



ECON 314

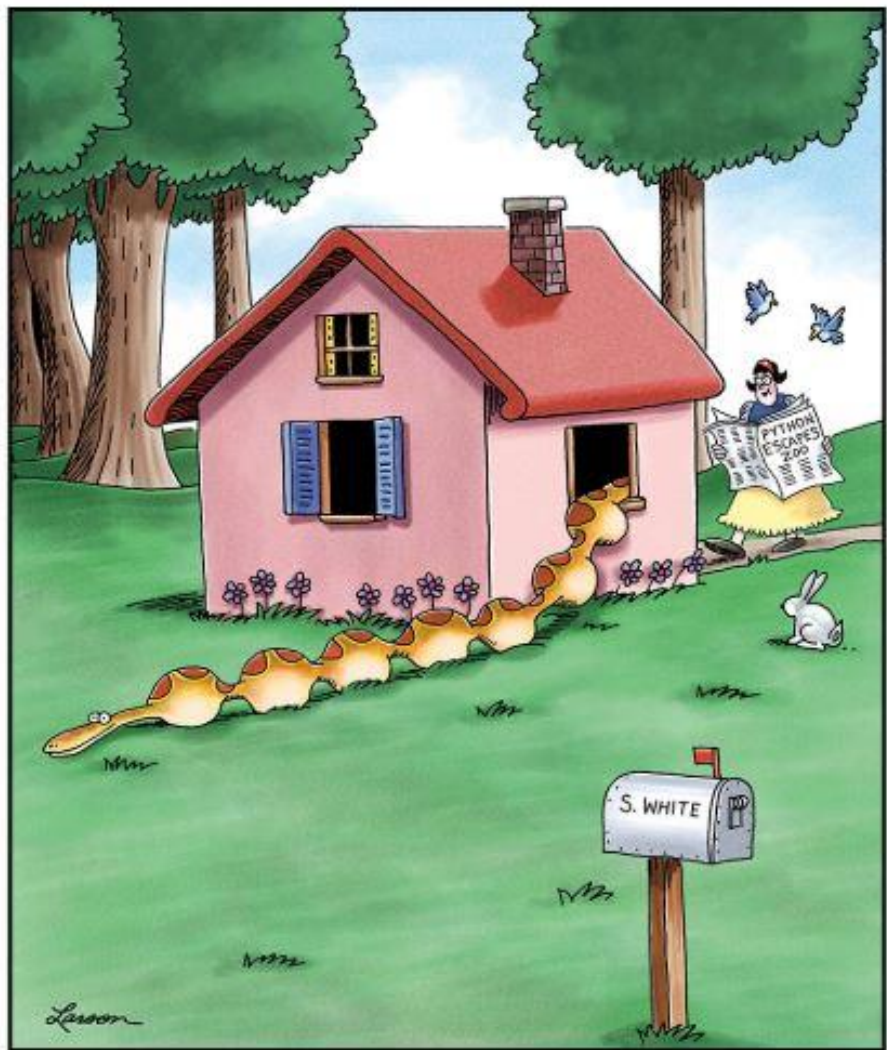
Friday, April 24

Basic Capital and Investment Theory

Readings: Romer, Section 9.1; Coursebook, Sections 15A, B, and C

Class notes: 152 - 153

Today's Far Side offering



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Yup ... seven humps!



Context and overview

- We begin our study of investment theory with basic discussion of the nature of capital and investment
- Capital is a stock that is valued by firms for the flow of productive services that it provides
- Investment is the flow gross or net increases to the capital stock
- A wealth-owner could choose among (at least) three alternatives: owning and using capital, owning capital and renting it out, and owning a bond: ignoring risk, the return on all three must be equal
- Equilibrium rental rate or user cost of capital is the flow cost of a unit of capital services that balances the rates of return
- Instantaneous adjustment of capital is not feasible because it would require infinite investment



Capital stock vs. capital services

- Firms use the services of labor and services of capital to produce output
 - Must rent labor services because slavery is illegal
 - Can either rent services of capital or own it outright
 - For macroeconomy, capital cannot be rented because there is no one else
- Gross investment is flow of new capital; net investment is gross investment minus depreciation, which is change in capital stock
- Demand for capital is firms' demand for services
 - This translates to demand for stock of capital
 - Changes in the desired stock of capital motivate investment



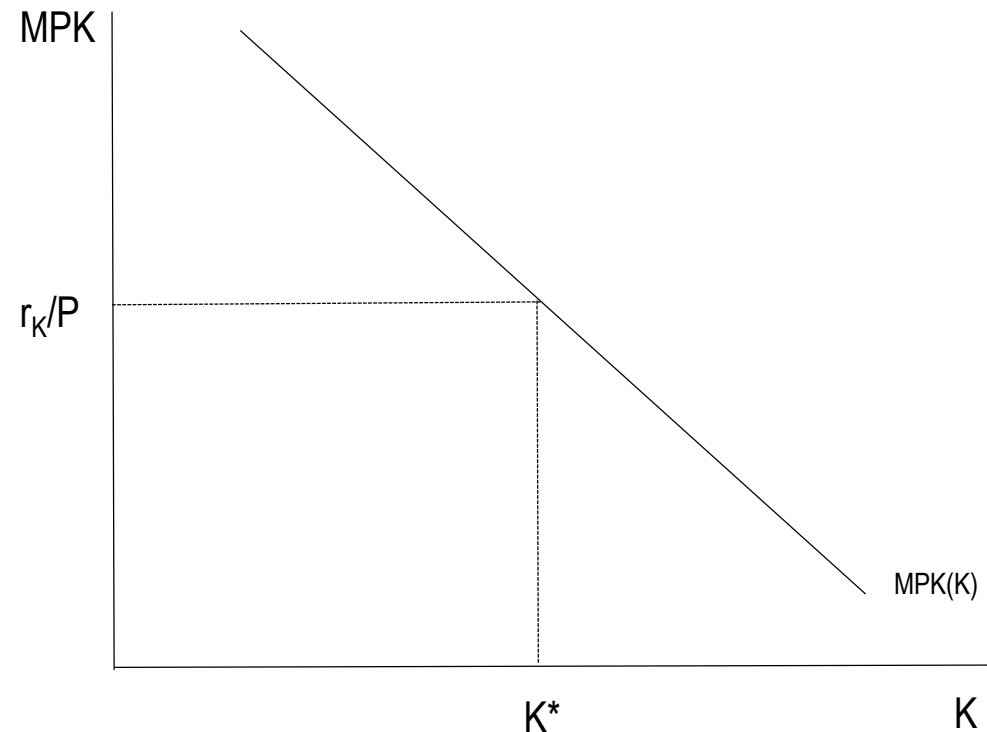
Capital services as an input to production

- In growth theory, we said that firms set $MPK = r + \delta$
 - Today, we derive that relationship as profit maximization
- Let r_K be the (nominal) rental rate for which a firm rents one unit of capital services
 - Analogous to nominal wage rate for one unit of labor services
- If firms sells output at P , it maximizes profit where $MPK = r_K/P$
 - Just like $MPL = W/P$



Demand curve for capital services

- Demand function for capital services is downward sloping MPK
 - Given market-determined r_K/P , firm desires K^* in capital services at level of MPK
- Note that we usually assume that capital services are proportional to stock, so K is both





Capital as an asset

- Three choices for wealth-holder
 - Buy a **bond**
 - Earn interest
 - Buy **capital and use it**
 - Earn MPK
 - Suffer depreciation
 - Get possible “capital gain or loss” if price of capital changes
 - Buy **capital and rent it** to someone else to use
 - Earn rental price
 - Suffer depreciation
 - Get possible “capital gain or loss” if price of capital changes
- In equilibrium, the return to all three should be equal



Returns on three choices

- Owning a bond
 - Get back $p_K (1 + r)$ at end of period
- Own capital and use it
 - Get output worth $p \times \text{MPK}$
 - Have $(1 - \delta) p_K$ worth left
 - Get capital gain \dot{p}_K
 - Have $p \times \text{MPK} + \dot{p}_K + (1 - \delta) p_K$ at end of period
- Own capital and rent it out
 - Get rental fee of r_K
 - Have $(1 - \delta) p_K$ worth left
 - Get capital gain \dot{p}_K
 - Have $r_K + \dot{p}_K + (1 - \delta) p_K$ at end of period
- Three gross returns must balance



Equilibrium conditions among returns

- Bond-holding vs. renting out capital:

$$p_K (1 + r) = r_K + \dot{p}_K + (1 - \delta) p_K$$

$$r_K = p_K \left(r + \delta - \frac{\dot{p}_K}{p_K} \right)$$

- This is equilibrium “rental price of capital”

- Using vs. renting out capital:

$$r_K + \dot{p}_K + (1 - \delta) p_K = p \times \text{MPK} + \dot{p}_K + (1 - \delta) p_K$$

$$\text{MPK} = \frac{r_K}{p} = \frac{p_K}{p} \left(r + \delta - \frac{\dot{p}_K}{p_K} \right)$$

- This is marginal product condition from above
- User cost of capital = rental rate of capital



Adjustment to optimal capital stock

- At firm level, producers can get to K^* by renting capital or buying it from another owner/firm
- At aggregate level, new capital must be produced
 - No one from whom to rent or buy
 - Note that physical capital is harder to transport than goods
- Jump in aggregate K^* means we want more capital ... NOW
 - Jump in K would mean infinite $I = \dot{K}$ at moment of change
 - Infinite I requires infinite Y , since $Y = C + I + G$
 - Infinite Y requires infinite resources since $Y = F(K, L)$
- Change in K must be gradual due to adjustment costs



Review and summary

- Capital provides services to production
- Firms want capital up to where $MPK = \text{rental rate on capital}$
- Wealth-holders have choice in use of funds
 - Own capital and use it
 - Own capital and rent it out
 - Own bond and earn interest
- Rates of return on these must be equal (ignoring risk)
- Rental rate on capital = user cost of capital
- Aggregate capital stock must adjust slowly to changes in desired stock



Another bad economist joke ...

Q: What do economists use for birth control?

A: Their personalities.

--Taken from Jeff Thredgold, *On the One Hand: The Economist's Joke Book*



What's next?

- In this class we introduced the basics of capital theory
- In the next class (April 27) we examine the issue of adjustment costs in detail, considering how that connects the flow of investment to the stock of capital
- We also lay the groundwork for the q theory of investment when adjustment costs are a quadratic function of the change in capital