Chapter 4 (continued)

Investment

Investment

- There is a trade-off between the present and the future.

- A firm commits its resources to increasing its capacity to produce and earn profits in the future.

- Investment spending fluctuates sharply over the business cycle and typically contributes half of the total decline in spending.

- Investment plays a crucial role in determining the long-run productive capacity of the economy and its growth.

The Desired Capital Stock

- Desired capital stock is an amount of capital that allows a firm to earn the largest expected profit.

- The marginal product of capital (MPK) is the firm's increase in output due to adding a unit of capital (other factors held constant).

- Managers compare the cost and benefit of using additional capital, *e.g.* a new machine.

- The firm's benefit is MPK^f – the future MPK.

- It is the future MPK^f since the benefits won't be seen immediately.

- The firm's cost is the user cost of capital.

The User Cost of Capital

- User cost of capital is the expected real cost of using a unit of capital for a specified period of time.

$$uc = rp_K + dp_K = (r + d)p_K$$

uc is the user cost of capital

r is the expected real rate of interest

d is the rate at which capital depreciates

p_K is the real price of capital goods

Determining the Desired Capital Stock

- The desired capital stock is the capital stock at which the MPK^f equals the uc.

- The expected profit is maximized when the MPK^f equals the uc.

- The MPK^f curve slopes downward because the marginal product of capital falls as the capital stock increases. It comes from the production function already discussed.

- The uc curve does not depend on the amount capital and is a horizontal line.

FIGURE 4.3

DETERMINATION OF THE DESIRED CAPITAL STOCK

The desired capital stock (50 cubic metres of oven capacity in this example) is the capital stock that maximizes profits. When the capital stock is 50 cubic metres, the expected future marginal product of capital MPK^f is equal to the user cost of capital uc. If the MPK^f is larger than uc, as it is when the capital stock is 40 cubic metres, the benefit of extra capital exceeds the cost, and the firm should increase its capital stock. If the MPK^f is smaller than uc, as it is at 60 cubic metres, the cost of extra capital exceeds the benefit, and the firm should reduce its capital stock.

The desired capital stock, 50 cubic metres, sets MPK^f equal to uc
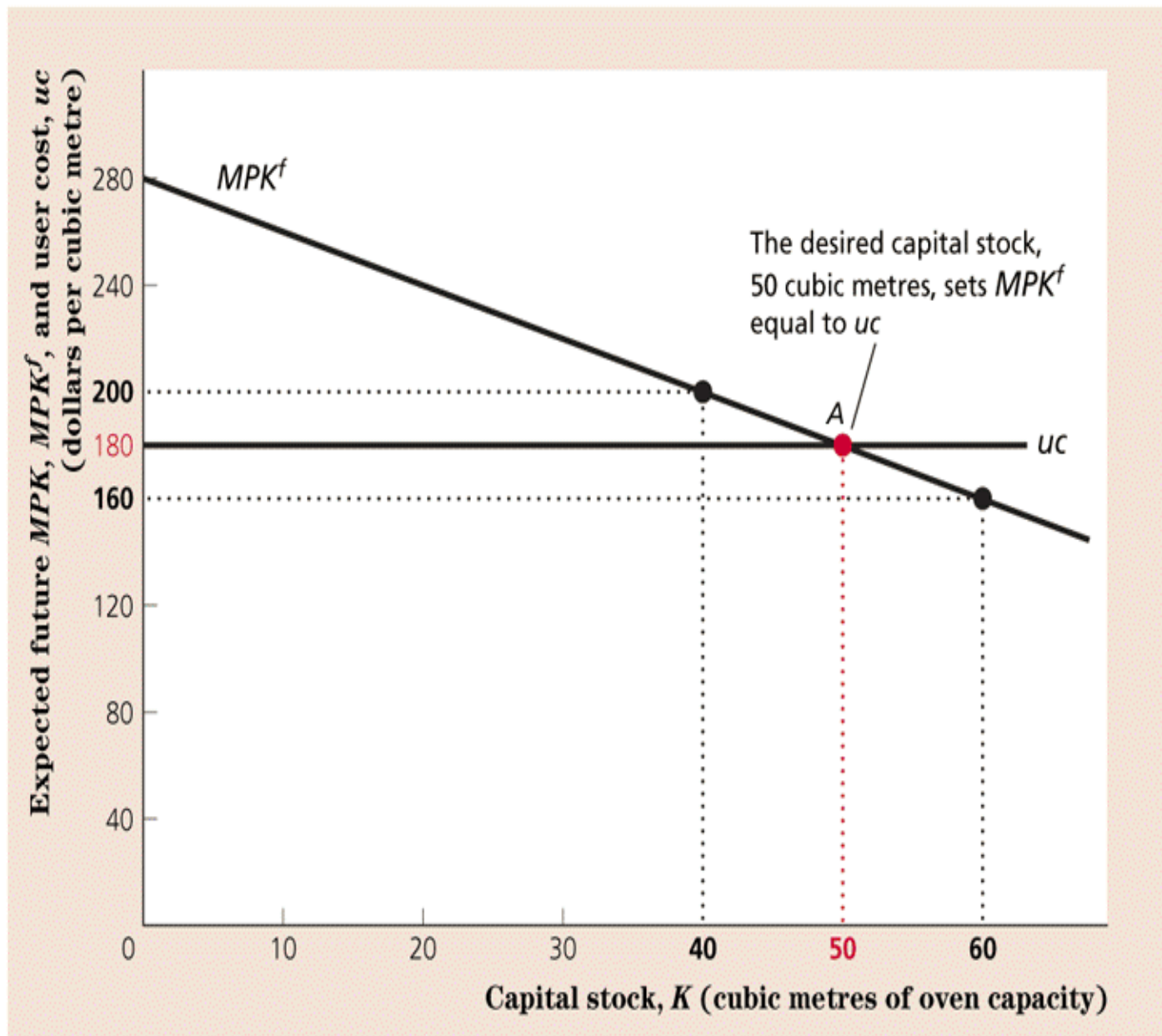
Changes in the Desired Capital Stock

- If r falls (other factors held constant), the uc line falls (shifts downward), then $MFK^f > uc$, and K rises.

- The same is true when d or p_K fall (other factors held constant).

- When technology improves (other factors held constant) the MFK^f curve shifts upward, then $MFK^f > uc$, and K rises.

FIGURE 4.4

A DECLINE IN THE REAL INTEREST RATE RAISES THE DESIRED CAPITAL STOCK

For the Tony's Bakery example, a decline in the real interest rate from 8% to 6% reduces the user cost, uc, of a cubic metre of oven capacity from $180 to $160 per cubic metre and shifts the user cost line down from uc^1 to uc^2. The desired capital stock rises from 50 (point A) to 60 (point C) cubic metres of oven capacity. At 60 cubic metres, the MPK^f and the user cost of capital again are equal, at $160 per cubic metre.

1. A fall in the real interest rate lowers the user cost of capital
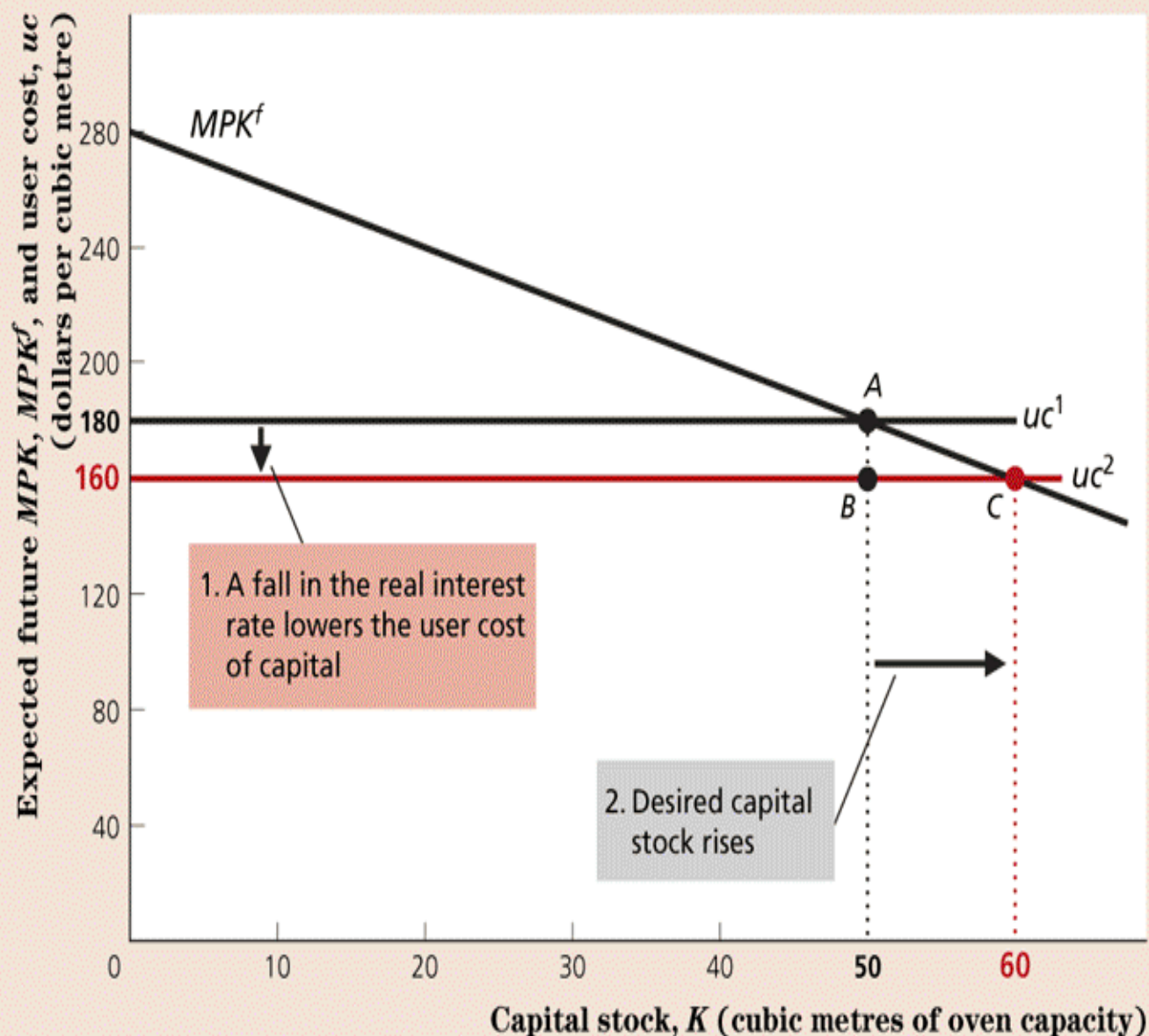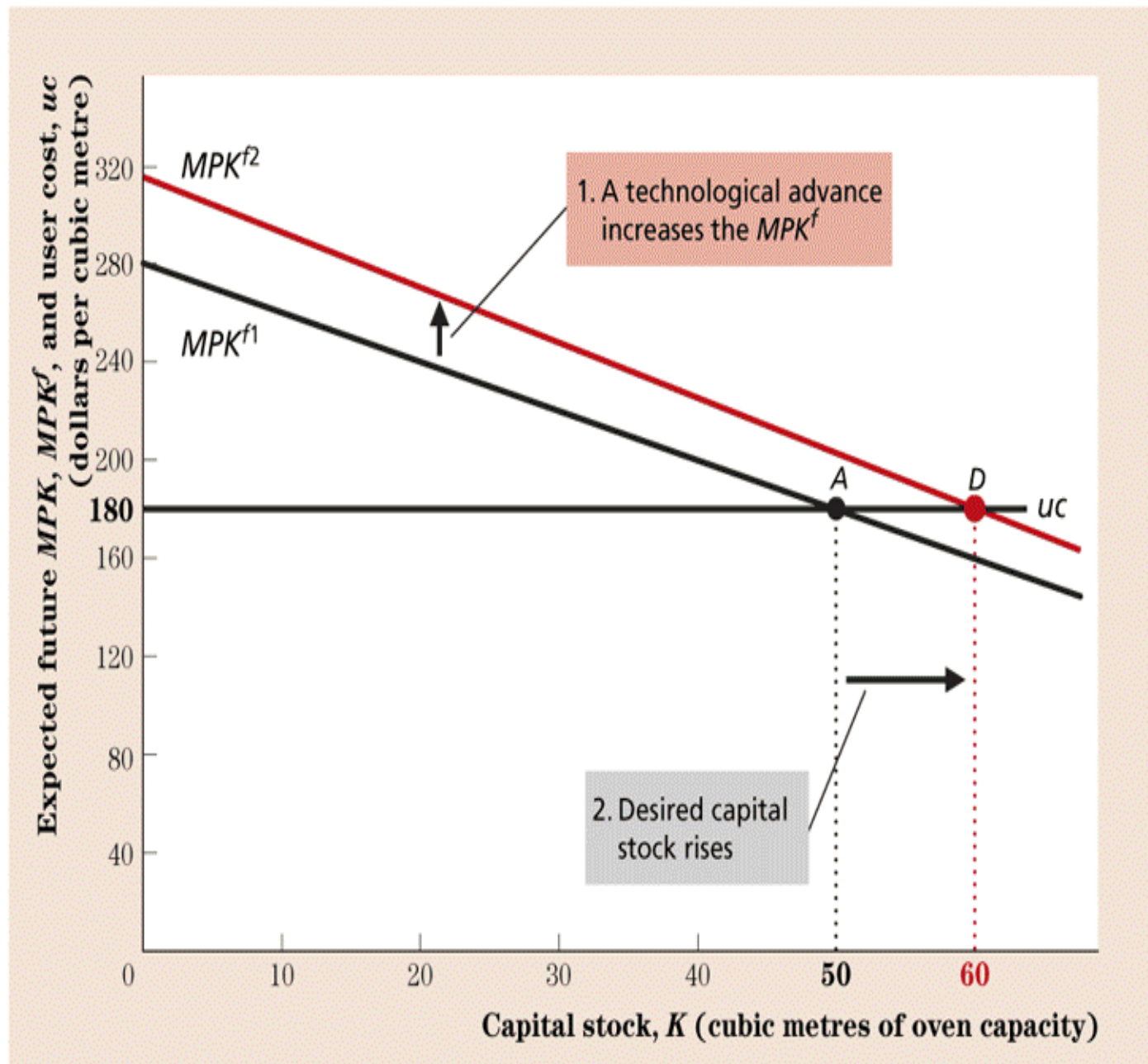
2. Desired capital stock rises

FIGURE 4.5

AN INCREASE IN THE
EXPECTED FUTURE *MPK*
RAISES THE DESIRED
CAPITAL STOCK

A technological advance raises the expected future marginal product of capital, MPK^f, shifting the MPK^f curve upward *from MPK^{f1} to MPK^{f2}.* The desired capital stock increases from 50 (point *A*) to 60 (point *D*) cubic metres of oven capacity. At 60 cubic metres, the MPK^f equals the user cost of capital *uc* at \$180 per cubic metre.

1. A technological advance increases the MPK^f

2. Desired capital stock rises

Expected future *MPK*, MPK^f, and user cost, *uc* (dollars per cubic metre)

Capital stock, *K* (cubic metres of oven capacity)

Taxes and the Desired Capital Stock

- The after-tax MPK^f is $(1 - \tau)MPK^f$.

$$MPK^f = \frac{uc}{1 - \tau} = \frac{(r + d)p_k}{1 - \tau}$$

- $uc/(1 - \tau)$ is tax-adjusted user cost of capital.

Taxes and the Desired Capital Stock (continued)

- An increase in the tax rate τ raises the tax-adjusted user cost and so reduces the desired stock of capital.

- The effective tax rate is a single measure of the tax burden on capital.

Investment

- The capital stock changes:

  - Gross investment is the total purchase or construction of new capital goods.

  - Depreciation is the capital wearing out.

Investment (continued)

- Net investment is the difference between gross investment and depreciation.

$$K_{t+1} - K_t = I_t - dK_t$$

$$I_t = K_{t+1} - K_t + dK_t$$

I_t is gross investment during year t.

K_t and K_{t+1} is capital stock at the beginning of year t and $t+1$.

- This says that gross investment is equal to changes in the capital stock and depreciation.

FIGURE 4.6

GROSS AND NET INVESTMENTS, 1926–2003

The figure shows private gross and net investments in Canada since 1926 as percentages of GDP. During some years of the Great Depression and World War II, net investment was negative, implying that the private capital stock was shrinking.

Source: 1926–1960: *Canadian Economic Observer, Historical Statistical Supplement,* Table 1; 1961–2003: Statistics Canada, CANSIM II series v33061 and v498927. Gross investment is investment in business fixed capital, and depreciation is capital consumption allowances.

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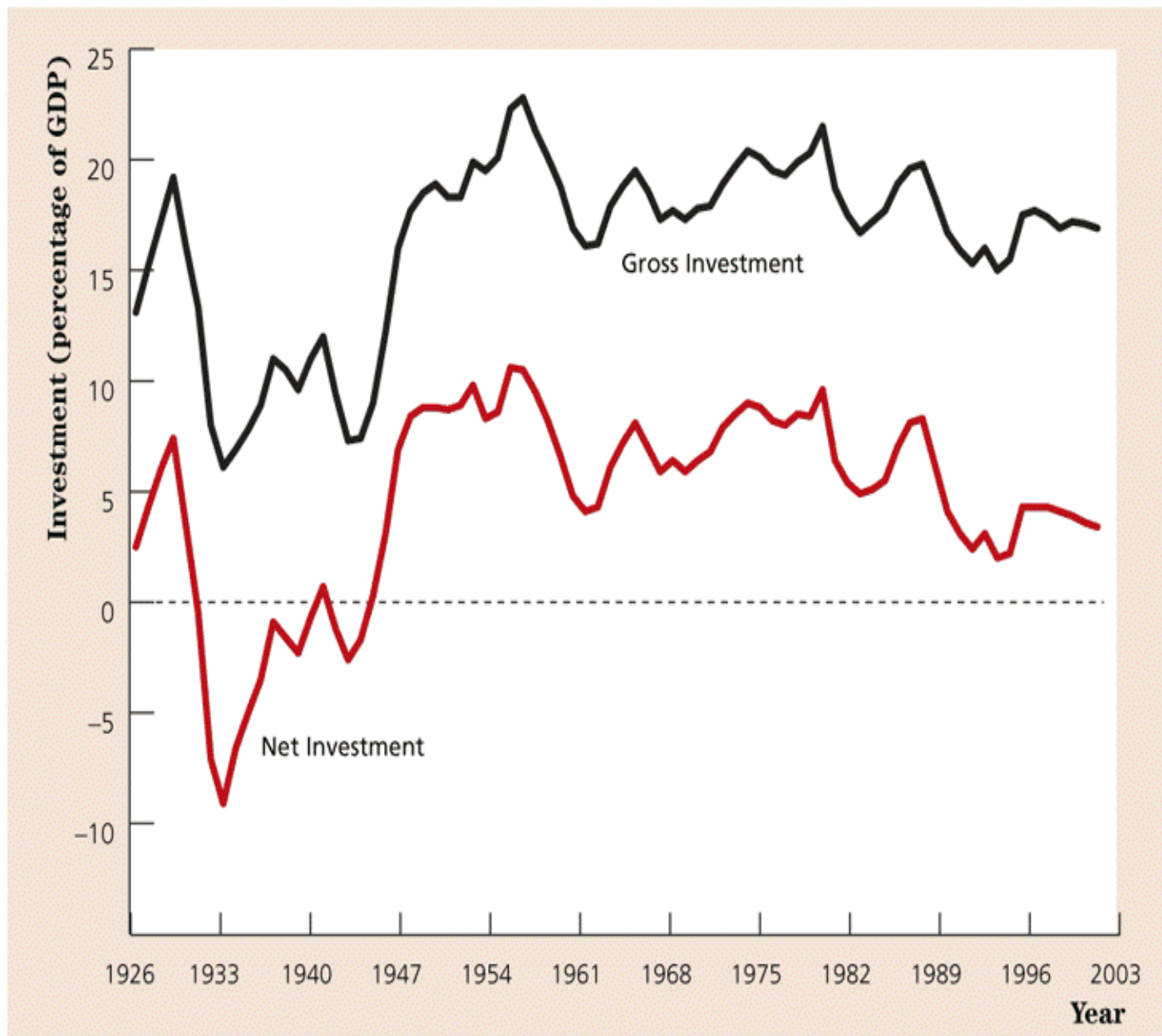
Investment (continued)

- The firm's gross investment during the year has two parts:
  - the desired net increase in capital stock over the year (K^*-K_t);
  - the investment needed to replace worn-out or depreciated capital (dK_t).

$$I_t = K^* - K_t + dK_t$$

- Typically there are lags in achieving K*.

Investment in Inventories

- A firm's inventories are unsold goods, unfinished goods, and raw materials.

- Inventory investment is the most volatile component of investment spending.

- It's future marginal product can be defined as expected future commissions or profits.

- The user cost would be depreciation and interest costs.

Investment in Housing

- Residential investment is the construction of housing or apartment buildings.

- An apartment builder will compare the expected benefits of renting out apartments with the respective user costs (depreciation of the building and interest cost).

Summary of Determinants of Desired Investment

All else equal, an increase in	Causes desired investment to	Reason
Real interest rate, *r*	Fall	The user cost increases, which reduces desired capital stock.
Effective tax rate	Fall	The tax-adjusted user cost increases, which reduces desired capital stock.
Expected future *MPK*	Rise	The desired capital stock increases

Goods Market Equilibrium

- The real interest rate is the key economic variable whose adjustments help bring the quantities of goods supplied and demanded into balance.

Goods Market Equilibrium (continued)

- The goods market equilibrium condition is:

$$Y = C^d + I^d + G$$

- Y is the quantity of goods supplied by firms.
- The right hand side is the aggregate demand for goods.

Goods Market Equilibrium (continued)

- The income-expenditure identity for a closed economy ($Y=C+I+G$) is always satisfied.

- The goods market is in equilibrium when desired national saving equals desired investment ($S^d=I^d$), since $S^d=Y-C^d-G$.

The Saving-Investment Diagram

- The saving curve, *S*, is upward sloping. A higher real interest rate raises desired national savings.

- The investment curve, *I*, is downward sloping. A higher interest rate increases the user cost of capital and, thus, reduces investment.

- Adjustments of the real interest rate, in response to excess supply or demand for saving, bring the goods market into equilibrium.

The Saving-Investment Diagram (Continued)

- Goods market equilibrium:

  - C^d depends on r because a higher r raises S^d.

  - I^d depends on r because a higher r raises uc, which lowers I^d.

- Adjustments of r eliminate excess supply or demand for saving.

FIGURE 4.7

GOODS MARKET EQUILIBRIUM

Goods market equilibrium occurs when desired national saving equals desired investment. In the figure, equilibrium occurs when the real interest rate is 6% and both desired national saving and desired investment equal 100. If the real interest rate were, say, 3%, desired investment (150) would not equal desired national saving (85), and the goods market would not be in equilibrium. Competition among borrowers for funds would then cause the real interest rate to rise until it reaches 6%.
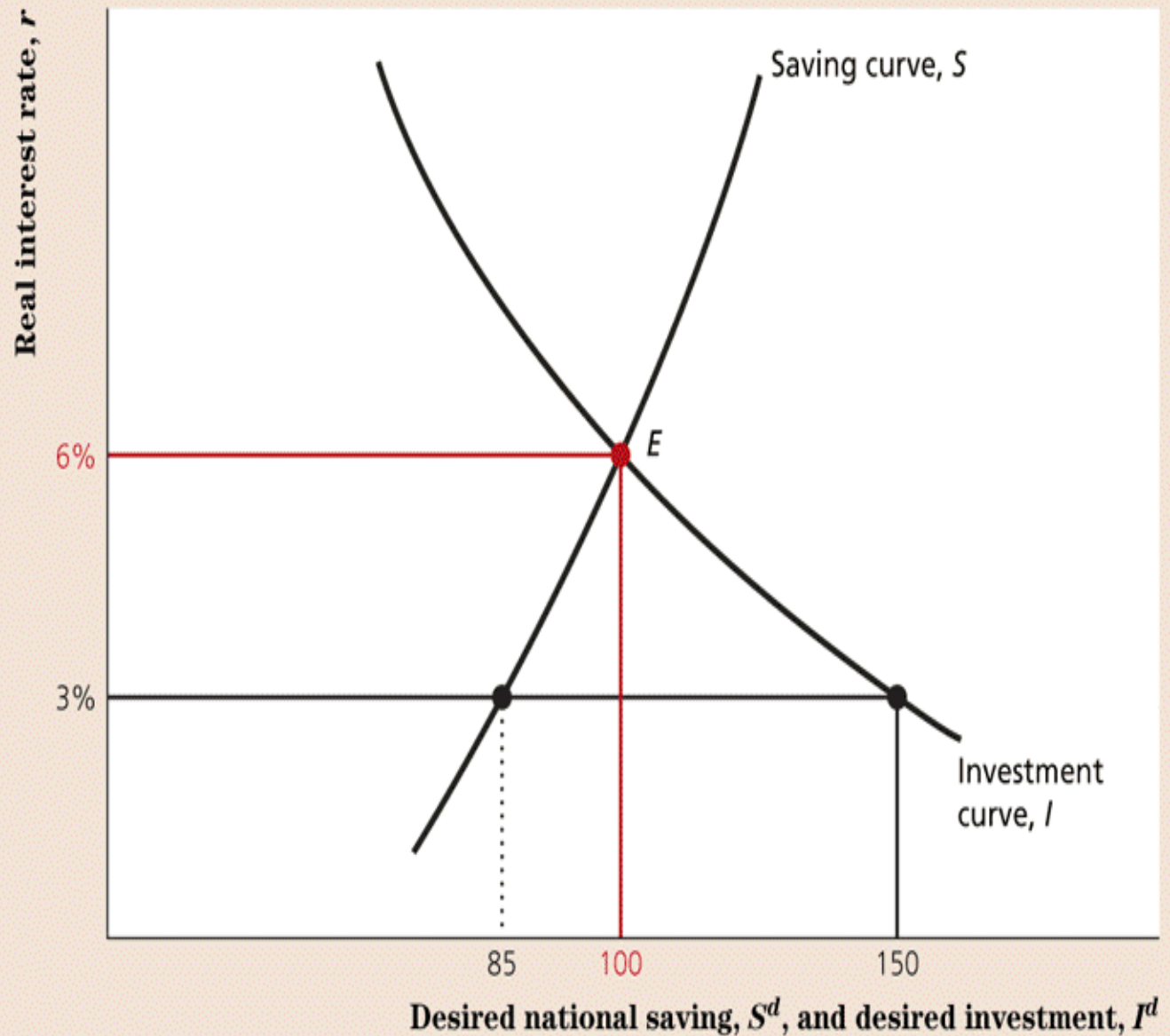
Shifts of the Saving Curve

- The saving curve shifters are all factors, excluding the real interest rate, which affect national saving.

- Example. The crowding out of investment by government purchases:
  - increase in G causes a decrease $S^{d;}$
  - S^d curve shifts to the left;
  - the equilibrium r goes up;
  - I^d falls because of higher uc.

FIGURE 4.8

A DECLINE IN DESIRED SAVING

A change that reduces desired national saving, such as a temporary increase in current government purchases, shifts the saving curve to the left, from S^1 to S^2. The goods market equilibrium point moves from E to F. The decline in desired saving raises the real interest rate, from 6% to 7%, and lowers saving and investment, from 100 to 85.
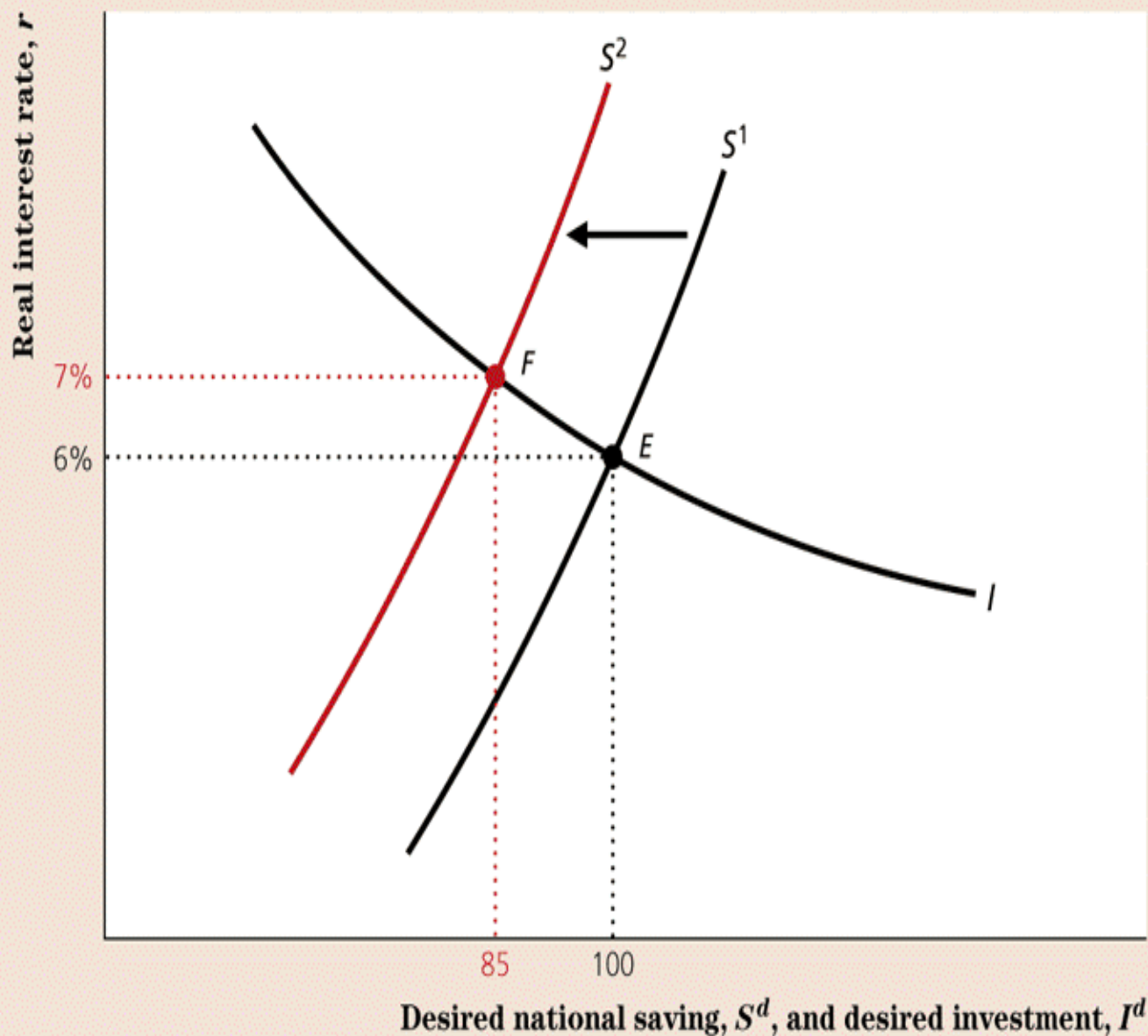
Shifts of the Investment Curve

- The investment curve shifters are all the factors which affect investment, excluding the real interest rate (it determines the movement along the curve).

- Example:
  - An innovation or economic reform raises MPK^f.
  - The increase in I^d shifts the investment curve to the right.
  - r rises to a new equilibrium level.
  - S increases.

FIGURE 4.9

AN INCREASE IN DESIRED INVESTMENT

A change in the economy that increases desired investment, such as an invention that raises the expected future MPK, shifts the investment curve to the right, from I^1 to I^2. The goods market equilibrium point moves from E to G. The real interest rate rises from 6% to 8%, and saving and investment also rise, from 100 to 110.
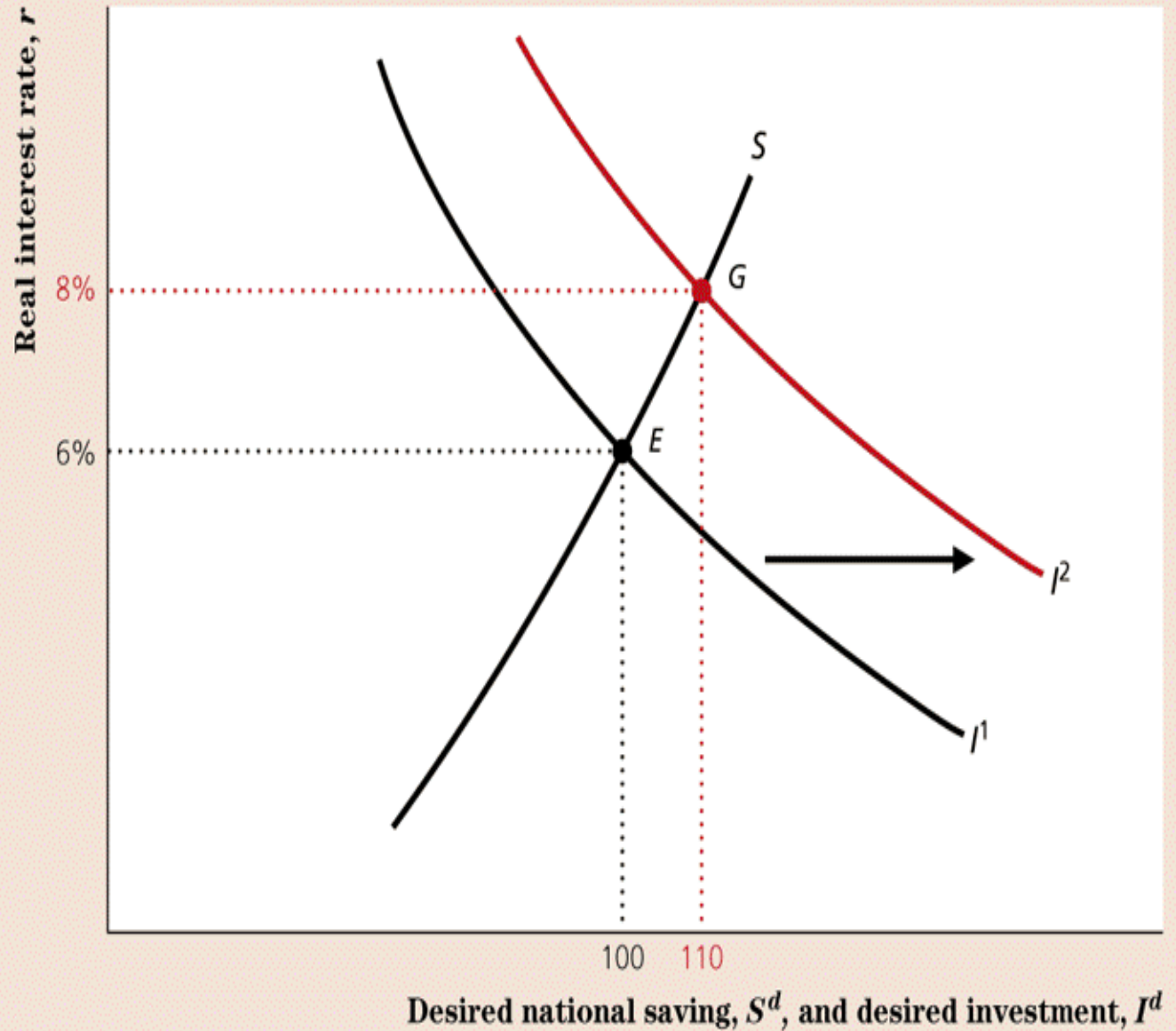
An Example of the Economy Moving Toward Equilibrium

TABLE 4.4

Components of Aggregate Demand for Goods (An example)

Real Interest Rate, r	Output, Y	Desired Consumption, C^d	Desired Investment, I^d	Government Purchases, G	National Saving, $S^d = Y - C^d - G$	Desired Aggregate Demand for Goods, $C^d + I^d + G$
3%	450	215	150	150	85	515
6%	450	200	100	150	100	450

An Equivalent Method

- Look at exercise 6.

- We can start with a consumption and an investment equation.

- We then use the definition of income:

- $Y = C + I + G$

- Then solve for the interest rate that gets goods market equilibrium