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# MACROECONOMICS

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## The Theory of Investment

# IN THIS CHAPTER, YOU WILL LEARN:

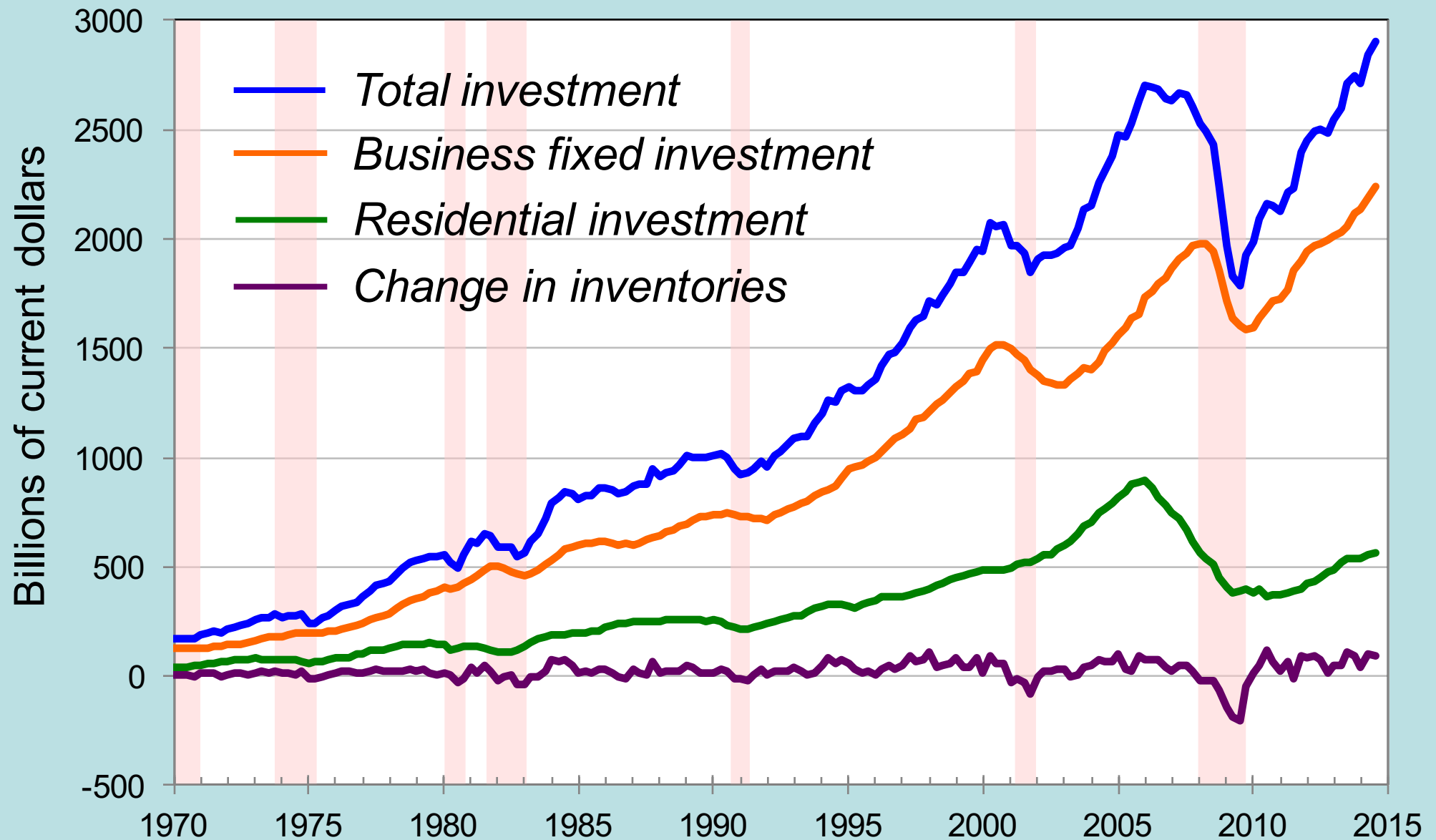
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- leading theories to explain each type of investment
- why investment is negatively related to the interest rate
- things that shift the investment function
- why investment rises during booms and falls during recessions

# Three types of investment

- **Business fixed investment:**  
businesses' spending on equipment and structures for use in production.
- **Residential investment:**  
purchases of new housing units  
(either by occupants or landlords).
- **Inventory investment:**  
the value of the change in inventories  
of finished goods, materials and supplies,  
and work in progress.

# U.S. Investment and its components, 1970–2014



# Understanding business fixed investment

- The standard model of business fixed investment:  
the **neoclassical model of investment**
- Shows how investment depends on:
  - *MPK*
  - interest rate
  - tax rules affecting firms

# Two types of firms

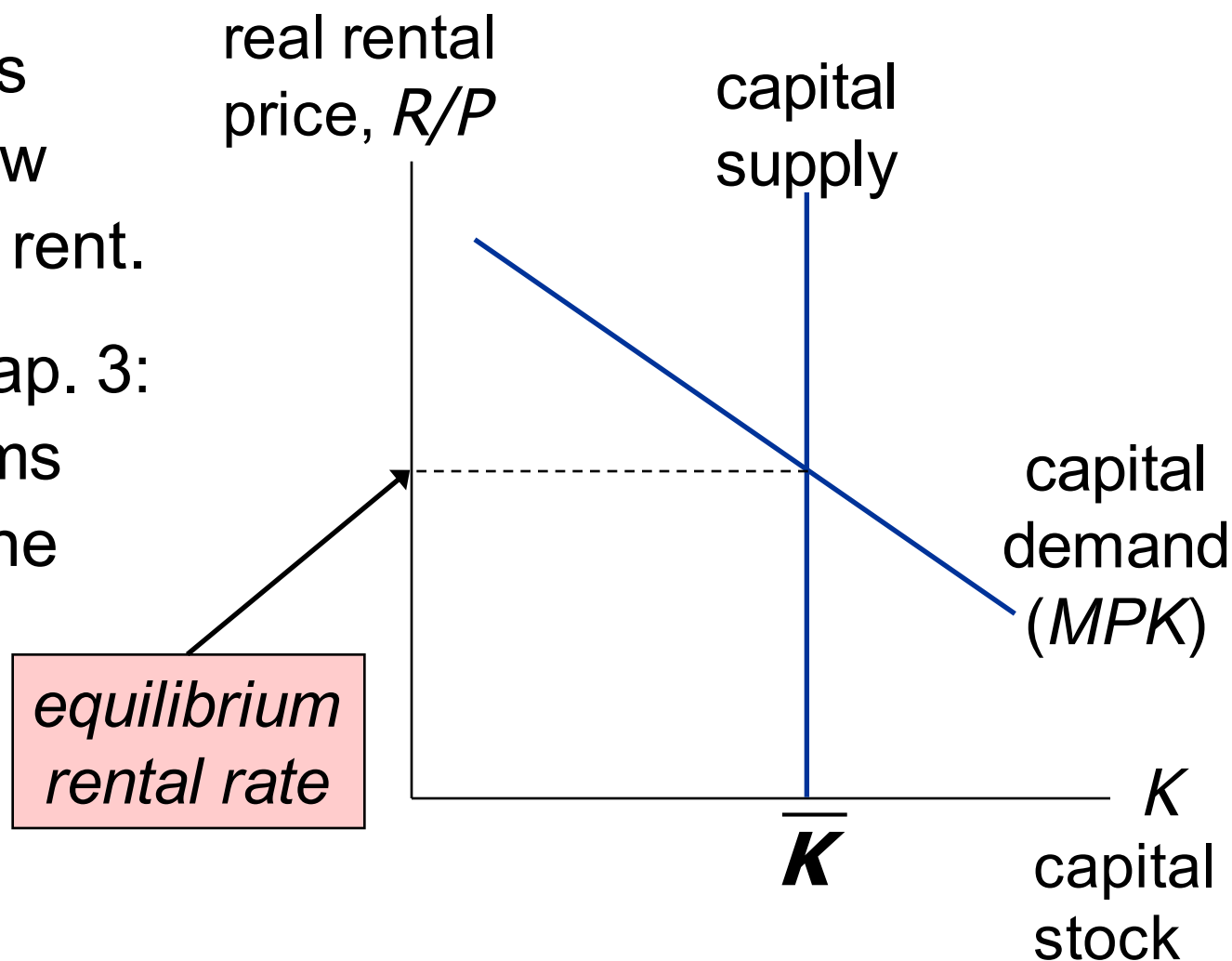
- For simplicity, assume two types of firms:
  1. **Production firms** rent the capital they use to produce goods and services.
  2. **Rental firms** own capital, rent it to production firms.

*In this context,  
“investment” is the rental firms’  
spending on new capital goods.*

# The capital rental market

Production firms must decide how much capital to rent.

Recall from Chap. 3:  
Competitive firms rent capital to the point where  $MPK = R/P$ .



# Factors that affect the rental price

For the Cobb-Douglas production function,

$$Y = AK^\alpha L^{1-\alpha}$$

the  $MPK$  (and hence equilibrium  $R/P$ ) is

$$\frac{R}{P} = MPK = \alpha A (L/K)^{1-\alpha}$$

The equilibrium  $R/P$  would increase if:

- $\downarrow K$  (e.g., earthquake or war)
- $\uparrow L$  (e.g., pop. growth or immigration)
- $\uparrow A$  (technological improvement or deregulation)



# Rental firms' investment decisions

- Rental firms invest in new capital when the benefit of doing so exceeds the cost.
- The benefit (per unit capital):  
 *$R/P$* , the income that rental firms earn from renting the unit of capital to production firms.

# The cost of capital

Components of the cost of capital:

*interest cost:*  $i \times P_K$ ,

where  $P_K$  = nominal price of capital

*depreciation cost:*  $\delta \times P_K$ ,

where  $\delta$  = rate of depreciation

*capital loss:*  $-\Delta P_K$

(a capital gain,  $\Delta P_K > 0$ , reduces cost of  $K$ )

Add these three parts to get the total cost of capital:

# The cost of capital

$$\begin{array}{l} \text{Nominal cost} \\ \text{of capital} \end{array} = i P_K + \delta P_K - \Delta P_K = P_K \left( i + \delta - \frac{\Delta P_K}{P_K} \right)$$

**Example: car rental company** (capital: cars)

Suppose  $P_K = \$10,000$ ,  $i = 0.10$ ,  $\delta = 0.20$ ,  
and  $\Delta P_K / P_K = 0.06$

Then, interest cost = \$1000

depreciation cost = 2000

capital loss = -600

total cost = \$2400

# The cost of capital

For simplicity, assume  $\Delta P_K / P_K = \pi$ .

Then, the nominal cost of capital equals

$$P_K(i + \delta - \pi) = P_K(r + \delta)$$

and the real cost of capital equals  $\frac{P_K}{P}(r + \delta)$

The real cost of capital depends positively on:

- the relative price of capital
- the real interest rate
- the depreciation rate

# The rental firm's profit rate

A firm's net investment depends on its profit rate:

$$\text{Profit rate} = \frac{R}{P} - \frac{P_K}{P}(r + \delta) = \mathbf{MPK} - \frac{P_K}{P}(r + \delta)$$

- If profit rate  $> 0$ ,  
then increasing  $K$  is profitable
- If profit rate  $< 0$ , then the firm increases profits by  
reducing its capital stock  
(*i.e.*, not replacing capital as it depreciates)

# Net investment & gross investment

Hence,

$$\text{net investment} = \Delta \mathbf{K} = \mathbf{I}_n \left[ \mathbf{MPK} - (\mathbf{P}_K / \mathbf{P})(\mathbf{r} + \delta) \right]$$

where  $\mathbf{I}_n[ ]$  is a function that shows how net investment responds to the incentive to invest.

Total spending on business fixed investment equals net investment plus replacement of depreciated  $\mathbf{K}$ :

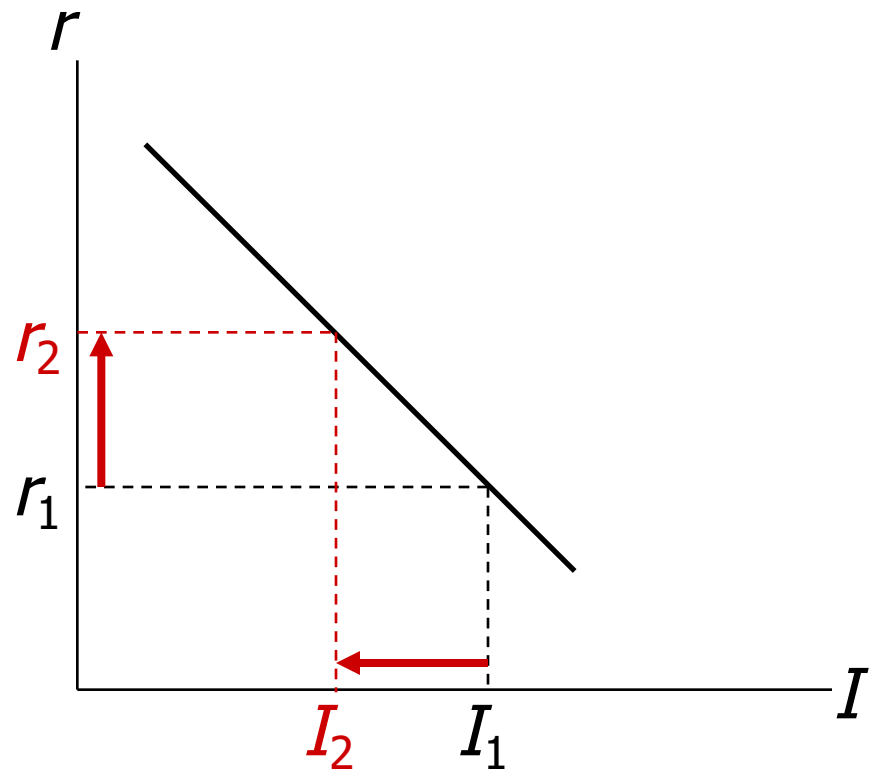
$$\begin{aligned} \text{gross investment} &= \Delta \mathbf{K} + \delta \mathbf{K} \\ &= \mathbf{I}_n \left[ \mathbf{MPK} - (\mathbf{P}_K / \mathbf{P})(\mathbf{r} + \delta) \right] + \delta \mathbf{K} \end{aligned}$$

# The investment function

$$\mathbf{I = I_n \left[ MPK - (P_K / P)(r + \delta) \right] + \delta K}$$

An increase in  $r$ :

- raises the cost of capital
- reduces the profit rate
- and reduces investment

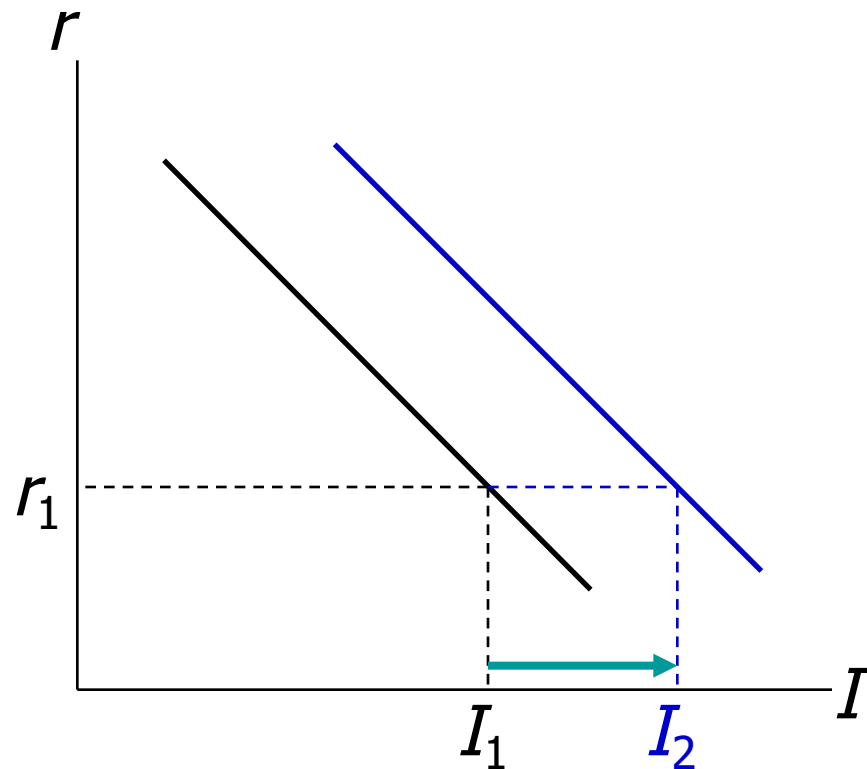


# The investment function

$$\mathbf{I} = \mathbf{I}_n \left[ \mathbf{MPK} - (\mathbf{P}_K / \mathbf{P})(\mathbf{r} + \delta) \right] + \delta \mathbf{K}$$

An increase in  $MPK$   
or decrease in  $P_K/P$

- increases the profit rate
- increases investment at any given interest rate
- shifts  $\mathbf{I}$  curve to the right





# Taxes and investment

Two of the most important tax policies affecting investment:

1. Corporate income tax
2. Investment tax credit

# Corporate income tax: A tax on profits

Impact on investment depends on definition of “profit.”

- In our definition (rental price minus cost of capital), depreciation cost is measured using current price of capital, and the CIT would not affect investment.
- But, the legal definition uses the historical price of capital.
- If  $P_K$  rises over time, then the legal definition understates the true cost and overstates profit, so firms could be taxed even if their true economic profit is zero.

Thus, corporate income tax discourages investment.

# The Investment Tax Credit (ITC)

- The ITC reduces a firm's taxes by a certain amount for each dollar it spends on capital.
- Hence, the ITC effectively reduces  $P_K$ , which increases the profit rate and the incentive to invest.

# Tobin's $q$

$$q = \frac{\text{Market value of installed capital}}{\text{Replacement cost of installed capital}}$$

- numerator: the stock market value of the economy's capital stock.
- denominator: the actual cost to replace the capital goods that were purchased when the stock was issued.
- If  $q > 1$ , firms buy more capital to raise the market value of their firms.
- If  $q < 1$ , firms do not replace capital as it wears out.

# Relation between $q$ theory and neoclassical theory

$$q = \frac{\text{Market value of installed capital}}{\text{Replacement cost of installed capital}}$$

- The stock market value of capital depends on the current & expected future profits of capital.
- If  $MPK > \text{cost of capital}$ , then profit rate is high, which drives up the stock market value of the firms, which implies a high value of  $q$ .
- If  $MPK < \text{cost of capital}$ , then firms are incurring losses, so their stock market values fall, so  $q$  is low.

# The stock market and GDP

*Reasons for a relationship between the stock market and GDP:*

1. A wave of pessimism about future profitability of capital would:
  - cause stock prices to fall
  - cause Tobin's  $q$  to fall
  - shift the investment function down
  - cause a negative aggregate demand shock

# The stock market and GDP

*Reasons for a relationship between the stock market and GDP:*

2. A fall in stock prices would:
  - reduce household wealth
  - shift the consumption function down
  - cause a negative aggregate demand shock

# The stock market and GDP

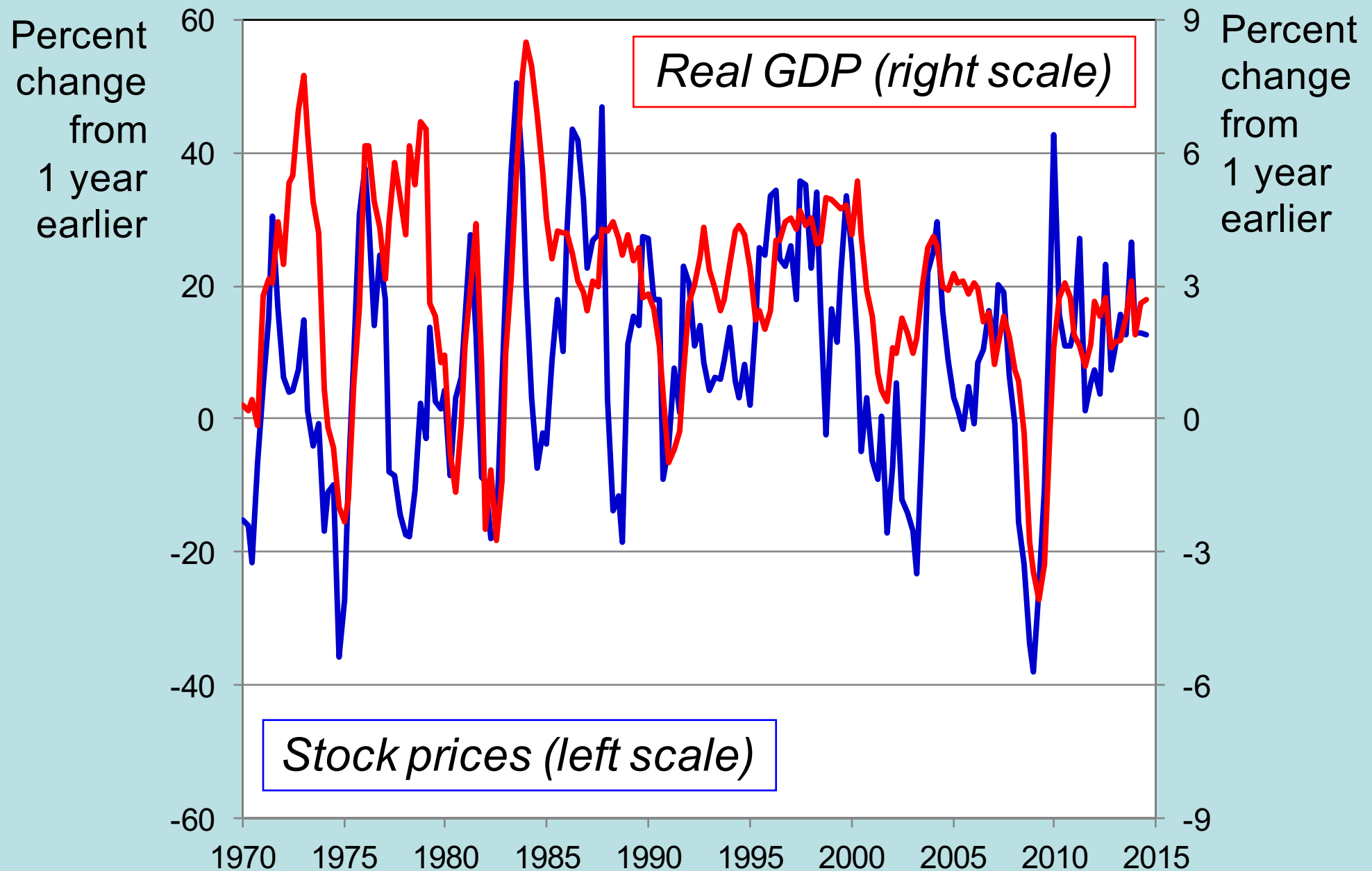
*Reasons for a relationship between the stock market and GDP:*

3. A fall in stock prices might reflect bad news about technological progress and long-run economic growth.

This implies that aggregate supply and full-employment output will be expanding more slowly than people had expected.



# The stock market and GDP



# Alternative views of the stock market:

## The efficient markets hypothesis

- **Efficient markets hypothesis (EMH):**  
The market price of a company's stock is the fully rational valuation of the company, given current information about the company's business prospects.
- Stock market is **informationally efficient**:  
each stock price reflects all available information about the stock.
- Implies that stock prices should follow a **random walk** (be unpredictable) and should only change as new information arrives.

# Alternative views of the stock market: Keynes's "beauty contest"

- Idea based on newspaper beauty contest in which a reader wins a prize if he or she picks the women most frequently selected by other readers as most beautiful.
- Keynes proposed that stock prices reflect people's views about what other people think will happen to stock prices; the best investors could outguess mass psychology.
- Keynes believed stock prices reflect irrational waves of pessimism/optimism ("animal spirits").

# **Alternative views of the stock market: EMH vs. Keynes's beauty contest**

Both views persist.

- There is evidence for the EMH and random-walk theory (*see p.508*).
- Yet, some stock market movements do not seem to rationally reflect new information.

# Financing constraints

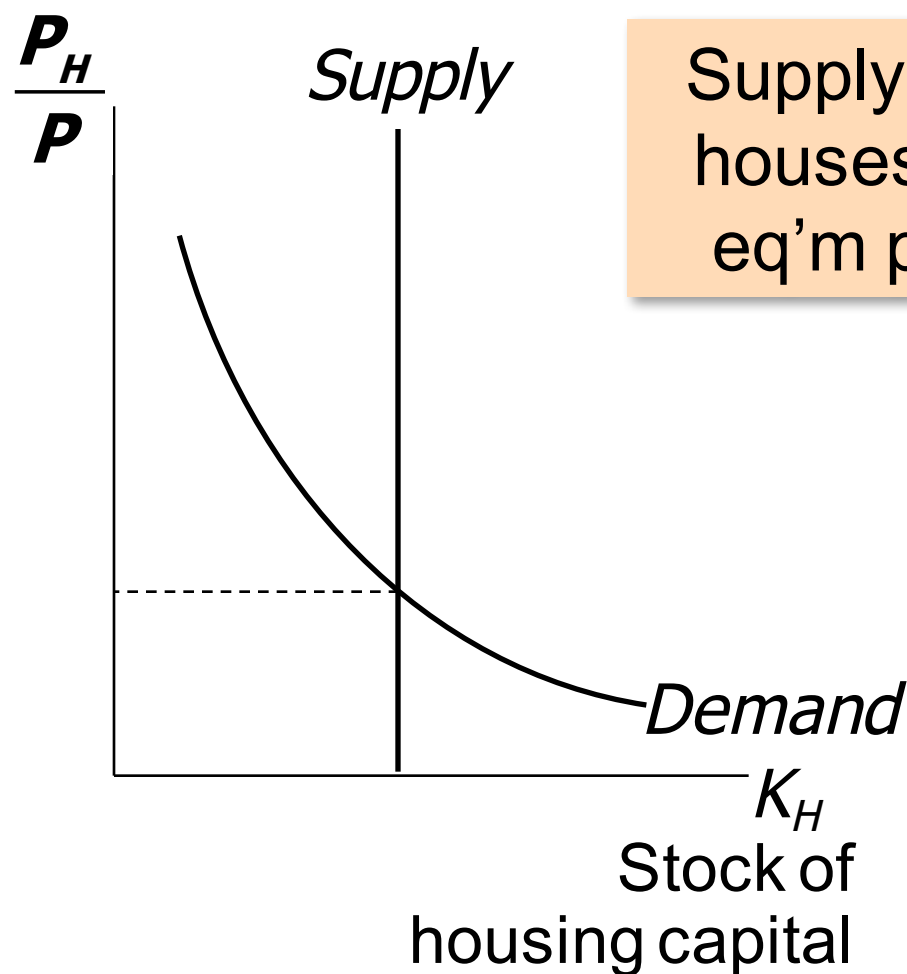
- Neoclassical theory assumes firms can borrow to buy capital whenever doing so is profitable.
- But some firms face **financing constraints**: limits on the amounts they can borrow (or otherwise raise in financial markets).
- A recession reduces current profits. If future profits expected to be high, investment might be worthwhile. But if firm faces financing constraints and current profits are low, firm might be unable to obtain funds.

# Residential investment

- The flow of new residential investment,  $I_H$ , depends on the relative price of housing  $P_H/P$ .
- $P_H/P$  determined by supply and demand in the market for existing houses.

# How residential investment is determined

(a) The market for housing

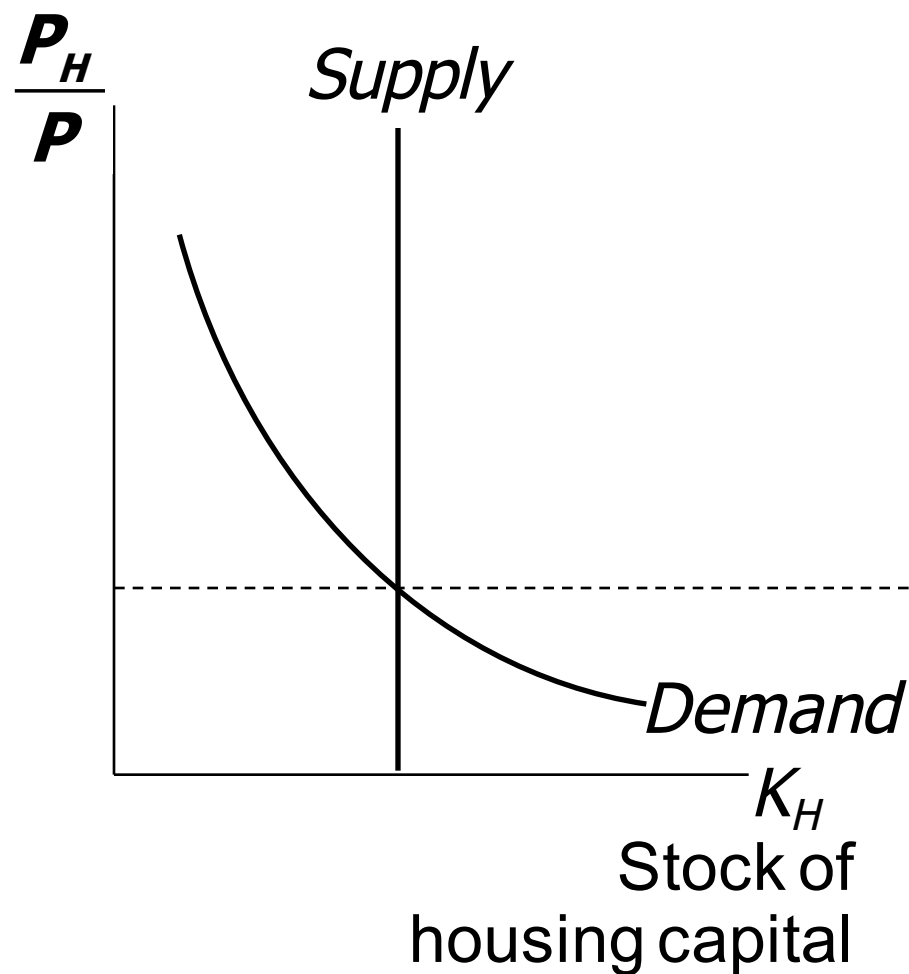


Supply and demand for houses determines the eq'm price of houses.

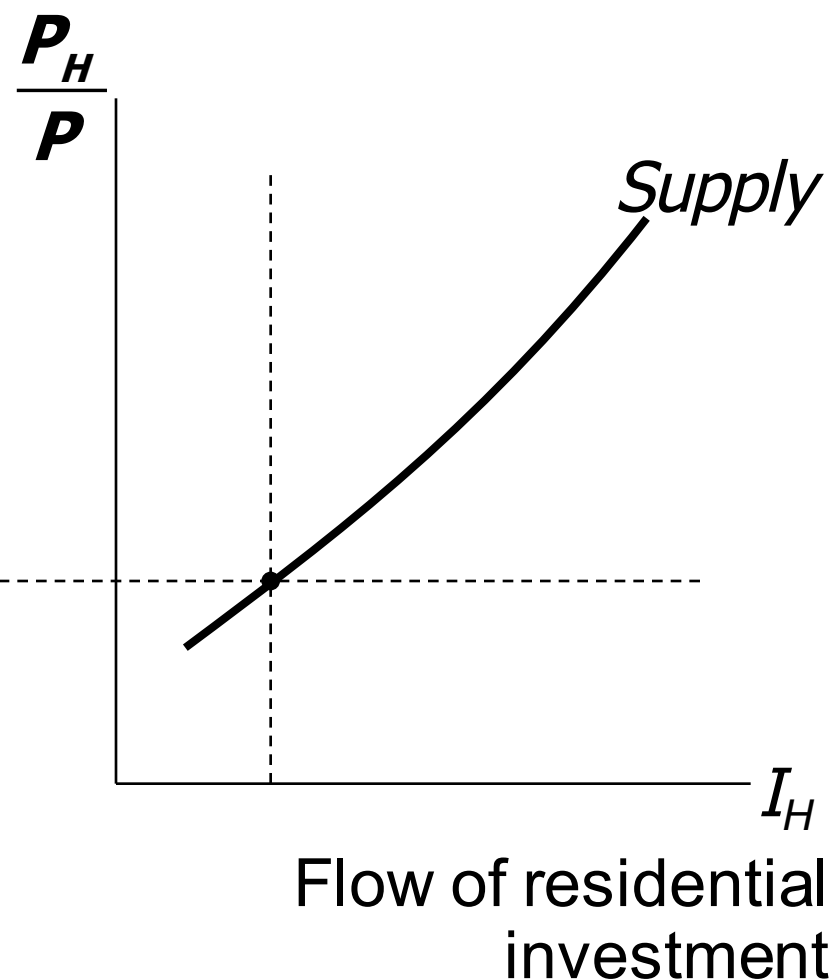
The equilibrium price of houses then determines residential investment:

# How residential investment is determined

(a) The market for housing



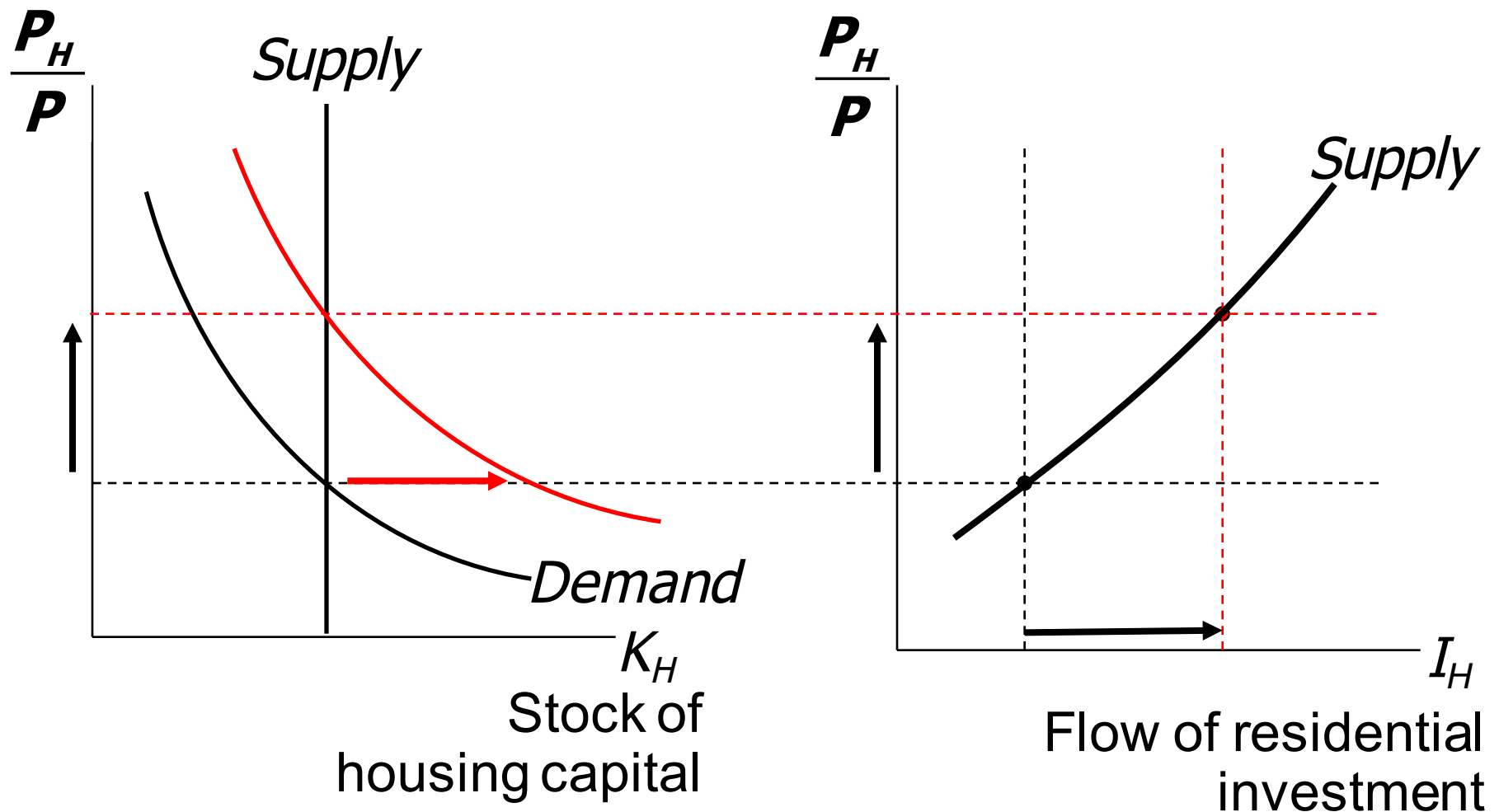
(b) The supply of new housing



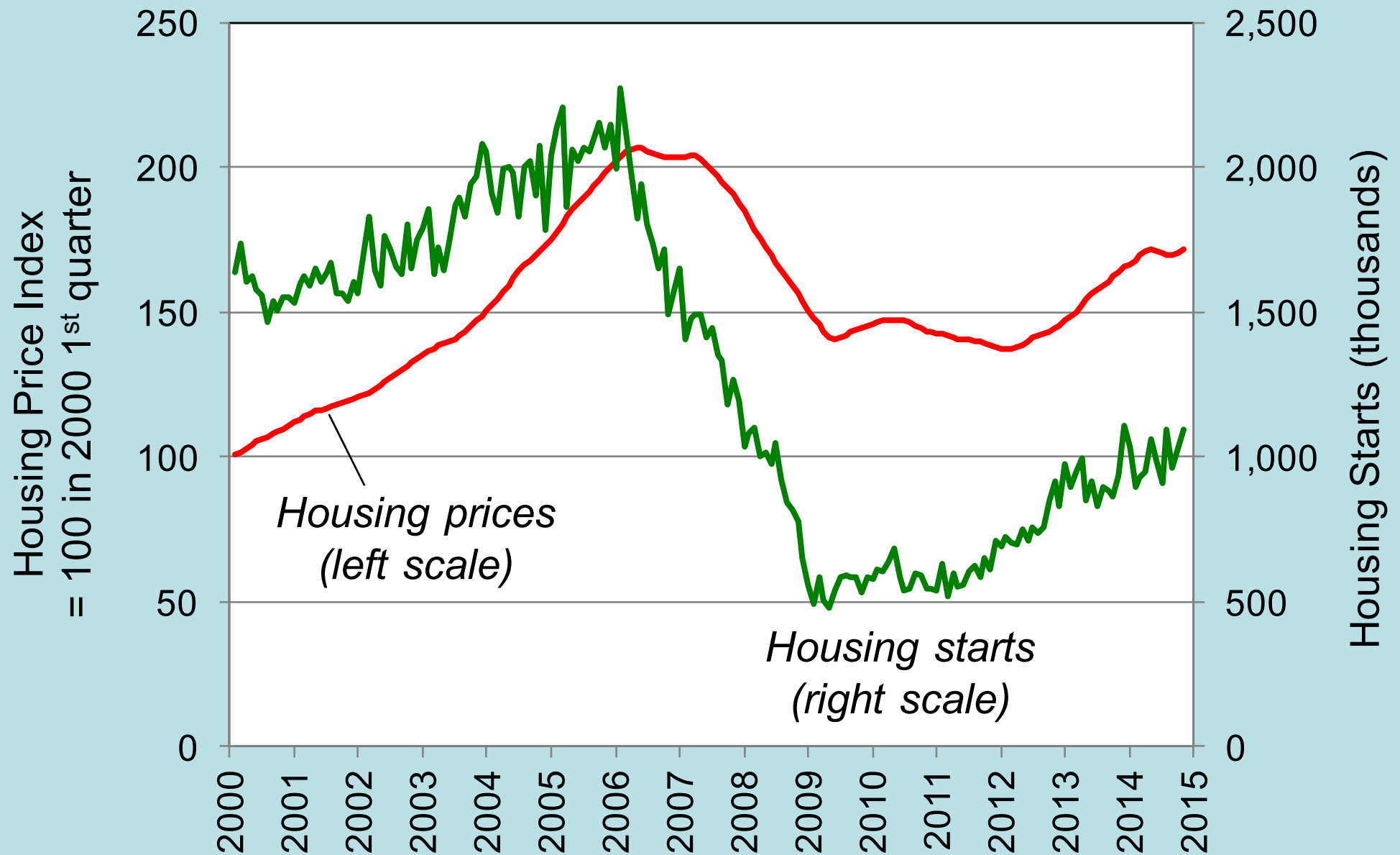


# How residential investment responds to a fall in interest rates

(a) The market for housing      (b) The supply of new housing



# U.S. Housing Prices and Housing Starts, 2000-2014



# Inventory investment

Inventory investment is only about  
1% of GDP.

Yet, in the typical recession,  
more than half of the fall in spending  
is due to a fall in inventory investment.

# Motives for holding inventories

## 1. **production smoothing**

Sales fluctuate, but many firms find it cheaper to produce at a steady rate.

- When sales  $<$  production, inventories rise.
- When sales  $>$  production, inventories fall.

# Motives for holding inventories

1. production smoothing
2. **inventories as a factor of production**

Inventories allow some firms to operate more efficiently.

- samples for retail sales purposes
- spare parts for when machines break down

# Motives for holding inventories

1. production smoothing
2. inventories as a factor of production
3. **stock-out avoidance**

To prevent lost sales when demand is higher than expected.

# Motives for holding inventories

1. production smoothing
2. inventories as a factor of production
3. stock-out avoidance
4. **work in process**

Goods not yet completed are counted in inventory.

# Inventories, the real interest rate, and credit conditions

- Inventories and the real interest rate
  - The real interest rate is the opportunity cost of holding inventory (instead of bonds, *e.g.*)
  - Example: High interest rates in the 1980s motivated many firms to adopt just-in-time production, which is designed to reduce inventories.
- Inventories and credit conditions
  - Many firms purchase inventories using credit.
  - Example: The credit crunch of 2008–09 helped cause a huge drop in inventory investment.



# CHAPTER SUMMARY

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1. All types of investment depend negatively on the real interest rate.
2. Things that shift the investment function:
  - Technological improvements raise MPK and raise business fixed investment.
  - Increase in population raises demand for, price of housing and raises residential investment.
  - Economic policies (corporate income tax, investment tax credit) alter incentives to invest.

# CHAPTER SUMMARY

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3. Investment is the most volatile component of GDP over the business cycle.
- Fluctuations in employment affect the MPK and the incentive for business fixed investment.
  - Fluctuations in income affect demand for, price of housing and the incentive for residential investment.
  - Fluctuations in output affect planned & unplanned inventory investment.