

Economics 302  
Intermediate Macroeconomic  
Theory and Policy  
(Fall 2009)

Lecture 21-22

Nov. 12-17, 2009

# Outline: Investment

- Fluctuations in investment spending
- How firms make investment decisions
- The investment function
- Taxes and investment
- Residential investment
- Inventory investment

Figure 11.1: Fixed Investment and GDP

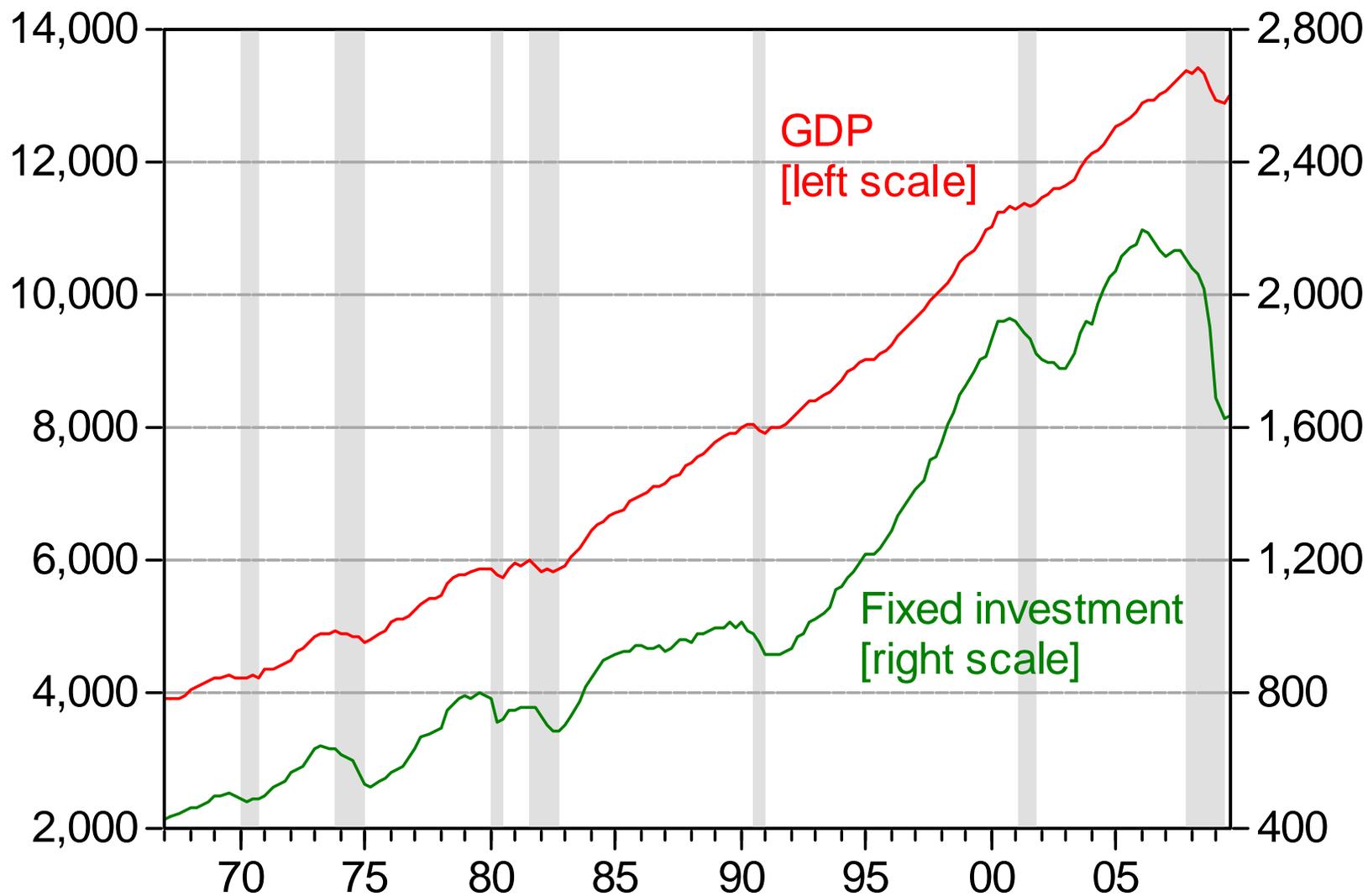
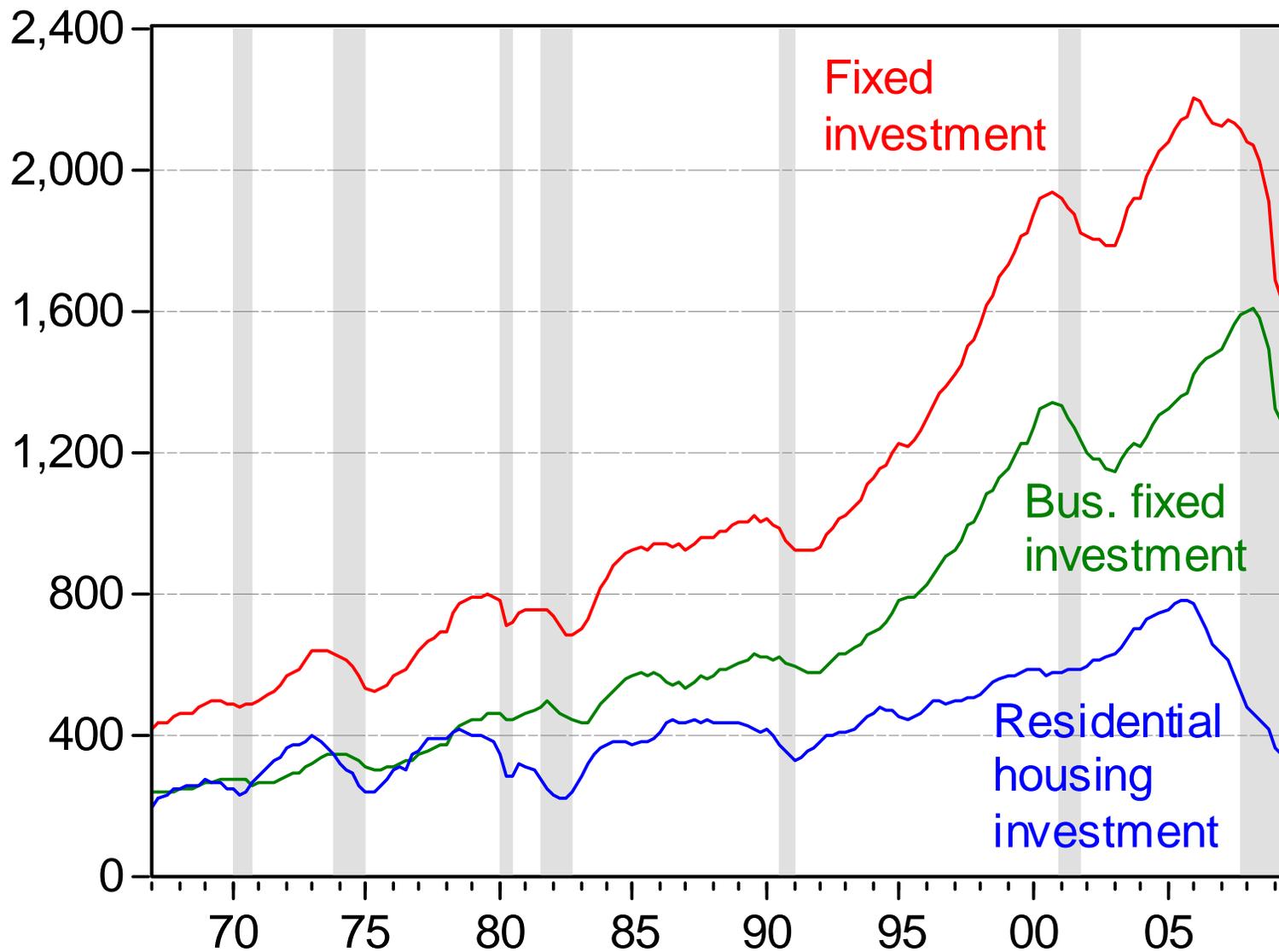


Figure 11.2: Housing versus Factories and Equipment



# Investment

- **In the economy as a whole, the volume of investment observed is the joint outcome of three factors:**
  - **investment demand**, decisions made by businesses about the amount of investment to undertake;
  - **saving supply**, decisions made by consumers about the amount to save;
  - **investment supply**, decisions made by producers of investment goods about how much to supply.
- This chapter focuses on investment demand.

# INVESTMENT ANALYSIS

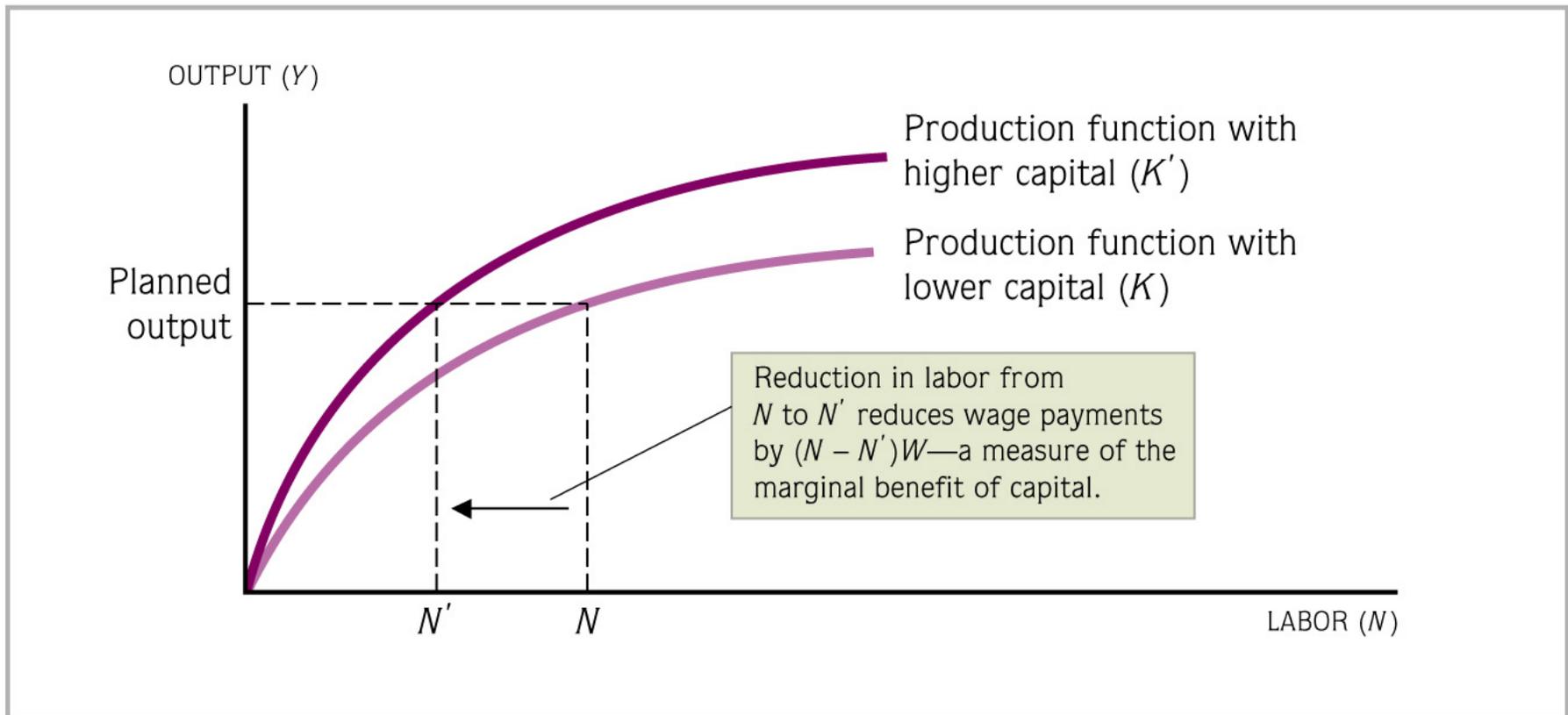
- Investment is the flow of newly produced capital goods.
- Declines in business fixed investment are closely timed with declines in the overall economy.
- Declines in housing investment lead the declines in the overall economy.

# 11.2 HOW FIRMS MAKE INVESTMENT DECISIONS

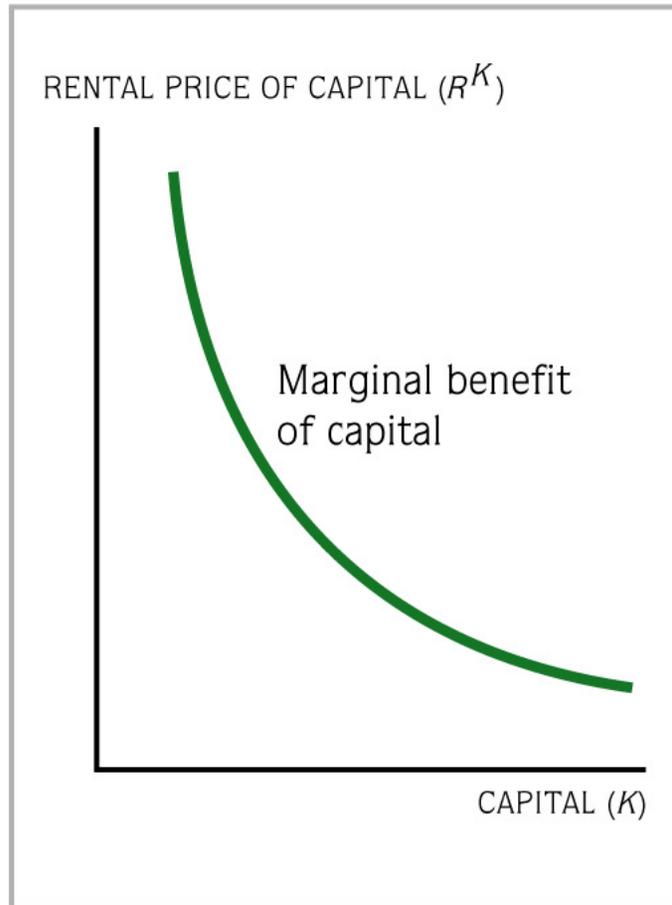
- From a firm's perspective two decisions can be distinguished:
  1. How many factories and machines do they want?
    - What is the firm's desired **capital stock**?
  2. The second question is How fast do they build the factories and when do they order the machines that they want?
    - What is the ***flow of investment***?

# The Firm's Problem

- ***How much capital will the firm choose to rent?***
  - Answer: the amount that equates the marginal benefit to the marginal cost.
    - The **marginal benefit** is the amount of dollars saved by using fewer of the other factors of production when more capital is employed.
    - The **marginal cost of capital** is the rental cost charged by the renting firm.



**FIGURE 11.3** The Production Function and the Marginal Benefit of Capital



**FIGURE 11.4** The Marginal Benefit of Capital Schedule

# The Rental Price of Capital

- How would the market set the rental price of capital?

- Total rental costs are:

$$R^K = (R + d) P^K$$

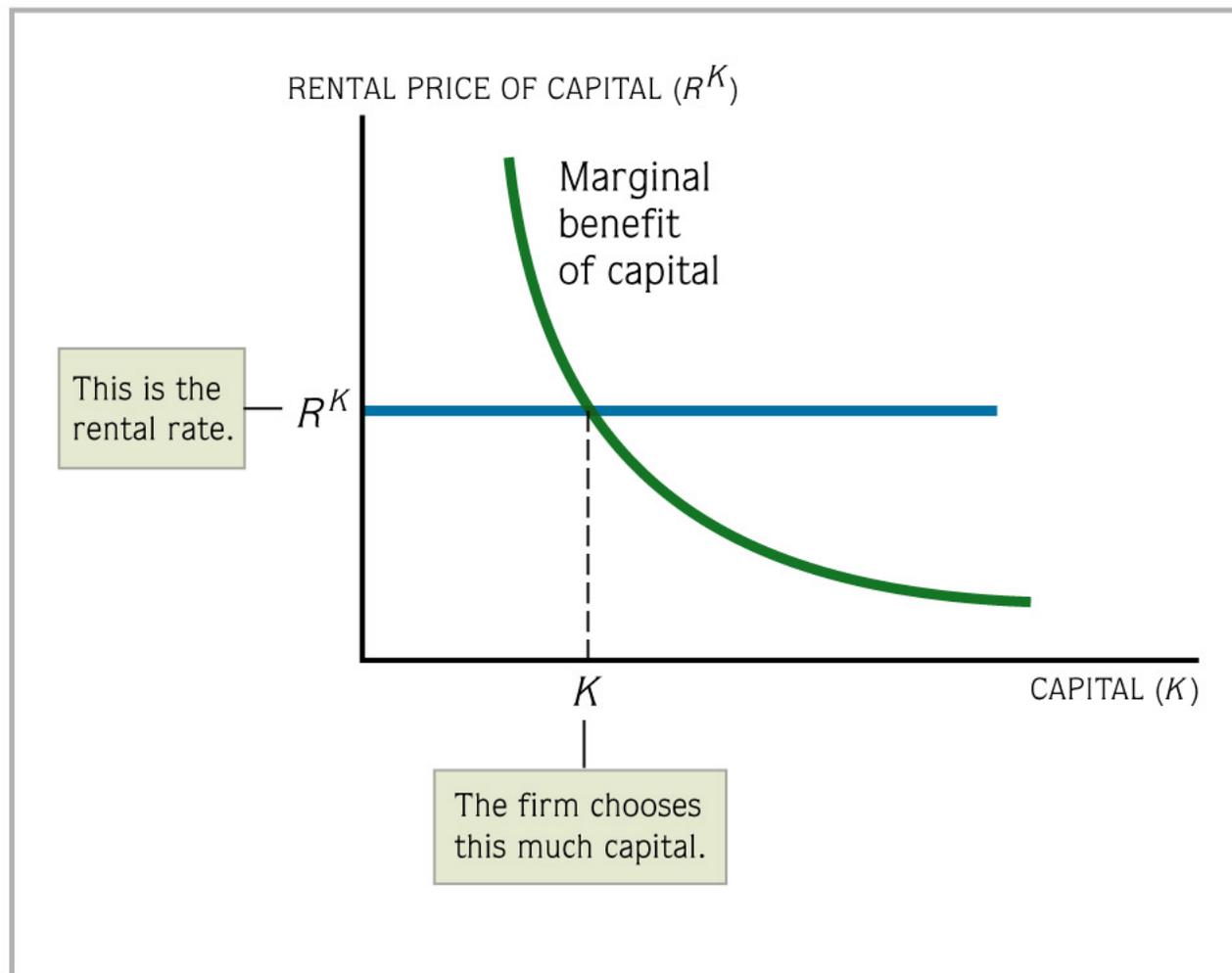
- $R^K$  is the rental price of a machine for a year
- $R$  is the real interest rate.
- $d$  is the rate of depreciation.
- $P^K$  is the price for purchasing a new machine

- The equation states:

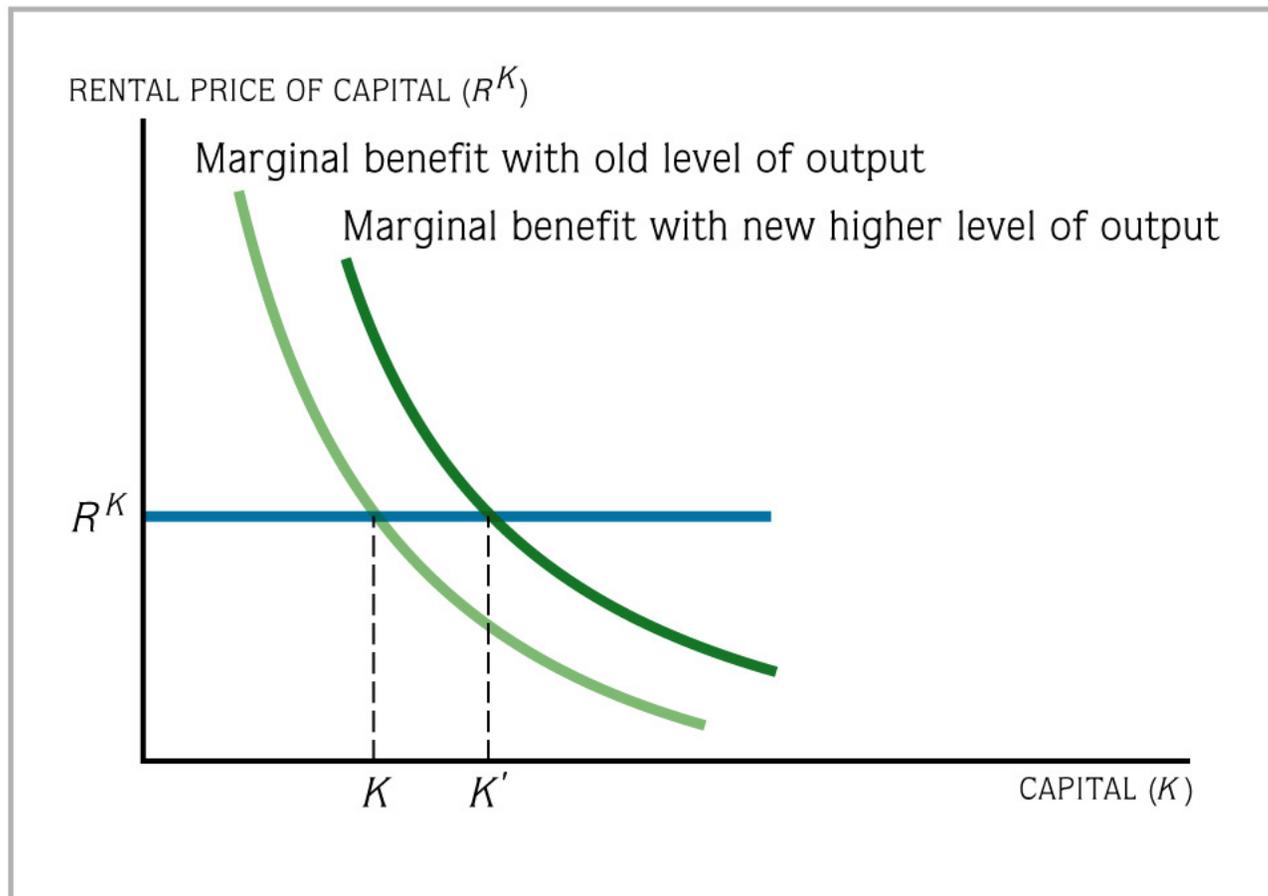
- The cost of renting out one machine for one year
- = (The rate of interest + The rate of depreciation) X  
The price of a new machine

# Numerical Example

- If the price of a word processor is \$1,000, the interest rate  $R = 0.05$ , and the depreciation rate  $d = 0.15$ , then the rental price is \$200 per year.
- If the renter does not have a monopoly in the rental market, the market rental price exactly equals the cost of renting.



**FIGURE 11.5** Choosing the Capital Stock



**FIGURE 11.6** Effect of Higher Output

# DEMAND FOR CAPITAL AND THE RENTAL PRICE

- The demand for capital declines if the rental price of capital rises. The rental price rises if the price of new equipment or the interest rate rises.
- The demand for capital rises if planned output rises.
- The demand for capital rises if the wage rises.

# The Rental Price and the Decision to Buy New Capital Goods

- *The firm uses capital up to the point where the marginal benefit of capital equals the rental price of capital.*
- An investment theory based on the equality of marginal benefit and rental price seems a reasonable approximation by which to deal with the aggregate economy

# Expected Changes in the Future Price of Capital

- What happens if the relative price of capital goods is expected to change?
  - The forward-looking aspects of the firm's investment decision now become important.
- $R^K = (R + d) P^K - \Delta P^K$ 
  - That is, the old formula in the total rental costs equation less the expected change in the price of capital equipment.

# Numerical Example

- For example, if the price is expected to fall from  $P^K = \$1,000$  to  $P^K_{+1} = \$950$  next year, the rental price would increase by \$50.

# Expected Changes in the Future Price of Capital

$$R^K = (R + d) P^K - \Delta P^K$$

- The same thing can be written more compactly as:

$$R^K = (R - \pi^K + d) P^K$$

- Where  $\pi^K$  is the expected percentage change in the relative price of capital equipment:

$$\square \pi^K = \Delta P^K / P^K$$

# 11.3 THE INVESTMENT FUNCTION

- The firm's **investment demand function** tells how much capital equipment the firm will purchase given its planned level of output and the rental price of capital.

# Desired Capital Stock ( $K^*$ )

- By adjusting the amount of capital, the marginal benefit can be brought into equality with the rental price.
- The result of this process is the firm's **desired capital stock**, which we call  $K^*$ .

# Desired Capital Stock ( $K^*$ )

- An example of an algebraic formula describing the desired capital stock is:

$$K^* = 0.5(W/R^K) Y$$

- $W$  is the wage rate
- $Y$  is the firm's level of output
- $R^K$  is the rental price of capital
- The formula says that the desired capital stock equals 0.5 times the ratio of the wage to the rental price of capital, times the level of output.

# Actual Capital Stock (K)

- If there is no depreciation, then the level of investment increases the capital stock by the amount of the investment
  - Investment equals the change in the capital stock:

$$I = K - K_{-1}$$

- If the firm wants its capital stock  $K$  to equal the desired capital stock  $K^*$ , then its investment demand  $I$  during the year is:

$$I = K^* - K_{-1}$$

# Investment Function

- The investment function for the example formula for the desired capital stock  $K^*$  can be written out as:

$$I = 0.5(W/R^k)Y - K_{-1}$$

- *Investment depends positively on the wage rate, negatively on the rental price of capital, and positively on output.*
- The effect of output on investment is called the **accelerator**.

# Investment Function

- If  $v = 0.5(W/R^K)$ , then:

$$K = vY \quad \text{and} \quad K_{-1} = vY_{-1}$$

$$I = vY - vY_{-1} = v\Delta Y$$

- In words, the *level* of investment  $I$  depends on the *change* in output delta  $Y$ .

# Lags in the Investment Process

- For many projects, there is a **lag** of several years between the firm's realization that new capital is needed and the completion of the capital installation.
- Suppose that firms change their capital stock by a fraction  $s$  of the difference between the desired capital stock and the capital stock at the end of the last year:

$$I = s(K^* - K_{-1})$$

# 11.4 TAXES AND INVESTMENT

- Taxation of capital tends to discourage investment by reducing the earnings the firm receives from its investment.
- This effect of taxation can readily be incorporated into the rental price formula.

# Permanent Tax Changes

- We can modify our rental price deviation to account for taxes by equating the after-tax rental income to the after-tax costs of renting.
- $(1-u)R^K = (R+d) (1-z) P^K$  (11.10)
- Dividing by  $1 - u$  gives

$$R^K = \frac{(R + d)(1 - z)P^K}{1 - u} \quad (11.11)$$

## 11.5 RESIDENTIAL INVESTMENT

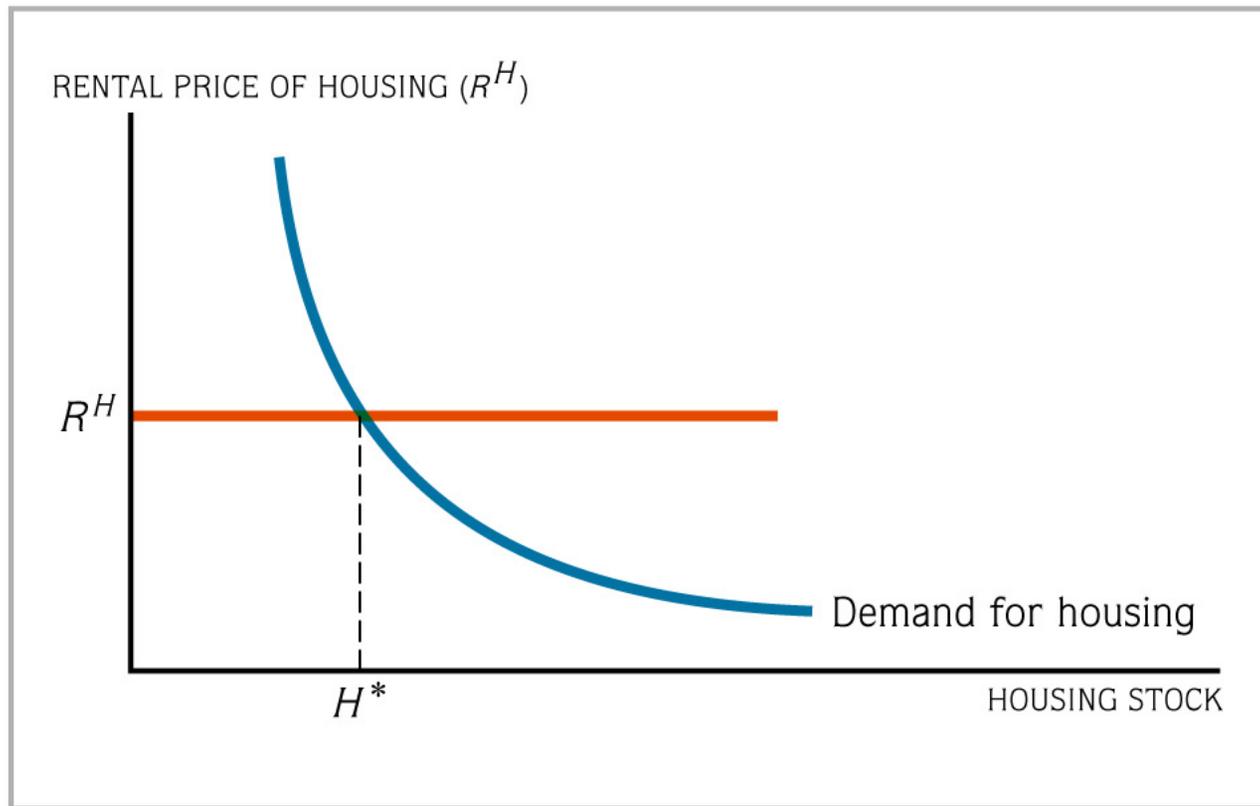
- The economic theory of residential investment can be approached in much the same way as the theory of business investment.
- $R^H = (R - \pi^H + d^H) P^H$

Where  $\pi^H = \Delta P^H / P^H$ ,  $d^H$  very small

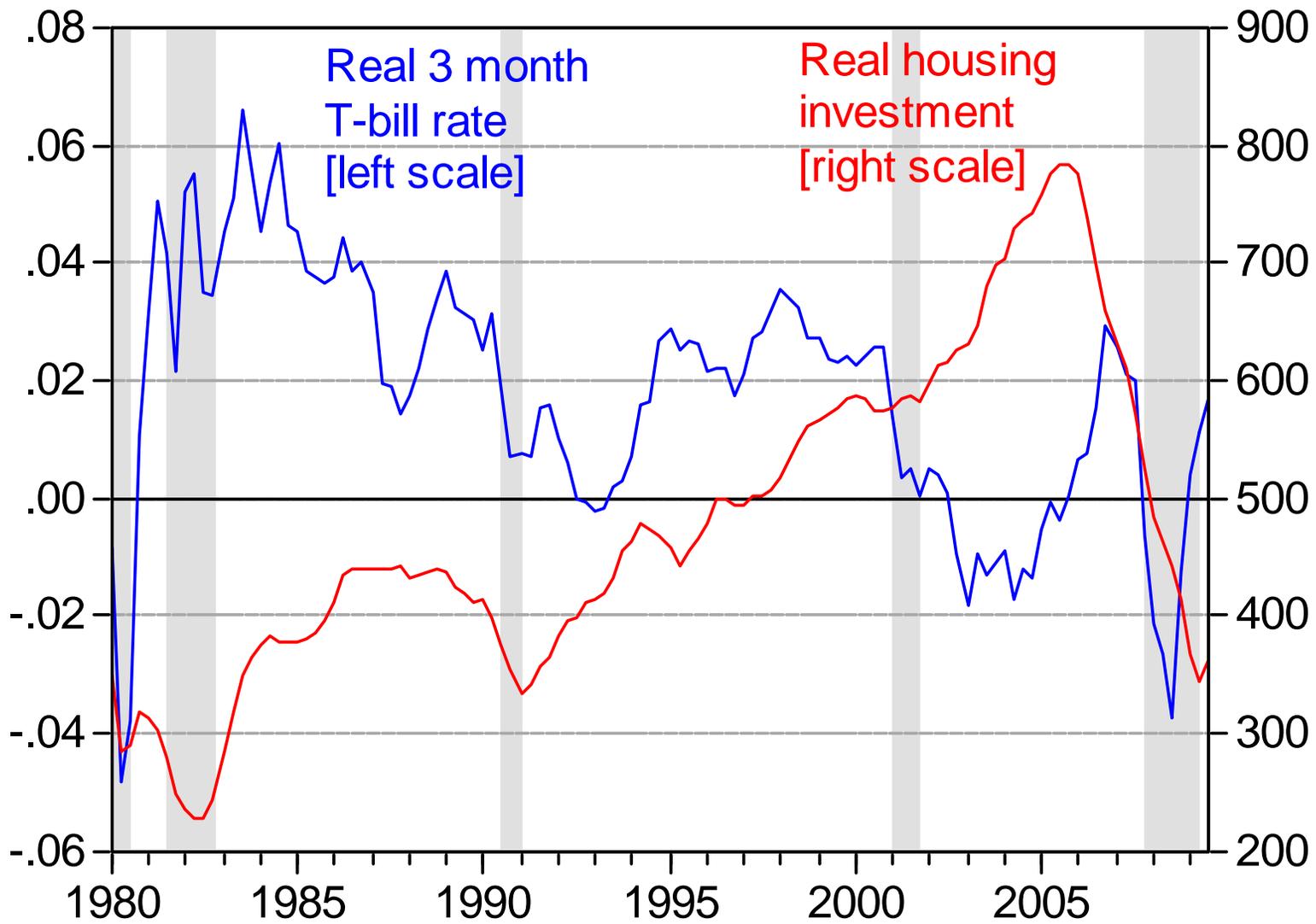
- $I = K^* - K_{-1}$

# HOUSING INVESTMENT

- Housing investment is negatively related to the interest rate.
- Housing investment is positively related to real GDP.
- Housing is the component of investment most sensitive to monetary policy through interest rates.
  - Because housing depreciates so slowly, its rental price is dominated by interest cost.

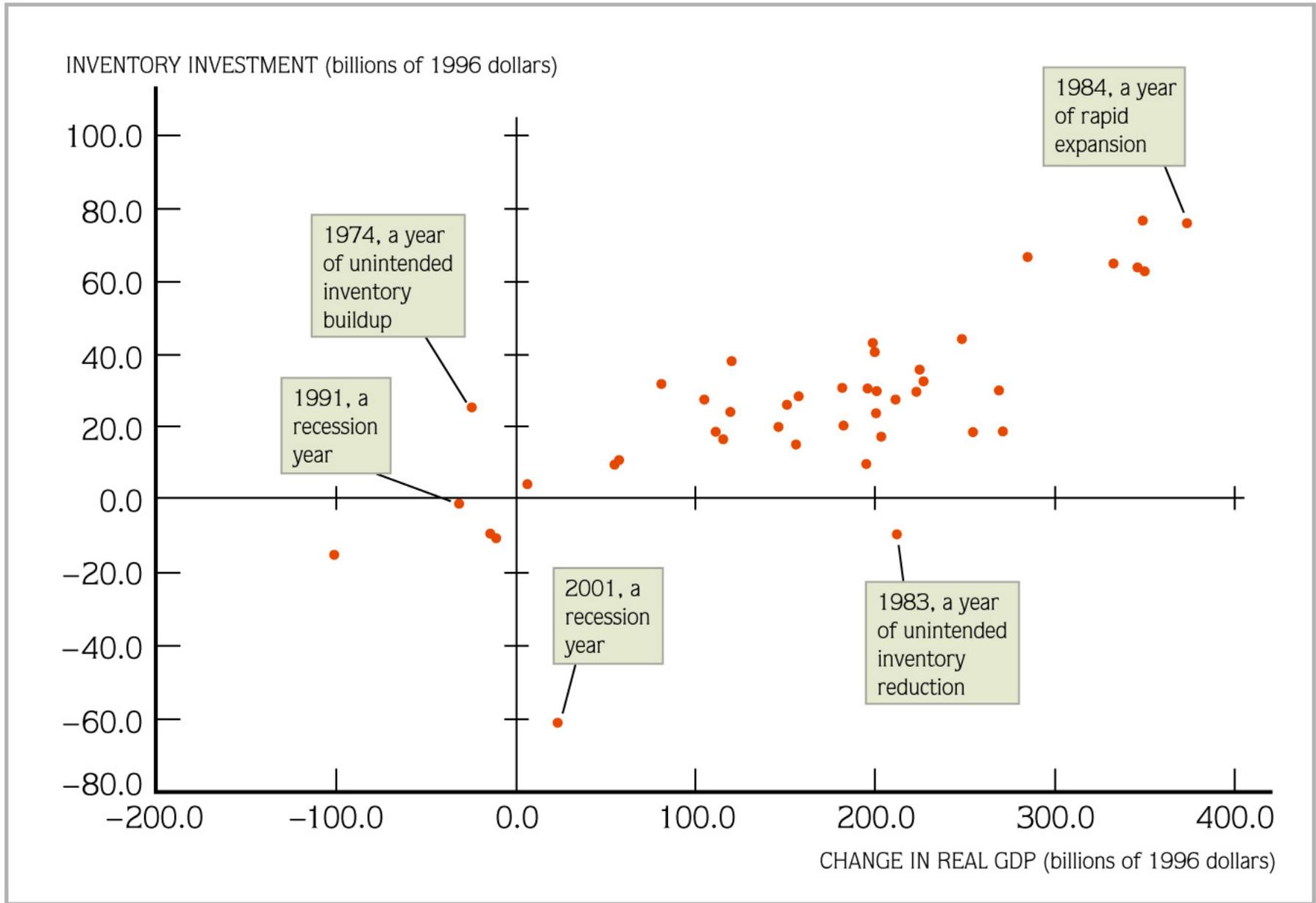


**FIGURE 11.7** Determination of the Desired Housing Stock



# 11.6 INVENTORY INVESTMENT

- Inventories are stocks of goods in the process of production and also finished goods waiting to be sold.
- What benefits do inventories provide the firm?
  - inventories are an intrinsic part of the physical production process (**pipeline function**).
  - maintain a **buffer stock** to accommodate unexpected changes in demand.



**FIGURE 11.8** Inventory Investment and the Change in GDP