Chapter 17: Micro-foundations: Investment

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Why Study Investment?

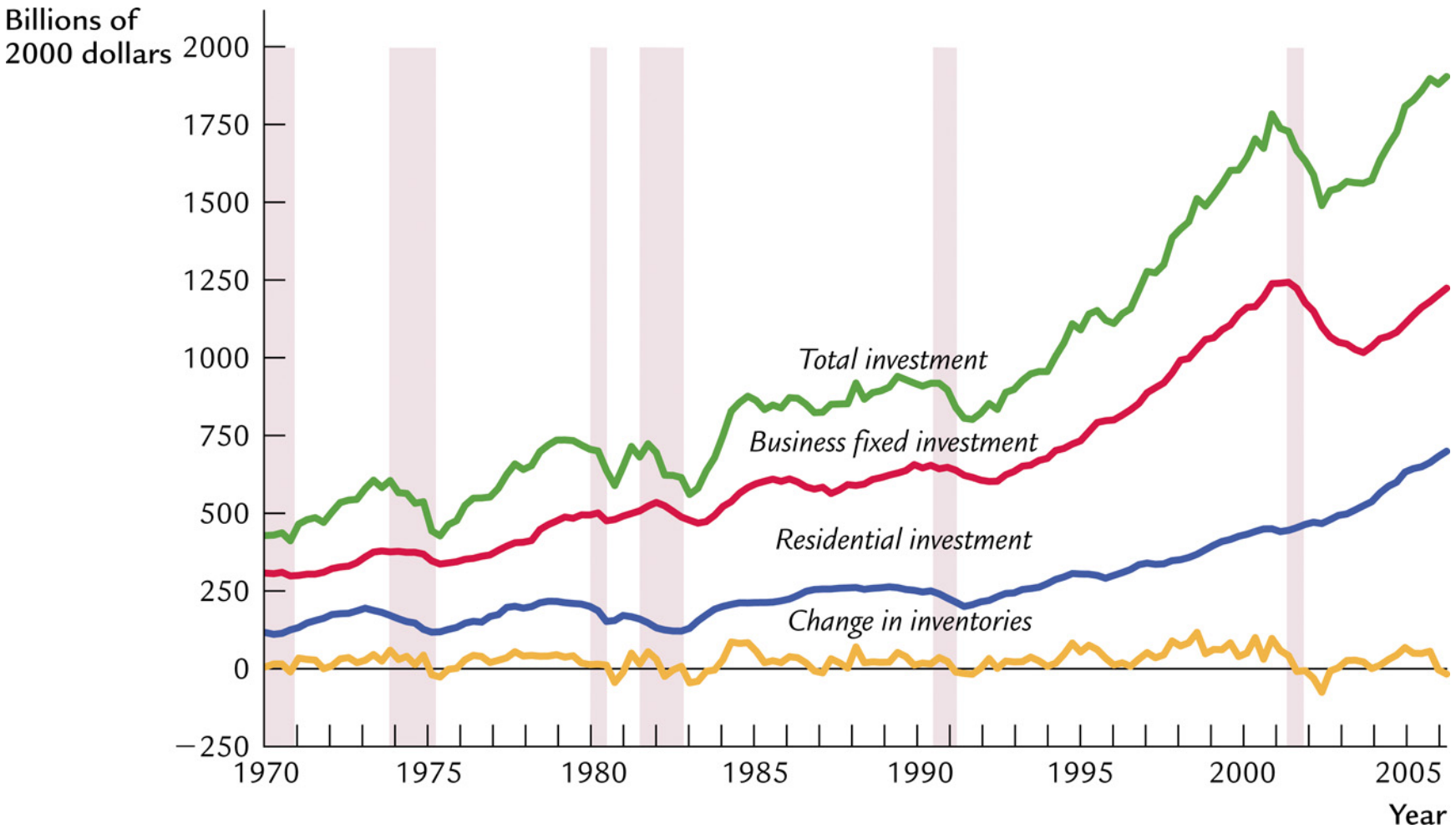
1. Investment is the part of GDP that links the present and the future.

2. During recessions, much of the decline in GDP is due to investment. E.g., during the 1982 recession in the US, GDP fell by \$105 billion and investment fell by \$152 billion.

3. Want to rationalize our investment function $I = I(r)$ studying the components of investment expenditures.

Types of Investment

- Business fixed investment—the equipment and building structures the firms buy to run their businesses.
- Residential investment—the *new* housing households and landlords purchase.
- Inventory investment—goods put in storage (materials, work in process, and finished goods).


Billions of 2000 dollars
2000
1750
1500
1250
1000
750
500
250
0
−250
1970
1975
1980
1985
1990
1995
2000
2005
Year
Total investment
Business fixed investment
Residential investment
Change in inventories

Explaining the Business Fixed Investment

Assume there are two types of firms: *production firms* that rent equipment/structures, and *rental firms* that purchase new capital and, thus, undertake all of the investment in the economy.

The Rental Price of Capital

- Assume that the economy is populated by competitive production firms, and all of them face the price for their good, P.
- Thus, the aggregate price level is P.
- The *real* cost of renting a unit of capital for the *production* firm is R/P, where R is the rental price of a unit of capital.
- If $Y = AK^{\alpha}L^{1-\alpha}$, the *real* return from renting a marginal unit of capital is $MPK = \alpha \times A(\frac{K}{L})^{\alpha-1}$.
- To maximize the profit, the firm sets the marginal return equal to the marginal real cost from renting a unit of capital. I.e., the firm chooses K such that $\frac{R}{P} = \alpha \times A(\frac{K}{L})^{\alpha-1}$.

Notes

$$\frac{R}{P} = \alpha \times A(\frac{K}{L})^{\alpha-1} = \alpha \times AK^{\alpha-1}L^{1-\alpha} = A\left(\frac{K^{\alpha}}{K}\right)\left(\frac{L}{L^{\alpha}}\right).$$

The real rental price, ceteris paribus, is higher if:

- A is higher, i.e., if technology improves;
- L is higher;
- K is lower.

The Cost of Capital to the Rental Firm

Since I is done by *rental* firms, we want to understand the marginal costs and benefits of carrying one unit of capital from current to the next period for the rental firm.

- Define the interest rate from period t to period $t+1$ as i.
- Define the price of a unit of capital in period t as $P_{K,t}$, and in period $t+1$ as $P_{K,t+1}$.
- Define the depreciation rate as δ. I.e., $(1-\delta)$ units of capital are left in $t+1$ from one unit of capital acquired at t.

The Cost of Capital to the Rental Firm—Contd.

Consider the cost of the following transaction:

The rental firm acquires one unit of capital at time t and sells it at time $t+1$. The (expected) cost is:

$$
\begin{aligned}
& P_{K,t} + P_{K,t} \times i - (1-\delta) \times P^e_{K,t+1} \\
&= P_{K,t} \times (1 + i - (1-\delta) \times \frac{P^e_{K,t+1}}{P_{K,t}}) \\
&= P_{K,t} \times (1 + i - (1-\delta) \times (1+\pi^e)) \\
&= P_{K,t} \times (1 + i - 1 - \pi^e + \delta + \delta \times \pi^e) \\
&= P_{K,t} \times (i - \pi^e + \delta + \delta \times \pi^e) \\
&\approx P_{K,t} \times (i - \pi^e + \delta) = P_{K,t} \times (r + \delta).
\end{aligned}
$$

The Cost of Capital—Summary

We've done two assumptions to arrive at the formula:

1. The proportional change in the price of capital is equal to the proportional change in the overall price level. I.e., $P^e_{K,t+1}/P^e_{K,t} = P^e_{t+1}/P_t$.
2. The term $\delta \times \pi^e$ is small and so can be safely ignored.
3. Note that an *investment tax credit*—a tax provision that reduces a firm's taxes for each dollar spent on capital goods—stimulates investment.

The Real Cost of a Unit of Capital

The real cost of a unit of capital is: $\frac{P_{K,t}}{P_t} \times (r + \delta)$.

A per unit *real* profit of the rental firm is:

$$\begin{aligned} &\frac{R}{P} - \frac{P_{K,t}}{P_t} \times (r + \delta) \\ &= MPK - \frac{P_{K,t}}{P_t} \times (r + \delta), \end{aligned}$$

where the second line comes from the maximization problem of the production firm.

- Thus, the net investment—alterations of the capital stock—is positive if the real benefit from investing, MPK, is higher than the real cost of investing.

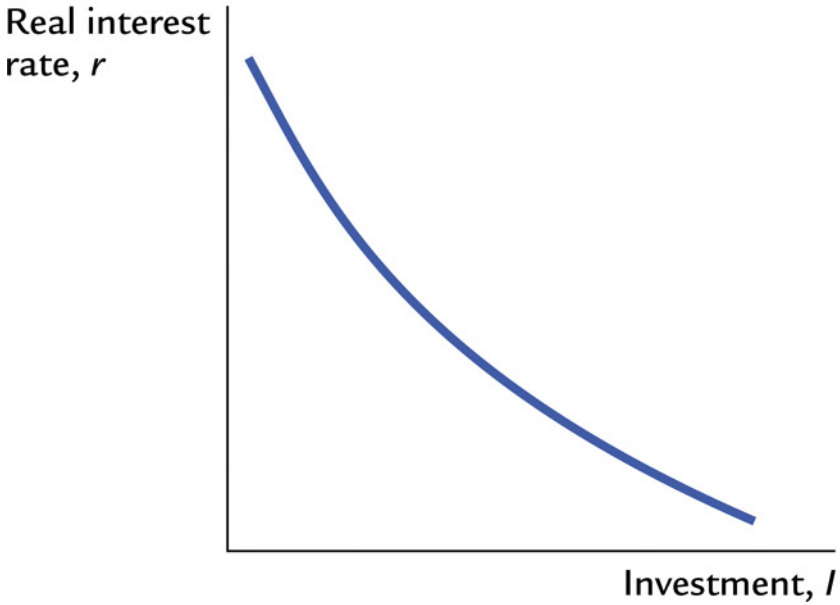
The Investment Function

The *net* investment, I_n, is a *function* of the profit rate. I.e., $I_n = I_n(MPK - (P_K/P) \times (r + \delta))$, or $I_n = I_n(MPK - (r + \delta))$ if we assume that $P_K = P$.

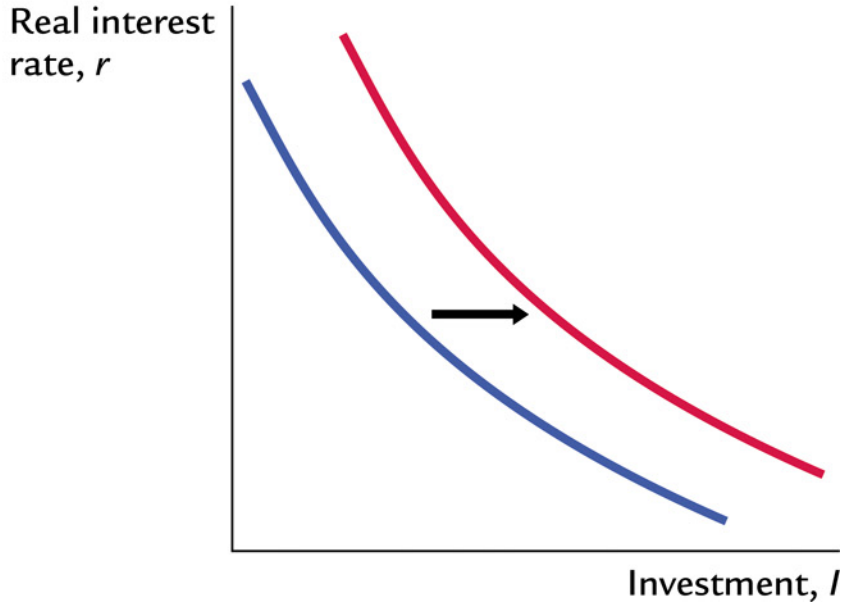
The real *gross* investment is the sum of I_n and the depreciation fund $\delta \times K_t$.

The firm adjusts its capital until the profit rate is zero, i.e., when $MPK = r + \delta$—when the marginal benefit of an additional unit of capital is equal to its marginal cost.

(a) The Downward-Sloping Investment Function



(b) A Shift in the Investment Function



Why Investment is so Volatile?

Fluctuations in investment are linked to fluctuations in the stock market, where the firms' shares are traded. Stock prices, in general, reflect incentives to invest.

Tobin's q:

q=(Market Value of Installed Capital/Replacement Cost of Installed Capital).

If $q > 1$, the stock market values installed capital at more than its replacement cost, and managers can raise the value of the firm by purchasing more capital.

If $q < 1$, the stock market values capital at less than its replacement cost.

Concluding Notes

If firms are financially constrained, they cannot smooth investment during (short) recessions, and, thus, business fixed investment can be sensitive to current income.

Residential investment and inventory investment are sensitive to the real interest rate and the economy's income as well.