EC502 Macroeconomics

Week 18 Seminar: Investment Theory

Malavika Thirumalai Ananthakrishnan

Contact: *mt600@kent.ac.uk*

University of Kent - School of Economics
Spring Term 2020

February 19, 2024

1. Explain...

a) Marginal product of capital

- Additional output resulting from the unit variation of capital stock

$$Y = F(K) \quad \longleftrightarrow \quad MPK \equiv \frac{\partial Y}{\partial K} = F'(K) > 0$$

- Diminishing returns to capital: each additional unit increases output a lower amount

$$\frac{\partial MPK}{\partial K} = F''(K) < 0$$

- In perfect competition, it is equal to the cost of capital $MPK = 1 + r$

b) Tobin's Q

- Ratio of the market value of a company divided by its assets' replacement cost

$$Q = \frac{\text{market value of a firm}}{\text{(book) asset value}} = \frac{V}{P_K \cdot K} = \frac{\frac{F'(K)}{1+r}}{P_K \cdot K}$$

- Compares market valuation and intrinsic valuation
- If $Q < 1$, stock is undervalued (and vice-versa)
- Usable for investment and take-over decisions
- Example: exercise 4

2. Why is investment so volatile?

1. Accelerator principle
   - Assume the economy requires a fixed amount of K per unit of Y

$$v = K^* / Y_{t+1}$$

   - Compare capital across two periods $K_1^* = vY_2$ and $K_2^* = vY_3$
   - Take the difference between both:

$$I = K_2^* - K_1^* = vY_3 - vY_2 = v\Delta Y$$

   - So to keep a constant I, Y has to increase ($\Delta Y > 0$)
   - Investment would depend not on the business level, but on its rate of change...
   - Volatility: investment fluctuates more than output ($v \approx 2.5$)
   - Variations in labour employment? Not accounted by it

Borrowing constraints

- Access to borrowing allows agents to smooth consumption
- Firms can also face borrowing constraints, so they will rely mostly on internal cash flow
- Cash flow depends on profits, which depends on output
- Variations in output will cause large investment variations

Tobin's Q

- Recall Tobins Q reflect market perceptions of asset stocks vs replacement costs
- Whenever $Q > 1$, investment shall increase
- Stock market prices can be affected by changes in
  - Interest rates ($\downarrow r \quad \longleftrightarrow \quad \uparrow$ stock value)
  - Technology ($\uparrow A \quad \longleftrightarrow \quad \uparrow$ future profitability)
  - Expectations

3. Optimal investment

$$Y = AK^{0.5}L^{0.5} \quad L = 50 \quad A = 300 \quad i = 10\% \quad \pi = 4\% \quad \delta = 10\%^{1}$$

a) Find optimal K - where
$MPK + 1 - \delta = 1 + r$
$MPK = r + \delta$
solution: $K^* \approx 4,435.56$

$$MPK \equiv \frac{\partial Y}{\partial K} = A \cdot 0.5 \cdot K^{-0.5}L^{0.5} = (i - \pi) + \delta$$

$$300 \cdot 0.5 \cdot K^{-0.5}50^{0.5} = 10\% - 4\% + 10\% = 16\%$$

$$K^{-0.5} = \frac{16\%}{300 \cdot 0.5 \cdot 50^{0.5}}$$

$$K^* \approx 4,435.56$$

[1] Note: use this data in percentage and not per unit values to solve the problem.

3. Optimal investment

If initial $K_0 = 2,000$ pounds, calculate gross and net investment

$$\text{Net I} = K^* - K_0 = 4,435.56 - 2,000 = 2,435.56$$

$$\text{Gross I} = \underbrace{K^* - K_0}_{\text{Net I}} + \delta \cdot K_0 = 4,435.56 - 2,000 + 0.1 \cdot 2,000 = 2,635.56$$

Effect of an increase to $i' = 12\%$
MPK$\equiv \frac{\partial Y}{\partial K} = (i - \pi) + \delta$
$300 \cdot 0.5 \cdot K^{-0.5} 50^{0.5} = 12\% - 4\% + 10\% = 18\%$
K** $\approx 3,457.44$

Explain what these numbers mean!

4. Enigma Productions

a) What would be the future investment plans?

- The market value of the firm, pre- and post-film:

$$V_0 = 20 \cdot 2,500 = 50,000 \qquad V_1 = 30 \cdot 2,500 = 75,000$$

- Market value of the fixed capital stock of the firm:

$$P_K K = 50,000$$

- Tobin's Q:

$$Q_0 = \frac{V_0}{P_K K} = \frac{50,000}{50,000} = 1 \qquad Q_1 = \frac{V_1}{P_K K} = \frac{75,000}{50,000} = 1.5$$

- As $Q_1 > 1$, managers would invest as the market value of their investment exceeds the replacement cost of the firm
- Would Warner (a different firm) take over Enigma P.?NO, it is too expensive to buy it in the stock market, and it is cheaper to buy the working capital themselves

4. Enigma Productions

b) If you regress *investment* $= \alpha + \beta \cdot$ (*stock market index*), describe $\hat{\beta}$ and R^2

- $\hat{\beta} > 0$, recall $Q > 1$
- R^2 low: volatility of the stock market is higher than investment

4. Enigma Productions

Installation costs: why does Q diverge from 1 for long periods?

- The present value of the return of 1 unit of investment is equal to its cost

$$\frac{MPK}{1+r} = 1$$

- With adjustment costs ψ, there is an extra marginal cost of installing new equipment

$$\frac{MPK}{1+r} = 1 + \psi$$

- This leads to a lower level of K with higher MPK $\leftrightarrow$ lower per-period investment
- Recall Tobin's $Q > 1$ implies positive investment (higher K)

$$Q = \frac{MPK/(1+r)}{1} = 1 + \psi > 1$$

- With installation costs, we invest at a slower rate to avoid large costs
- The next period after the investment, we face the same decision with lower installation costs
- And so on, reducing IAC until $\psi = 0$ and reaching K^*