Economics 302
Intermediate Macroeconomic Theory and Policy
(Fall 2010)

Lecture 19-21

November 15, 20, 2010

Outline: Investment

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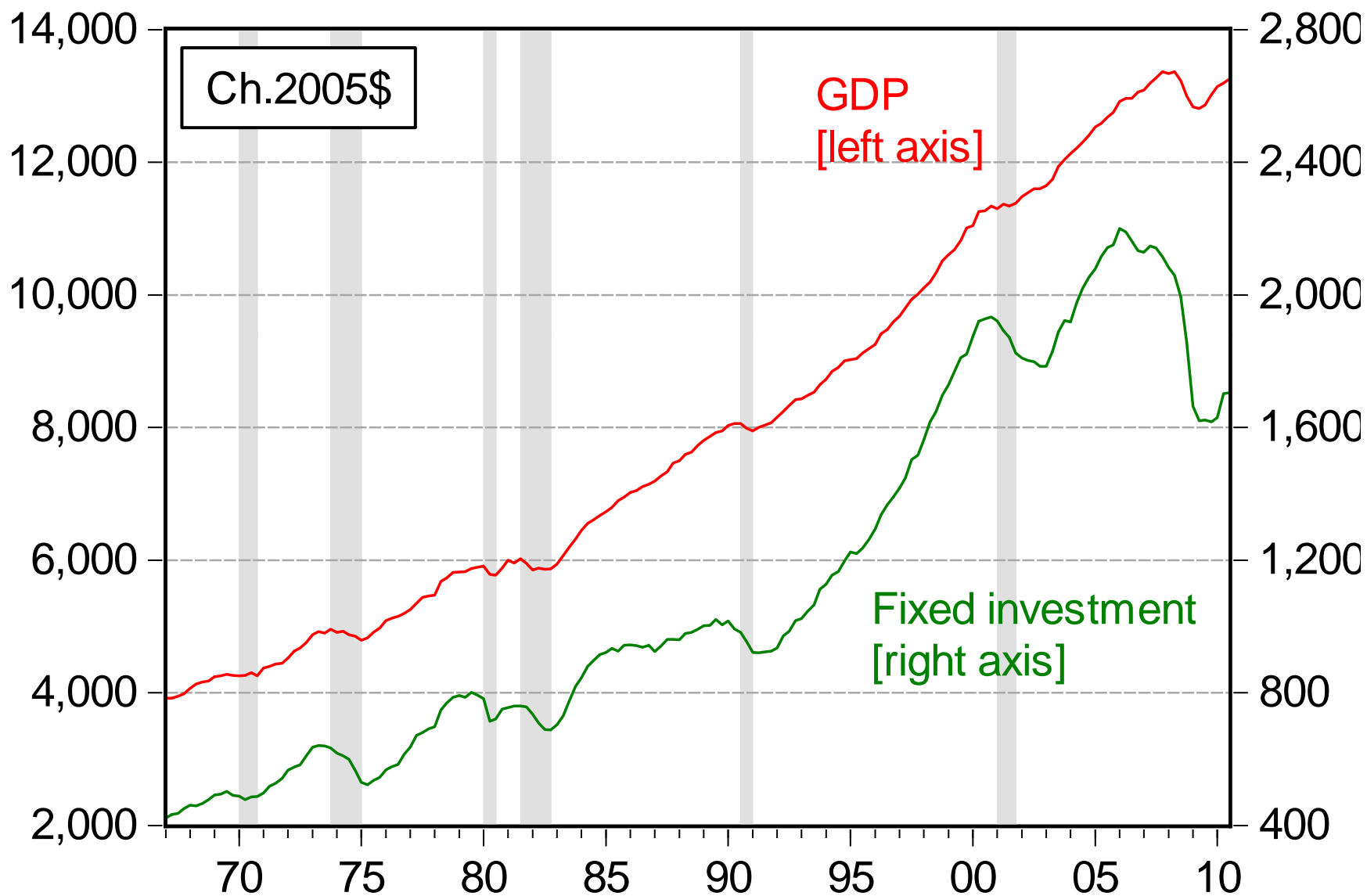- Inventory investment

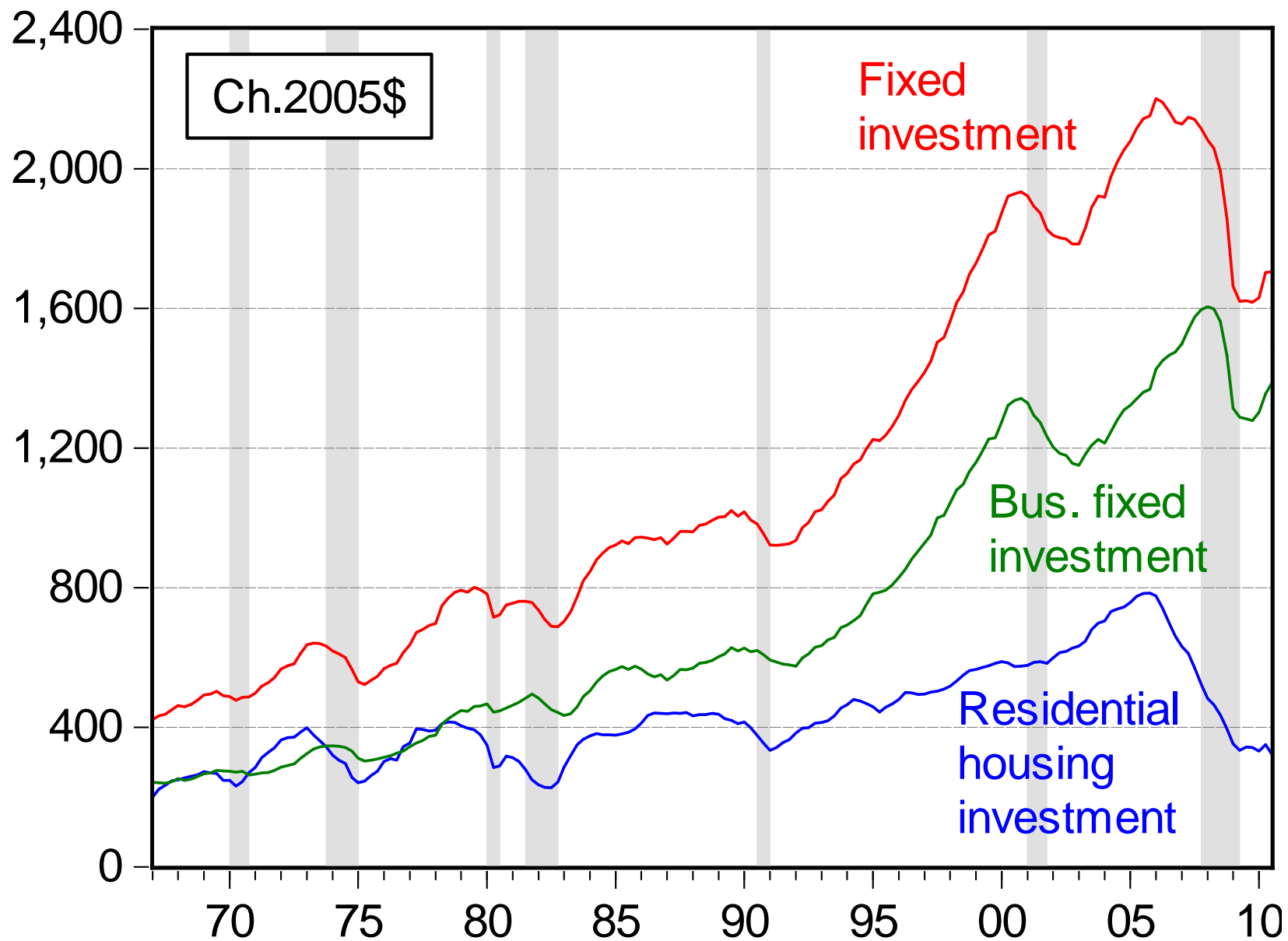# Figure 11.1: Fixed Investment and GDP

Ch.2005$

GDP
[left axis]

Fixed investment
[right axis]

Figure 11.2: Housing versus Factories and Equipment

Ch.2005$

Fixed investment

Bus. fixed investment

Residential housing investment

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.
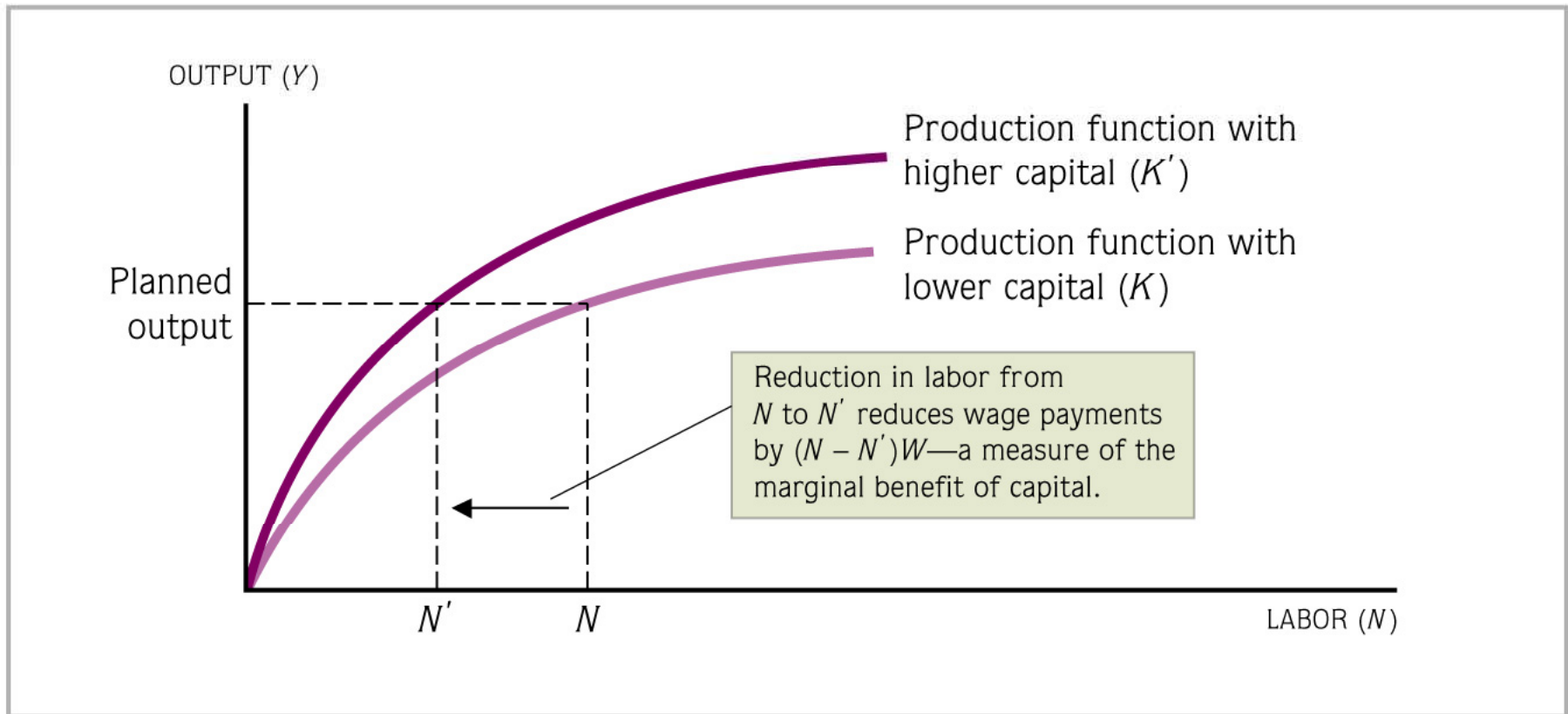- Declines in housing investment lead the declines in the overall economy.

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.

OUTPUT (Y)

Planned
output

Production function with
higher capital (K')

Production function with
lower capital (K)

Reduction in labor from
N to N' reduces wage payments
by $(N - N')W$—a measure of the
marginal benefit of capital.

N' N

LABOR (N)

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

RENTAL PRICE OF CAPITAL (R^K)

Marginal benefit of capital
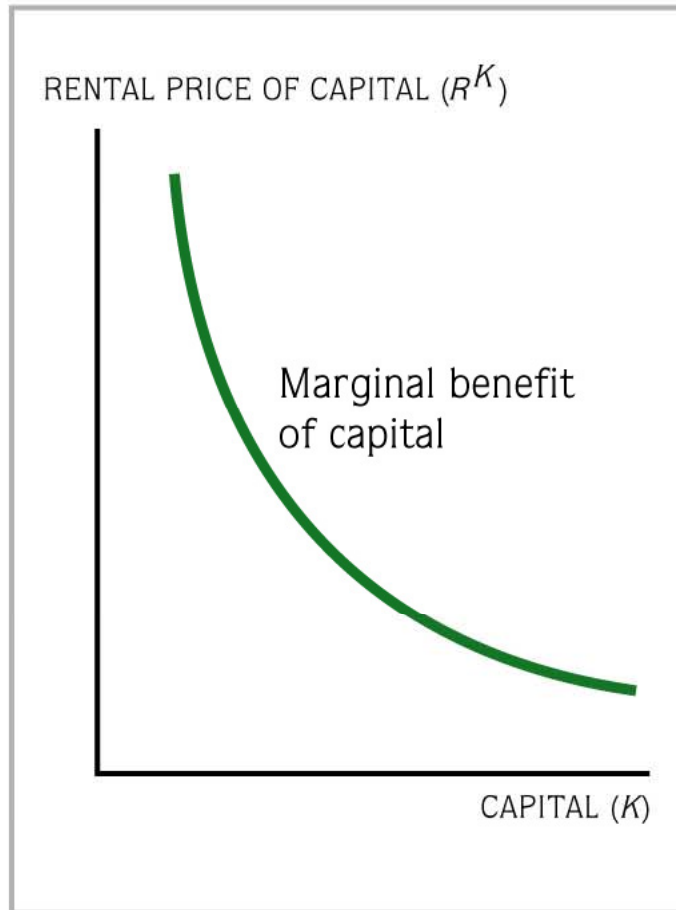
CAPITAL (K)

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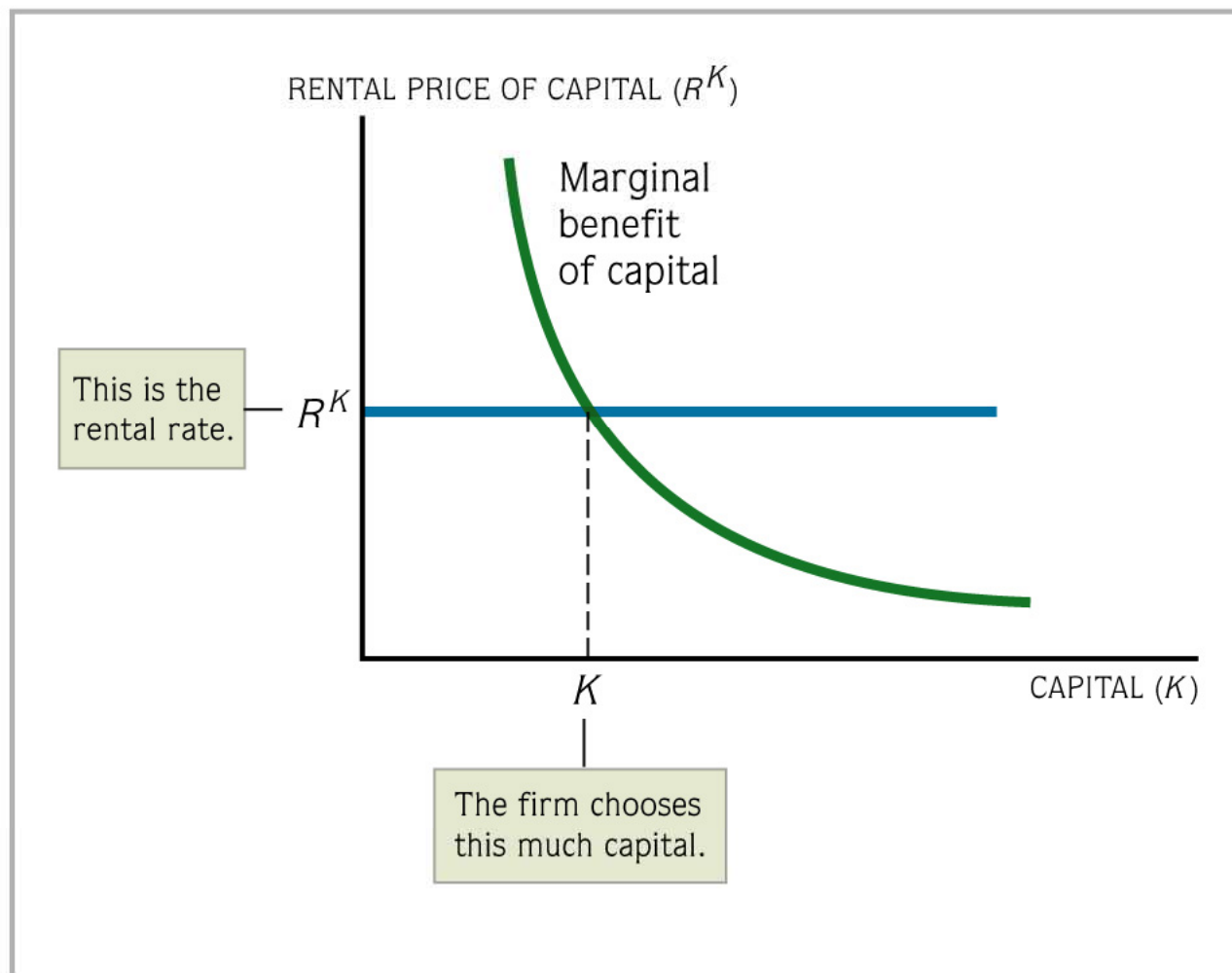
The Rental Price of Capital

- How would the market set the rental price of capital?
- Total rental costs are:
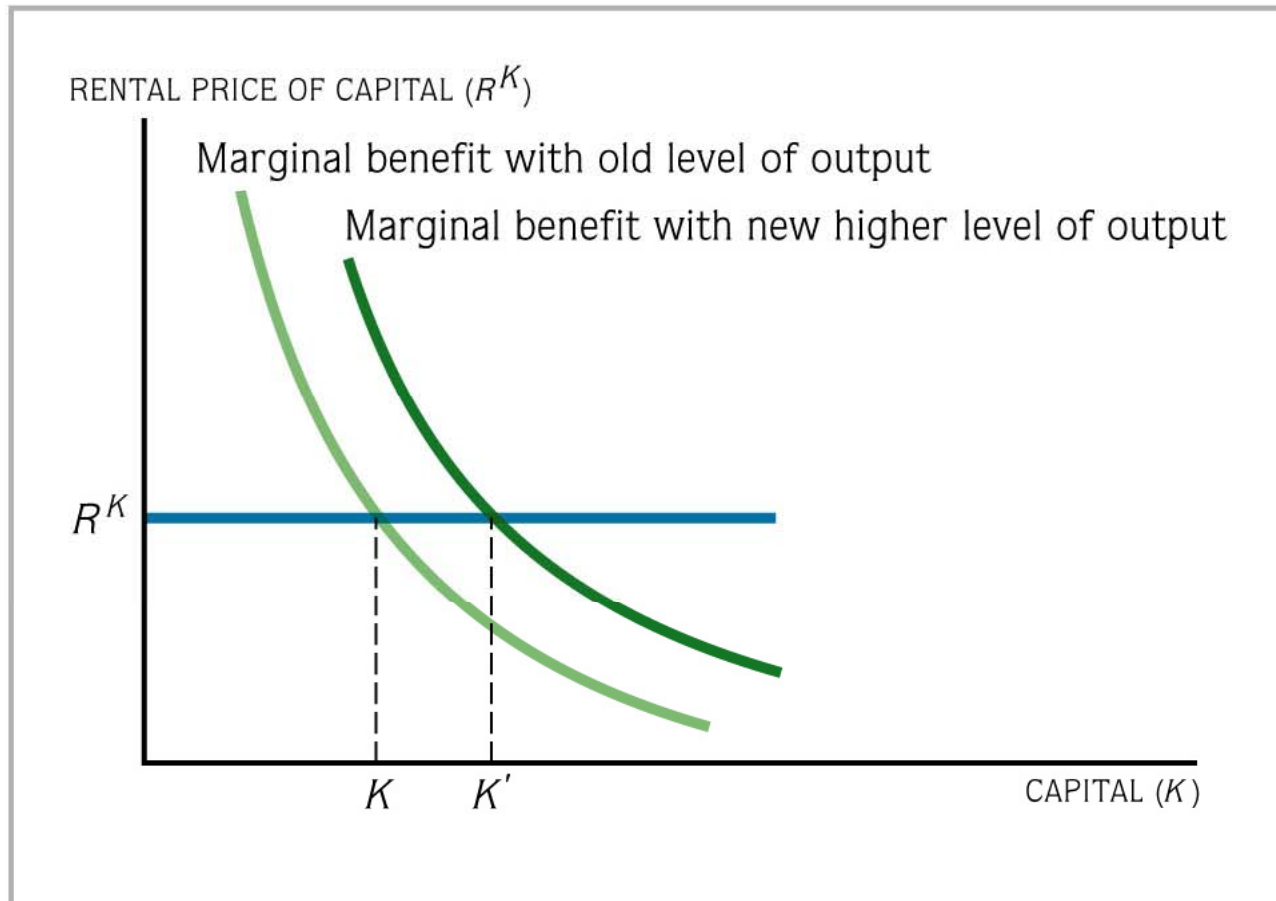
$$R^K = (R + d) \, P^K$$

  - 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.

RENTAL PRICE OF CAPITAL (R^K)

Marginal benefit of capital

This is the rental rate.

R^K

The firm chooses this much capital.

K

CAPITAL (K)

FIGURE 11.5 **Choosing the Capital Stock**

RENTAL PRICE OF CAPITAL (R^K)

Marginal benefit with old level of output

Marginal benefit with new higher level of output

R^K

K K'

CAPITAL (K)

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.

- $R^K = (R + d)\ P^K - \varDelta P^K$
    - 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 π^K is the expected percentage change in the relative price of capital equipment:

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

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

$$R^K = \frac{(R+d)(1-z)P^K}{1-u} \qquad (11.11)$$
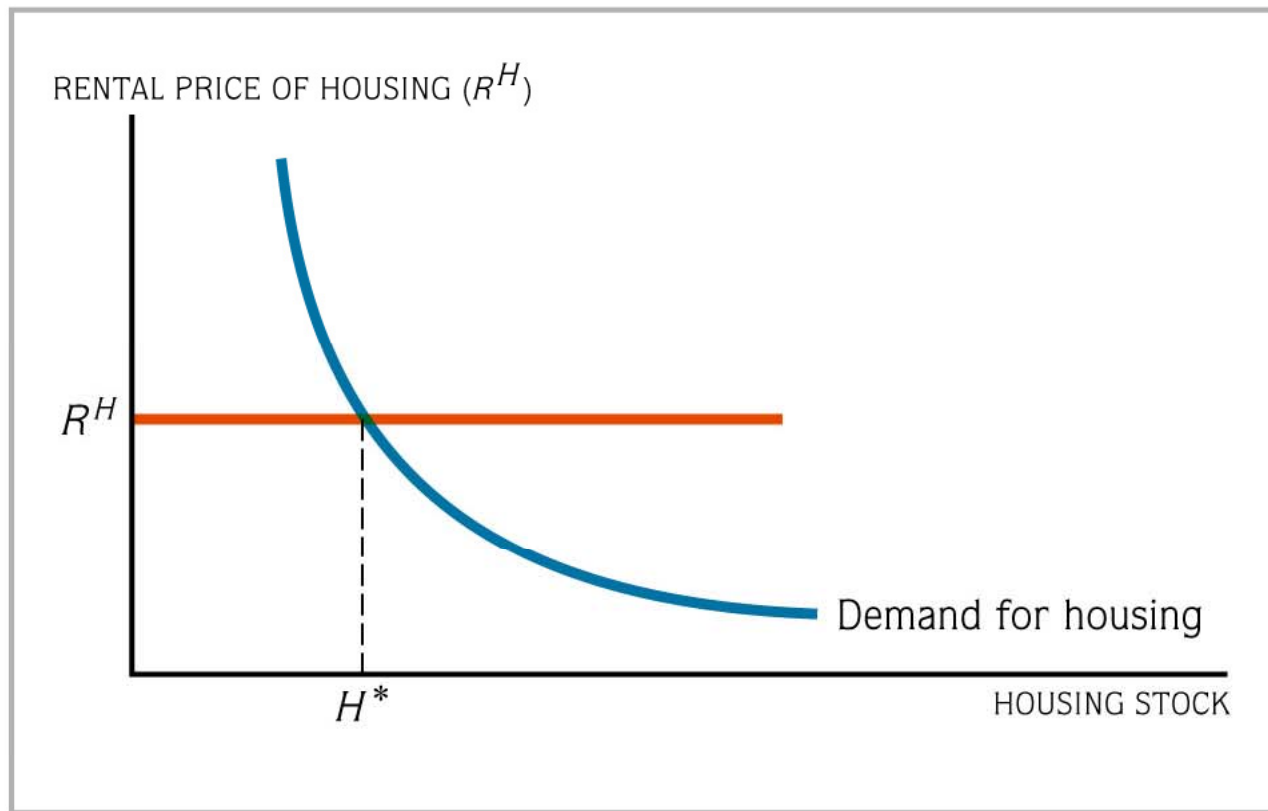
11.5 RESIDENTIAL INVESTMENT

- The economic theory of residential investment can be approached in much the same way as the theory of business investment.

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

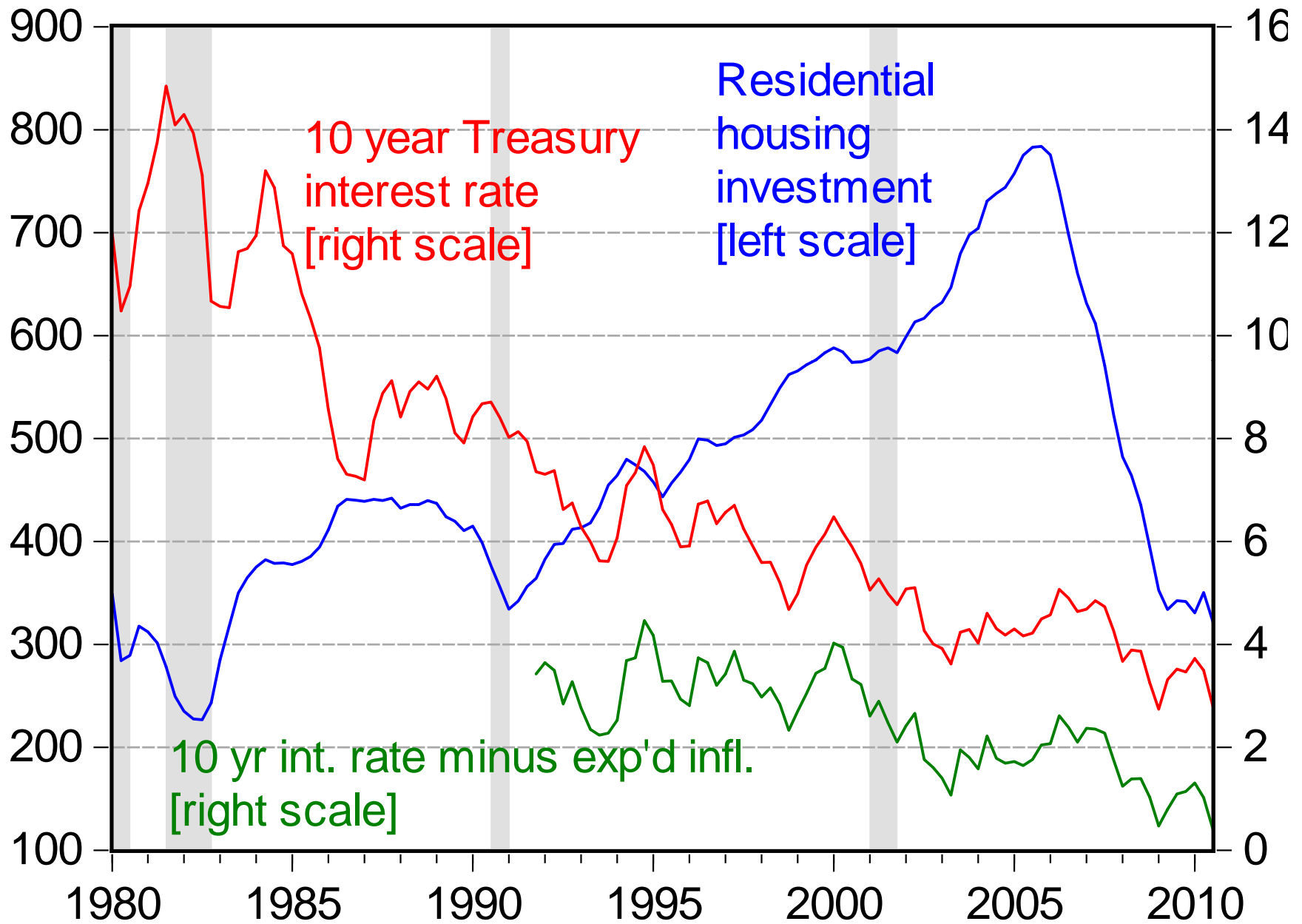Where $\pi^H = \Delta P^H / P^H$, d^H very small

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

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.

RENTAL PRICE OF HOUSING (R^H)

R^H

Demand for housing

H^*

HOUSING STOCK

FIGURE 11.7 Determination of the Desired Housing Stock

10 year Treasury interest rate [right scale]

Residential housing investment [left scale]

10 yr int. rate minus exp'd infl. [right scale]

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.

INVENTORY INVESTMENT (billions of 1996 dollars)

1984, a year of rapid expansion

1974, a year of unintended inventory buildup

1991, a recession year

2001, a recession year

1983, a year of unintended inventory reduction

CHANGE IN REAL GDP (billions of 1996 dollars)
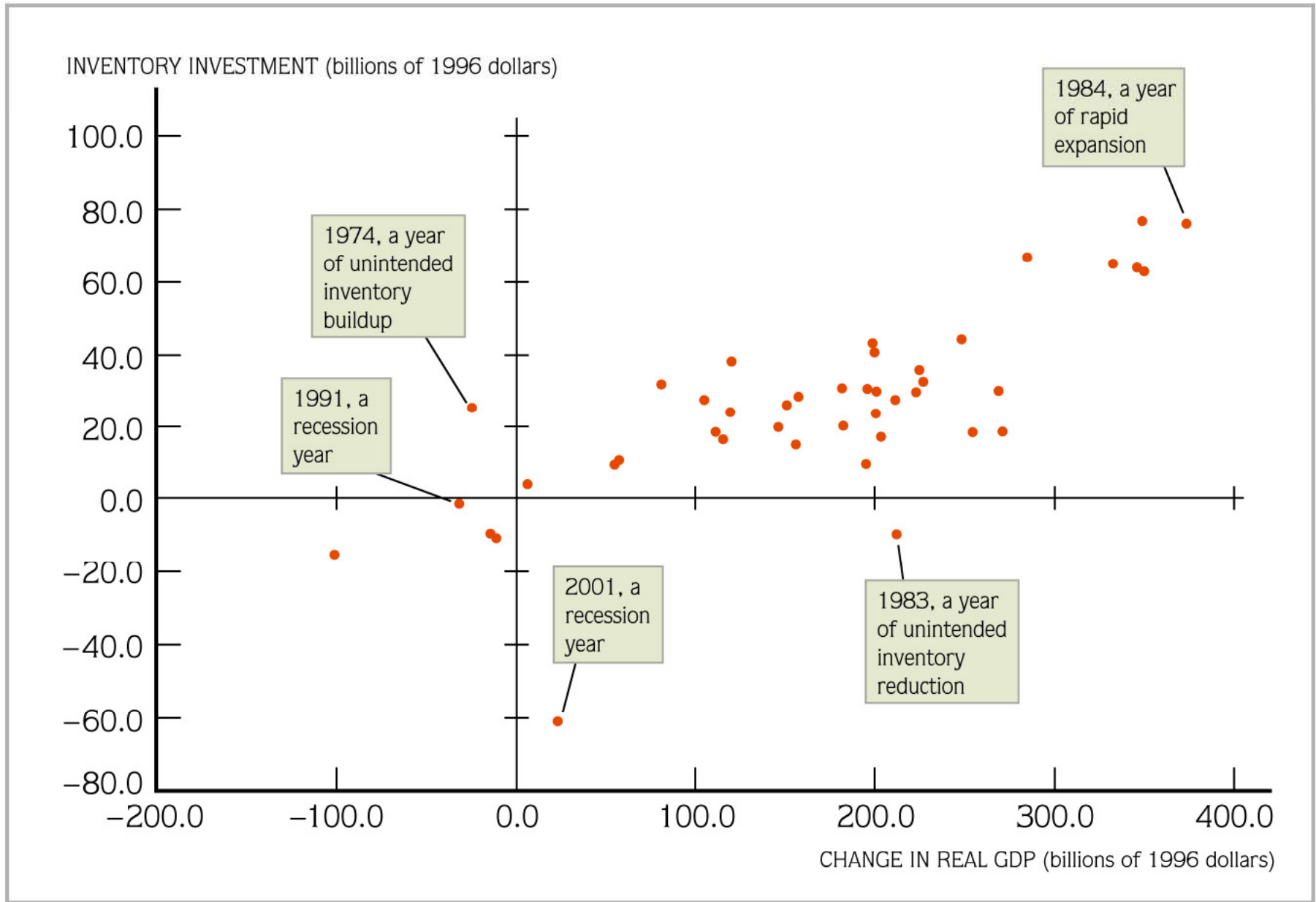
FIGURE 11.8 Inventory Investment and the Change in GDP

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