Macroeconomics
Theories and Policies

TENTH EDITION

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# Macroeconomics: Theories and Policies

Global Edition

Equation (6.9) also indicates that investment depends on the interest rate and saving depends on income. Our task is to find combinations of the interest rate and income that equate investment with saving.

Figure 6-11 illustrates the construction of the *IS* schedule for this case. In Figure 6-11*a* investment is plotted as a negatively sloped function of the interest rate; a decline in the interest rate will increase investment expenditures. Saving is depicted as a positively sloped function of income, the slope being the positive marginal propensity to save (MPS).

Consider an interest rate of r_0. For this level of the interest rate, investment is the amount I_0, as shown along the investment schedule. An amount of saving just equal to I_0 is shown as S_0 along the saving function. This level of saving results if income is at Y_0. Thus, for the interest rate r_0, a point of product market equilibrium will be at Y_0. This interest-rate–income combination (r_0, Y_0) is one point on the *IS* schedule, shown as point A in Figure 6-11*b*.

FIGURE 6-11   Construction of the *IS* Schedule ($T = G = 0$)

a. Investment and Saving Schedules
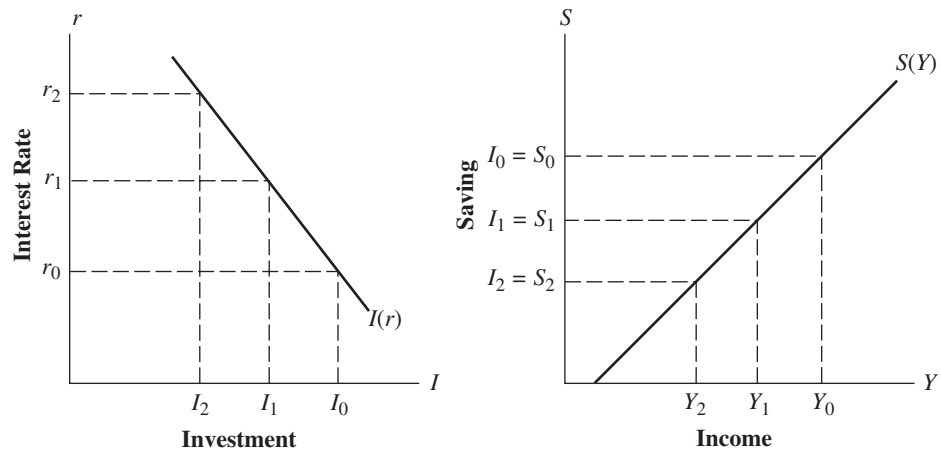
b. The *IS* Schedule
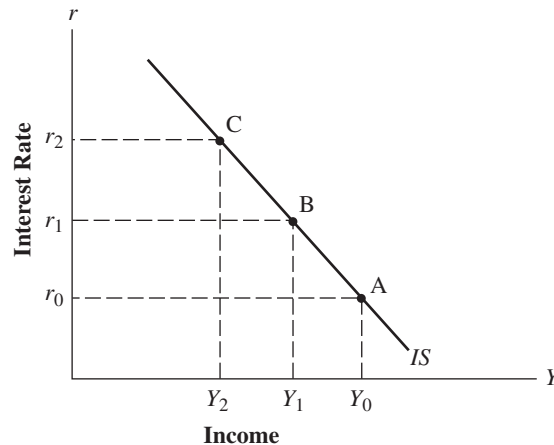
At interest rates r_0, r_1, r_2, investment levels will be I_0, I_1, and I_2 in part *a*. To generate saving S_0, S_1, and S_2 equal to these levels of investment, income must be at Y_0, Y_1, and Y_2, respectively. Therefore, interest-rate–income combinations $(r_0, Y_0), (r_1, Y_1)$, and (r_2, Y_2) are points (A, B, C) along the *IS* schedule in part *b*.

Now consider a higher value of the interest rate, such as r_1. At interest rate r_1, investment will be I_1, a smaller amount than at r_0. For equilibrium, saving must be at S_1, lower than S_0. This saving level is generated by income level Y_1, which is lower than Y_0. Thus a second point on the *IS* schedule will be at r_1 and Y_1, point B on Figure 6-11*b*. Notice that for the higher interest rate, the corresponding equilibrium income level is lower. *The IS schedule has a negative slope.* By choosing additional interest rate values such as r_2 in Figure 6-11*a* and finding the corresponding income level for equilibrium Y_2, where $I_2 = S_2$, we can find additional points on the *IS* schedule in Figure 6-11*b*, such as point C. In this way we trace the complete set of combinations of income and interest-rate levels that equilibrate the product market.

Factors That Determine the Slope of the *IS* Schedule

Next, we consider the factors that determine the degree of the slope of the *IS* schedule. We know that the schedule will be negatively sloped, but will it be steep or flat? As with the *LM* schedule, the question is of interest because we will see that the steepness of the *IS* schedule is a factor determining the relative effectiveness of monetary and fiscal stabilization policies.

In constructing the *IS* schedule, we have looked at how investment changes as we vary the interest rate and then at the required change in income to move saving to equal the new investment level. In considering the steepness of the *IS* schedule, we are asking whether, at progressively lower interest rates, for example, equilibrium in the product market requires *much* higher income levels (the schedule is relatively flat) or only *slightly* increased income levels (the schedule is steep). The answer depends on the slopes of the investment and saving functions. Figure 6-12 illustrates how the slope of the *IS* schedule is related to the slope of the investment function. Two investment schedules are depicted. Schedule *I* is very steep, indicating that investment is not very sensitive to changes in the interest rate; the interest elasticity of investment demand is low.[4] Schedule *I'* is drawn for the case in which investment is more sensitive to movements in the interest rate. For either investment schedule, the graph is constructed so that an interest rate of r_1 corresponds to investment of I_1 (the schedules have different intercepts on the interest-rate axis). Equilibrium in the product market for this interest rate will be at Y_1, as can be seen from Figure 6-12*b* (at that point, $I_1 = S_1$). This will be one point along the product market equilibrium schedules that we construct corresponding to each of these investment schedules. These product market equilibrium schedules, *IS* for investment schedule *I* and *IS'* for investment schedule *I'*, are shown in Figure 6-12*c*. They have a common point at (Y_1, r_1), point A.

Now consider the point along each of these equilibrium schedules corresponding to a lower interest rate r_2. If investment is given by schedule *I* in Figure 6-12*a*, at the lower interest rate r_2 investment will increase to I_2. Equilibrium in the product market requires an equal increase in saving to S_2, which requires that income be at Y_2 in Figure 6-12*b*. Along the *IS* schedule, we move to point B in Figure 6-12*c*. Notice that, because investment was assumed to be relatively insensitive to changes in the interest rate, the increase in investment when the interest rate falls to r_2 is small. Consequently, the required increase in saving, and therefore income, in Figure 6-12*b* is small. The *IS* schedule is steep in this case; lower levels of the interest rate correspond to only slightly higher levels of income along the product market equilibrium schedule.

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[4]The concept of elasticity is defined in footnote 2. Here, as in the case of money demand, the interest elasticity is negative; an increase in the interest rate lowers investment. By saying that elasticity is low, we refer to the absolute value of elasticity.

FIGURE 6-12   Interest Elasticity of Investment and the Slope of the *IS* Schedule

a. Investment Schedule

b. Saving Schedule
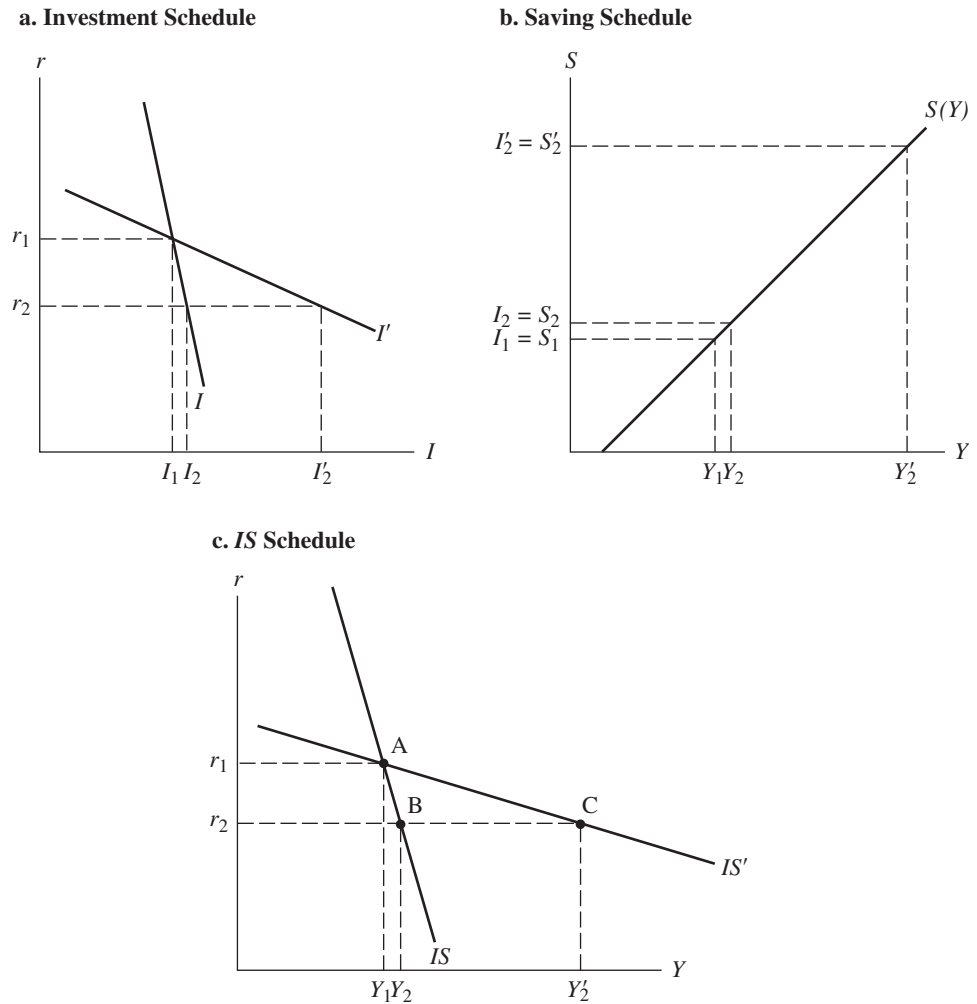
c. *IS* Schedule

Where the investment schedule is steep (*I*) in part *a*, a fall in the interest rate will increase investment by a small amount. In part *b*, therefore, only a small increase in saving and, hence, income is required to restore product market equilibrium. Therefore, the *IS* schedule in part *c* (*IS* in this case) will be steep. Where the investment schedule is relatively flat (*I'*), investment will increase by a greater amount with a fall in the interest rate. Saving, and therefore income, must then increase by a greater amount; the *IS* schedule for this case (*IS'*) will be relatively flat.

Next, consider the case in which investment is given by the flatter schedule I' in Figure 6-12*a*. At the lower interest rate r_2, investment will be at I'_2. The level of income corresponding to r_2 along the investment-equals-saving curve for this case, IS' in Figure 6-12*c*, would be Y'_2 at point C. Saving must increase to S'_2, and this requires income Y'_2. In this case, investment is more highly interest-elastic and increases by a greater amount as the interest rate falls to r_2. Consequently, saving must increase by a greater amount than when investment is interest-inelastic, and for this larger saving increase, income must increase by a greater amount. The product market equilibrium schedule (IS') is flatter when investment is more sensitive to the interest rate.

This, then, is the first of the factors determining the slope of the *IS* schedule. The schedule will be relatively steep if the interest elasticity of investment is low. The schedule will be flatter for higher (absolute) values of investment interest elasticity.

One extreme case for the slope of the *IS* schedule is when the interest elasticity of investment demand is zero; investment is completely insensitive to the interest rate. In this case, the investment schedule in Figure 6-12*a* will be vertical and the *IS* schedule will also be vertical. For this case, a fall in the interest rate from r_1 to r_2 would not increase investment at all. Consequently, equilibrium in the product market requires the same level of saving, and hence income, at r_2 as at r_1.

The second factor affecting the slope of the *IS* schedule is the saving function. Until we consider more elaborate theories of consumption, we do not encounter controversy over the slope of the saving function in Figure 6-12*b*, which is equal to the MPS. Consequently, in this section the value of the MPS does not play much of a role in our discussion of the factors determining the slope of the *IS* schedule. It can be shown, however, that the *IS* curve will be relatively steeper the higher the MPS.

To see this relationship, first note that the higher the value of the MPS, the steeper is the saving function in Figure 6-12*b* (saving increases by more per unit of income). Once we have determined the slope of the investment schedule, we fix the change in investment for a given change in the interest rate. A given decline in the interest rate, for example, then leads to a given increase in investment, and for product market equilibrium along the *IS* schedule, saving must be higher by the same amount. If the MPS is relatively high, then a smaller increase in income will generate this new saving than if the MPS were low. Thus, for a given fall in the interest rate, the amount by which income would have to be increased for a new point of equilibrium in the product market is smaller (larger) the higher (lower) the value of the MPS. This means that the *IS* schedule is relatively steeper, other factors as given, the higher the MPS.

### Factors That Shift the *IS* Schedule

Next, consider the factors that determine the position of the *IS* schedule and changes that shift the schedule. Here we drop the assumption that government expenditures and taxes are zero; we bring the government sector back into the model. The *IS* schedule will shift when any or all of the components of autonomous expenditures change: a, T, I, and G. With the government sector in the model, the condition for product market equilibrium is given by (6.8), which we rewrite as

$$I(r) + G = S(Y - T) + T \tag{6.10}$$

Notice that saving must now be written as a function of *disposable income* ($Y_D = Y - T$), which differs from income by the amount of tax collections.

Construction of the *IS* schedule for this more general case is illustrated in Figure 6-13. In part *a*, we plot both the investment function and the level of investment plus government spending. Note that the $I + G$ schedule is downward sloping only because investment depends on the rate of interest. The $I + G$ schedule lies to the right of the I schedule by the fixed amount of government spending. In Figure 6-13*b*, the saving schedule is plotted against the level of income. Saving plus taxes $[S(Y - T) + T]$ is also plotted. We assume that tax collections are fixed exogenously, so the saving-plus-taxes schedule lies above the saving schedule by a fixed distance (equal to T).

Consider the interest rate r_0 in Figure 6-13. At this interest rate, the level of investment [which can be read from the $I(r)$ schedule] plus the fixed level of government spending equals $I_0 + G$. For equilibrium, this must be balanced by an equal total of saving plus tax collections, given by $S_0 + T$ in Figure 6-13*b*. The level of income that generates this level of saving plus tax collections is given by Y_0. Thus, one point along the *IS* schedule is point A in Figure 6-13*c*, corresponding to interest rate r_0 and income level Y_0. If we considered a higher interest rate, such as r_1, investment would be less; hence, with government spending unchanged, investment plus government spending

FIGURE 6-13   *IS* Schedule with the Addition of a Government Sector

a. Investment Plus Government Spending   b. Saving Plus Taxes

c. The *IS* Schedule
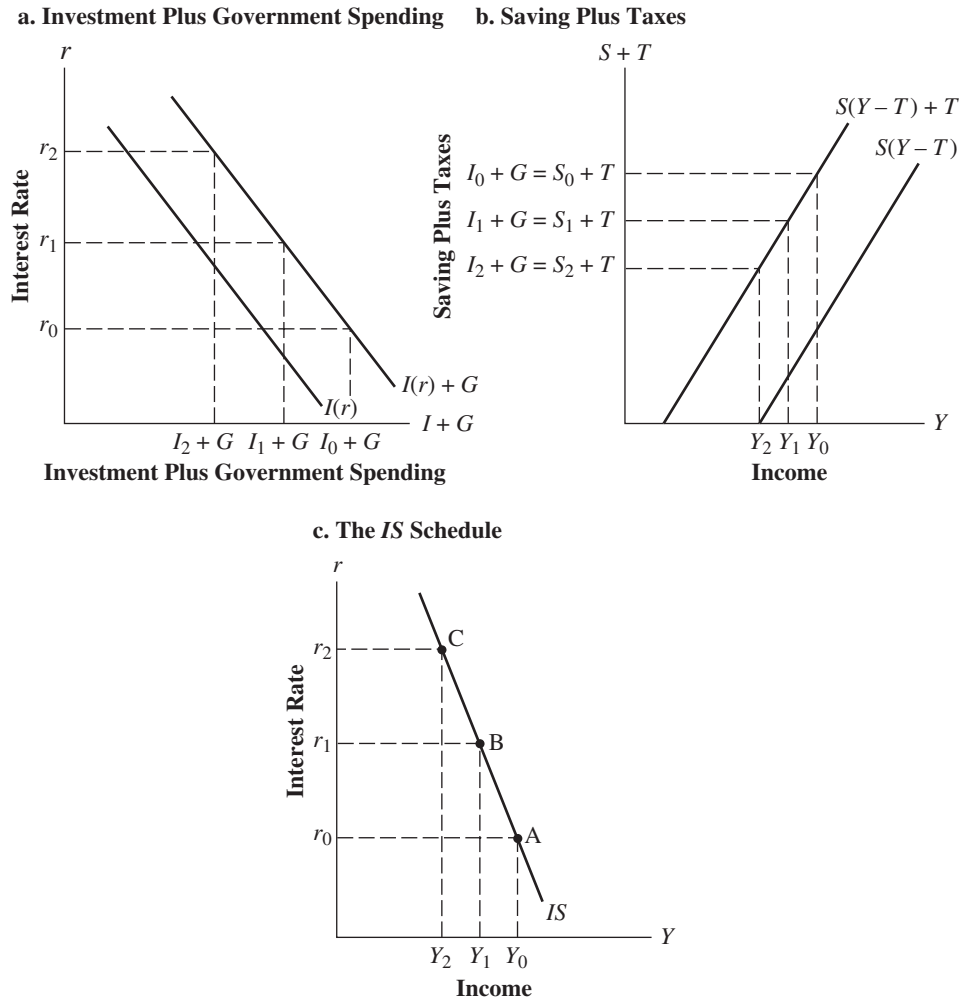
With the inclusion of the government sector, the condition for equilibrium in the goods market becomes $I + G = S + T$. At an interest rate of r_1 in part *a*, investment plus government spending will be equal to $I_1 + G$. Therefore, equilibrium in the goods market requires that saving plus taxes, as shown in part *b*, equal $S_1 + T (= I_1 + G)$, which will be the case at an income level Y_1. Thus, the combination r_1, Y_1 is one point (B) along the *IS* schedule in part *c*.

would be at the lower level $I_1 + G$. For equilibrium, a lower level of saving plus taxes is required. This level is shown as $S_1 + T$ in Figure 6-13*b*, where it should be noted that the change is only in the saving component, because taxes are fixed. For this lower level of saving, income must be at Y_1, below Y_0 in Figure 6-13*b*. The corresponding point on the *IS* schedule is point B in Figure 6-13*c*.

By similar reasoning, we can establish that an interest rate of r_2 will require an income level of Y_2 for equilibrium in the product market (point C in Figure 6-13*c*). The complete *IS* schedule is constructed by proceeding in this manner.

We can now look at factors that would cause a shift in the *IS* schedule. The equilibrium condition given by (6.10) shows that a change in either the level of government spending (G) or the level of taxes (T) will disturb an initial product market equilibrium position—this will be a shift in the *IS* schedule. In addition, an autonomous

investment change that shifts the investment function will shift the *IS* schedule. Note that, in general, the factors that shift the *IS* schedule are those that determined autonomous expenditures in the simple Keynesian model of Chapter 5.

Changes in Government Spending. Consider first the effects of a change in government spending. The shift in the *IS* schedule when government spending increases from an initial level G_0 to a higher level G_1 is illustrated in Figure 6-14. For the initial level of government spending, the *IS* schedule is given by IS_0 in Figure 6-14c. An interest rate of r_0, for example, will be an equilibrium level for the product market if income is at Y_0, as shown at point A on IS_0. At interest rate r_0, investment plus government spending will be $I_0 + G_0$, as shown in Figure 6-14a. As shown in Figure 6-14b, an income level of Y_0 generates saving plus taxes just equal to this amount of government spending plus investment ($S_0 + T_0 = I_0 + G_0$).

Now let government spending increase to G_1 Figure 6-14a shows that this increase shifts the investment-plus-government-spending schedule to the right. At a given interest

FIGURE 6-14 Shift in the *IS* Schedule with an Increase in Government Spending

a. Investment Plus Government Spending   b. Saving Plus Taxes

c. *IS* Schedule
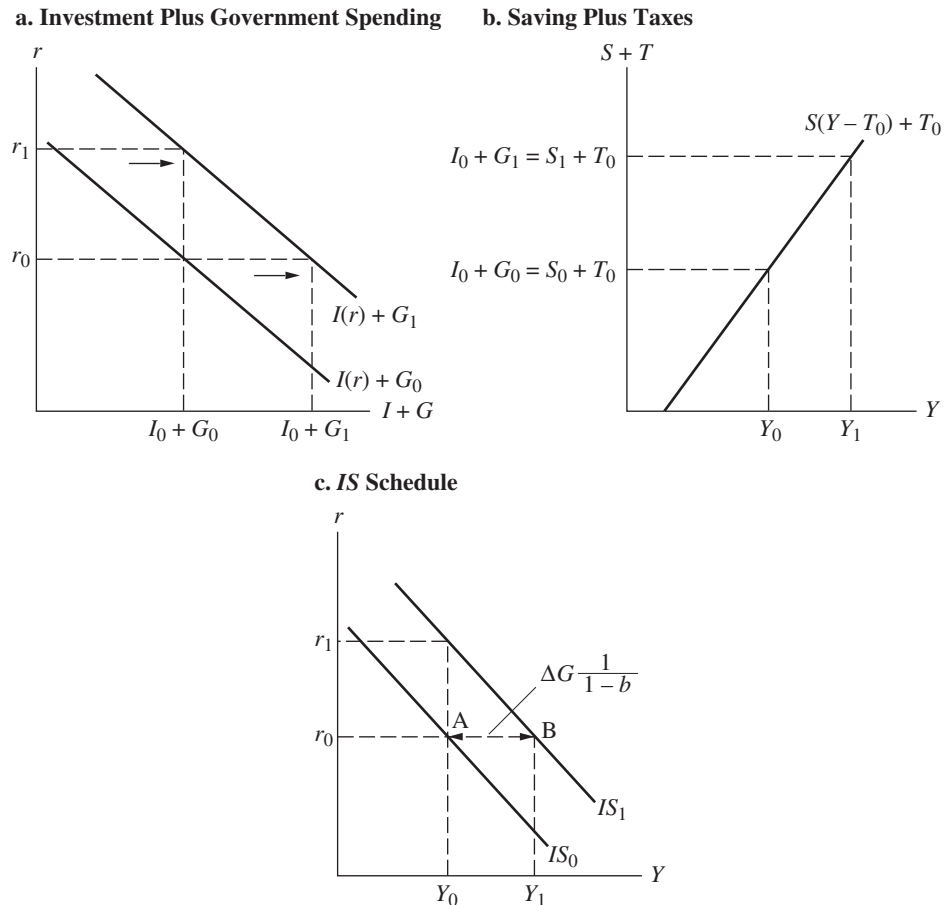
At interest rate r_0, an increase in government spending increases the total of investment plus government spending from $I_0 + G_0$ to $I_0 + G_1$ in part *a*. To maintain the condition $I + G = S + T$, with a fixed level of taxes, saving must rise from S_0 to S_1, which requires income to be Y_1 instead of Y_0 in part *b*. At interest rate r_0, the equilibrium point in the product market is point B instead of point A. An increase in government spending shifts the *IS* schedule to the right from IS_0 to IS_1 in part *c*.