Objectives

- Review types of investment
- Analyze factors affecting investment

I. Three types of investment

- Business fixed investment
  Machinery, equipment and structures used in production
- Residential investment
  New housing bought by owners or for rent
- Inventory investment
  Goods businesses put aside, including materials, supplies, work in progress and finished goods

Volatility of investment: over the business cycle, investment is the most volatile component of output.

II. Business fixed investment

Business fixed investment is the building and equipping of factories.

We will look factors affecting the change in capital stock, or **net investment.** Total investment will also include replacing depreciated capital stock. The model we consider is called the neoclassical model of investment.

Total investment can be divided into:

- net investment: addition to capital stock

$$I_n = \Delta K$$

  This is the main decision of the business firm: whether it should

  - add to its capital stock: $I_n = \Delta K > 0$
  - allow its capital stock to decline: $I_n = \Delta K < 0$ by not replacing depreciated capital

- replacement of the depreciated capital stock δK

  Depreciation: due to use and passage of time capital depreciates (becomes less valuable).
  - Physical depreciation
  - Obsolescence

$$I = I_n + \delta K$$

We will now analyze the factors affecting net investment. We then add the amount of depreciation to obtain total investment.

The decision to invest involves comparing the benefit and cost of investment
Benefit: extra capital leads to extra output produced: **the marginal product of capital**
Cost: all costs per year of using one unit of capital:

- interest costs
- change in price
- depreciation

1. Benefit from investment: Marginal Product of Capital

Production function:

Firms use capital and labour to produce output:

$$Y=F(K,L)$$

When a firm invests in an extra unit of capital, its output increases:

$$Y+\Delta Y=F(K+1,L)$$

We call the extra output (ΔY) the **Marginal Product of Capital (*MPK*):** extra output produced with one extra unit of capital

$$MPK= F(K+1,L) - F(K,L)$$

The marginal product of capital is

- positive
- decreasing

Note: benefits from investment are calculated **per year;** so $F(K.L)$ is the amount of output produced in a year and ***MPK* is the extra amount of output produced by using the extra capital for a year.**

2. Rental market for capital

We now calculate the cost of extra unit of capital held for a year.

The easiest way – imagine that there is a rental market for capital. Rather than constructing its own capital stock, a firm rents capital at the rental market.

In the rental market there are specialized firms. They purchase capital and rent it out.
A rental firm would acquire capital until the payment it gets from renting capital is equal to the cost of owning the capital.

We will do all calculations **for one unit of capital** in nominal terms and covert them into real terms.

(a) Cost of owning capital consists of:

- interest costs
- change in price
- depreciation

P_K - price of a unit of capital today – the price the rental firm is paying.

Interest costs: $i\ P_K$ is then the nominal interest cost of holding the unit of capital for a year (this is what the firm pays for borrowing or, if it uses own funds, what it could have earned if it lent the money

Change in price: $\Delta\ P_K$ – change in price of the unit of capital stock over the year.

Depreciation: due to use and passage of time capital depreciates (becomes less valuable).

$\delta\ P_K$ – amount of depreciation of one unit of capital

So the cost of owning capital is:

$$\text{Nominal cost of owning a unit of capital} = (i\ P_K - \Delta\ P_K + \delta\ P_K)$$

Note: we subtract change in price $\Delta\ P_K$ because we calculate the cost.

To get the real cost, divide by the price level:

$$\text{Real cost of owning capital} = (\text{nominal cost /P}) = \frac{P_K}{P}\left(i - \frac{\Delta P_K}{P_K} + \delta\right)$$

For simplicity assume prices of capital goods change at the same rate as of all goods:

$$\frac{\Delta P_K}{P_K} = \pi.$$

Since $i-\pi=r$ so real cost of owning capital is:

$$\text{Real cost of capital}=\frac{P_K}{P}(r+\delta)$$

The term $\frac{P_K}{P}$ is the relative price of capital goods

Sum up: the cost of owning capital depends on

- The relative price of capital goods
- The real interest rate
- The rate of depreciation

3. Determinants of investment

- in equilibrium the rental price of capital = marginal product of capital
- so the rental firm's return from holding a unit of capital is

$$MPK - \frac{P_K}{P}(r+\delta)$$

New investment depends on the firm's return from holding capital

- If it is positive, the rental firm will acquire more capital;
- if it is negative it will not

So we can write:

$$\text{Net investment } = \Delta K = I_n(\text{MPK}, \frac{P_K}{P}, r, \delta)$$

Net investment depends on:

- the marginal product of capital
- the relative price of capital goods
- real interest rate
- depreciation

To new investment we need to add replacement for depreciated capital stock.

- Each unit depreciates at the rate δ
- There are K units of capital
- So total amount of depreciation is δK

So, finally:

$$I=\Delta K+ \delta K= I_n(\text{MPK}, \frac{P_K}{P}, r, \delta)+ \delta K$$

Expectations about the future. We have not included so far a central determinant of investment: expectations about the future. Investment projects are planned in advance, since they take time to built and are then used for many years.

If the firm expects:

- Low interest rates
- High MPK

then it would be more willing to invest.

4. Investment schedule

Shows the relationship between the real interest rate and investment

- The investment schedule slopes down.
  Higher real interest rate raises the costs of investment and lowers the amount of investment

- Factors shifting the investment schedule (to the right)

- Higher *MPK*
- Lower relative price of capital
- **Expectations** about higher *MPK,* lower relative price of capital, lower interest rate in the future

Lower depreciation has two effects:
- It increases net investment by reducing the cost of owning capital
- It reduces the amount of investment needed to replace depreciating capital

5. Financing constraints

To invest – firms usually borrow.

Investment is usually undertaken with long-term horizon – decisions to invest depend on expectations about the future

Financing constraints – inability to borrow the desired amount

With financing constraints – the amount a firm invests depends on current cash flow, rather than expectations about the future.

III. Residential Investment

Two types:
- For own use
- For rental

Assume for simplicity all residential housing is for own use.

Determining the relative price of housing: stock equilibrium and flow supply

The amount of housing – a stock
- At any moment of time, supply of housing is fixed
- Demand for housing – inversely related to relative price of housing
- Relative price of housing: determined at the intersection of the fixed supply and downward sloping demand

Supply of new housing (residential investment) - a flow
- Depends on the relative price of housing.

Determinants of housing demand
- Interest rate (real)
- Availability of credit – liquidity constraints

From higher demand to higher supply:
- Given the fixed supply, higher demand raises the price of housing
- With higher price, the construction of new housing increases

IV. Inventory Investment

Reasons for holding inventories:
- Production smoothing
- Stock-out avoidance
- Inventories as factor of production
- Work in progress

Costs of holding inventories: interest paid or foregone

Volatility of inventory investment: over the business cycle, inventory investment varies more than business fixed investment and residential investment.

V. Investment in the Great Recession

Business fixed investment – fell because of:

- Lower expected *MPK*
- Financing constraints.

What is the effect of a recession on expected *MPK*? Recession lowers the expected revenue (in dollars) as well as the amount of output that can be **sold** , effectively reducing the expected *MPK*

Residential investment:

- Excess supply of existing housing and housing under construction
- Credit constraints

Inventory investment:

- Lower chance of stock-outs
- Lower sales require lower inventory