the goods market, and the *LM* curve shows the points that satisfy equilibrium in the money market. The intersection of the *IS* and *LM* curves shows the interest rate and income that satisfy equilibrium in both markets.

## KEY CONCEPTS

*IS*–*LM* model
*IS* curve
*LM* curve
Keynesian cross
Government-purchases multiplier
Tax multiplier
Theory of liquidity preference

## QUESTIONS FOR REVIEW

1. Use the Keynesian cross to explain why fiscal policy has a multiplied effect on national income.
2. Use the theory of liquidity preference to explain why an increase in the money supply lowers the interest rate. What does this explanation assume about the price level?
3. Why does the *IS* curve slope downward?
4. Why does the *LM* curve slope upward?

## PROBLEMS AND APPLICATIONS

1. Use the Keynesian cross to predict the impact of
   a. An increase in government purchases.
   b. An increase in taxes.
   c. An equal increase in government purchases and taxes.
2. In the Keynesian cross, assume that the consumption function is given by

$$C = 200 + 0.75\ (Y - T).$$

Planned investment is 100; government purchases and taxes are both 100.

a. Graph planned expenditure as a function of income.

b. What is the equilibrium level of income?

c. If government purchases increase to 125, what is the new equilibrium income?

d. What level of government purchases is needed to achieve an income of 1,600?

**3.** Although our development of the Keynesian cross in this chapter assumes that taxes are a fixed amount, in many countries (including the United States) taxes depend on income. Let's represent the tax system by writing tax revenue as

$$T = \overline{T} + tY,$$

where $\overline{T}$ and $t$ are parameters of the tax code. The parameter $t$ is the marginal tax rate: if income rises by \$1, taxes rise by $t \times \$1$.

a. How does this tax system change the way consumption responds to changes in GDP?

b. In the Keynesian cross, how does this tax system alter the government-purchases multiplier?

c. In the *IS–LM* model, how does this tax system alter the slope of the *IS* curve?

**4.** Consider the impact of an increase in thriftiness in the Keynesian cross. Suppose the consumption function is

$$C = \overline{C} + c(Y - T),$$

where $\overline{C}$ is a parameter called *autonomous consumption* and $c$ is the marginal propensity to consume.

a. What happens to equilibrium income when the society becomes more thrifty, as represented by a decline in $\overline{C}$

b. What happens to equilibrium saving?

c. Why do you suppose this result is called the *paradox of thrift*?

d. Does this paradox arise in the classical model of Chapter 3? Why or why not?

**5.** Suppose that the money demand function is

$$(M/P)^{\mathrm{d}} = 1{,}000 - 100r,$$

where $r$ is the interest rate in percent. The money supply $M$ is 1,000 and the price level $P$ is 2.

a. Graph the supply and demand for real money balances.

b. What is the equilibrium interest rate?

c. Assume that the price level is fixed. What happens to the equilibrium interest rate if the supply of money is raised from 1,000 to 1,200?

d. If the Fed wishes to raise the interest rate to 7 percent, what money supply should it set?