6. A consideration of the microfoundations of the equations that underlie the IS curve reveals important subtleties. The most important are associated with the no-free-lunch principle imposed by the government's budget constraint. The direct effect of changes in government purchases is to change $\bar{a}_g$. However, depending on how these purchases are financed, they can also affect consumption and investment, partially mitigating the effects of fiscal policy on short-run output.

KEY CONCEPTS

adverse selection
aggregate demand shock
automatic stabilizers
cash flow
the IS curve
the life-cycle/permanent-income hypothesis of consumption
moral hazard
multiplier effects
the no-free-lunch principle
permanent income
Ricardian equivalence

REVIEW QUESTIONS

1. What role does the IS curve play in our short-run model? What kind of economic questions does it allow us to analyze?
2. Why does the IS curve slope downward?
3. What are some examples of changes in the economy that would lead to movements along the IS curve? What are some changes that would shift the IS curve?
4. For the development of the rest of the short-run model in the next two chapters, we could just present the equation for the IS curve, $\tilde{Y}_t = \bar{a} - \bar{b}(R_t - \bar{r})$, and omit the six equations and six unknowns that allowed us to derive the curve. Why, however, do you think the underlying setup of the economy might prove useful?
5. What are three insights you gained from studying the microfoundations of the IS curve?
6. Why is the relationship between output and the real interest rate called the "IS curve"?

EXERCISES

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1. **Calculations with the IS curve:** Suppose the parameters of the IS curve are $\bar{a} = 0, \bar{b} = 3/4, \bar{r} = 2\%$ and the real interest rate is initially $R = 2\%$. Explain what happens to short-run output in each of the following scenarios (consider each separately):

   (a) The real interest rate rises from 2% to 4%.
   (b) The real interest rate falls from 2% to 1%.
   (c) $\bar{a}_c$ increases by 1 percentage point.

(d) $\bar{a}_g$ decreases by 2 percentage points.
(e) $\bar{a}_{im}$ decreases by 2 percentage points.

2. **Analyzing macroeconomic events with the IS curve (I):** Consider the following changes in the macroeconomy. Show how to think about them using the IS curve, and explain how and why GDP is affected in the short run.
   (a) The Federal Reserve undertakes policy actions that have the effect of lowering the real interest rate below the marginal product of capital. (We will learn how this can occur in Chapter 12.)
   (b) Consumers become pessimistic about the state of the economy and future productivity growth.
   (c) Improvements in information technology increase productivity and therefore increase the marginal product of capital.

3. **Analyzing macroeconomic events with the IS curve (II):** Consider the following changes in the macroeconomy. Show how to think about them using the IS curve, and explain how and why GDP is affected in the short run.
   (a) The government offers a temporary investment tax credit: for each dollar of investment that firms undertake, they receive a credit that reduces the taxes they pay on corporate income.
   (b) A booming economy in Europe this year leads to an unexpected increase in the demand by European consumers for U.S. goods.
   (c) U.S. consumers develop an infatuation with all things made in New Zealand and sharply increase their imports from that country.
   (d) A housing bubble bursts so that housing prices fall by 20% and new home sales drop sharply.

4. **Government purchases:** Suppose Congress and the president decide to increase government purchases today, say for national defense. Explain how this affects the IS curve. How does your answer depend on the way in which the spending is financed and on the extent to which Ricardian equivalence holds?

5. **Social Security transfers:** Suppose the government announces an increase in Social Security transfers. Which aggregate demand parameter is affected? How and why is it affected? How does this increase affect the graph of the IS curve? How does your answer depend on the way in which the spending is financed and on the extent to which Ricardian equivalence holds?

6. **Natural disasters:** Suppose a large earthquake destroys many houses and buildings on the West Coast but fortunately results in little loss of life. Show how to think about this event using the IS curve. Explain how actual output, potential output, and short-run output are affected in the short run, and why.

7. **Consumption and the multiplier:** Show how to derive an IS curve that includes the consumption multiplier. That is, show how to derive equation (11.16). Draw a graph of the original IS curve and the IS curve that includes the multiplier. Which one is flatter, and why?

8. **Imports and the multiplier:** The amount of goods that the U.S. economy imports might depend on the current state of the economy as well as on

potential GDP. For example, when the economy is booming, imports usually rise. To incorporate this channel into the model, suppose the import equation is given by

$$\frac{IM_t}{\overline{Y}_t} = \bar{a}_{im} + \bar{n}\tilde{Y}_t.$$

Assume the remainder of the model is unchanged from the original setup, as in Table 11.1.

(a) Derive the IS curve for this new specification.

(b) What is the economic explanation for why the $\bar{n}$ parameter shows up in the denominator of the new IS curve? Notice that an aggregate demand shock that increases $\bar{a}$ by 1 percentage point now has a *smaller* effect on output than it did in the original IS curve. Why?

9. **Consumption and the real interest rate:** According to the life-cycle/permanent-income hypothesis, consumption depends on the present discounted value of income. An increase in the real interest rate will make future income worth less, thereby reducing the present discounted value and reducing consumption. To incorporate this channel into the model, suppose the consumption equation is given by

$$C_t = \bar{a}_c\overline{Y}_t - \bar{b}_c(R_t - \bar{r})\overline{Y}_t.$$

Assume the remainder of the model is unchanged from the original setup, as in Table 11.1.

(a) Derive the IS curve for this new specification.

(b) How and why does it differ from the original IS curve? (*Hint*: Think about the slope of the IS curve.)

10. **The permanent-income theory of consumption:** According to the permanent-income hypothesis, how does your consumption change in each of the following scenarios? (The first question is answered for you.) To keep things simple, suppose the interest rate is 10% and you will live forever. Feel free to give answers that involve approximations.

(a) A distant aunt that you never knew dies and leaves you $100,000 in her will. (*Answer: Consumption rises today and in the future by a constant amount, equal to the "permanent-income equivalent" of the $100,000. Since you live forever, you can raise your consumption by the amount of interest earned on the bequest. So consumption rises in every period by 0.10 × $100,000 = $10,000.*[17])

(b) You receive an unexpected promotion today that raises your income permanently by $5,000 per year.

(c) To balance its budget, the government levies a onetime tax this year that costs you $10,000.

[17]Notice that this is only an approximation: the present discounted value of an annual flow of $10,000 starting from today is actually $100,000 × (1 + R) if R is the interest rate, so $10,000 per year is a little high. If interest were compounded continuously instead of annually, the $10,000 answer would be exactly correct.

(d) You win a lottery, which pays you a onetime amount of \$10 million today.

(e) You win a different lottery, which pays you a onetime amount of \$10 million, but the payment is made 5 years from now.

WORKED EXERCISES

2. Analyzing macroeconomic events with the IS curve (I): To get started, recall the equation for the IS curve:

$$\tilde{Y}_t = \bar{a} - \bar{b}(R_t - \bar{r}).$$

(a) When the Federal Reserve reduces the real interest rate so that it falls below the marginal product of capital, this is a movement along the IS curve. The result is shown in Figure 11.7. Because firms can borrow at a rate below the marginal product of capital, investment is stimulated, causing short-run output to increase as the economy moves from point A to point B.

(b) In our model, consumers' becoming pessimistic about the future of the economy can be represented as a decline in $\bar{a}_c$, which reduces the aggregate demand parameter $\bar{a}$. The reduction causes the IS curve to shift back, as shown in Figure 11.8. If we hold the real interest rate constant, this reduction in aggregate demand leads output to fall in the short run, from point A to point B. In fact, output falls one-for-one with the aggregate demand shock, so if $\bar{a}_c$ falls by 2 percentage points, then so does short-run output.

FIGURE 11.7

A Reduction in the Real Interest Rate

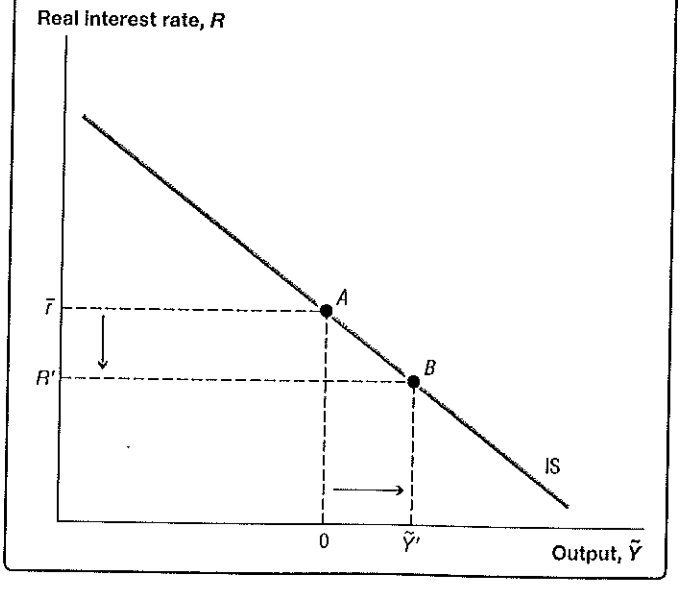
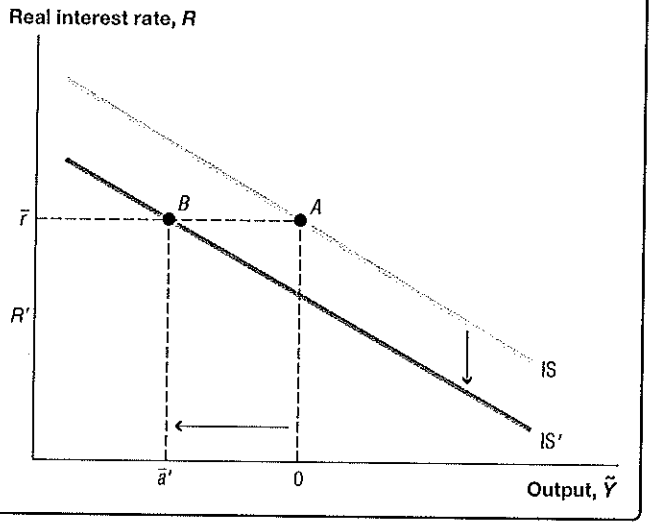


FIGURE 11.8

Pessimistic Consumers

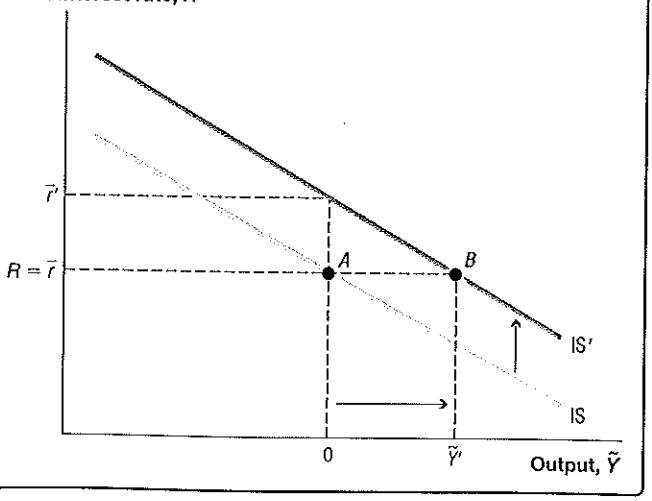


(c) Improvements in information technology cause the marginal product of capital $\bar{r}$ to increase. After this occurs, the real interest rate is lower than the marginal product of capital. This means firms wish to borrow at the low interest rate to take advantage of the high marginal product of capital, so investment demand goes up, stimulating the economy.

As shown in Figure 11.9, short-run output $\tilde{Y}$ is zero at the point where the real interest rate is $\bar{r}$. Since $\bar{r}$ increases, this means the IS curve shifts up, and the economy moves from point A to point B.

FIGURE 11.9

Improvements in Information Technology



10. The permanent-income theory of consumption:

(a) Answer given in exercise.

(b) This one should be relatively easy. Consumption rises today and in the future by a constant amount. How much? Your income has gone up by $5,000 per year, so your consumption rises by this same amount each year.

Parts (c), (d), and (e) are left as exercises for the student.