Econ 201: Introduction to Economic Analysis

October 21 Lecture: Capital Markets

Jeffrey Parker
Reed College

Daily dose of The Far Side

www.thefarside.com

How attack-wiener dogs are trained

Preview of this class session

- Physical capital is durable good that provides useful services
- Financial capital is a claim to resources (capital markets)
- Rates of return on capital; present value of assets
    - Evaluation of investment projects by return, present value
- Real vs. nominal rates of return
- Loanable-funds market and interest rates
- Modeling uncertainty and risk

Basic definitions

What we mean by “capital”

- Durable asset, measured as a stock
- **Physical capital** provides services (factories, houses, machines, cars)
- **Financial capital** is (possibly contingent) claim to real assets
    - Shares of **stocks** (ownership), **bonds** (loans)
- **Human capital** is wealth embodied in humans
- **Investment** is flow of new capital
- **Capital market**: forum for exchanging financial assets
    - Firms finance real investment by borrowing or issuing shares
    - Intermediated vs. direct lending

Present value

- r = market **interest rate** (0.05 = 5%)
- Lending $1 this year yields $(1 + r) in one year, $(1 + r)^2 in two years, or $(1 + r)^n in n years
  - n need not be an integer or even positive
  - $FV = PV \times (1 + r)^n$ is **future value** of PV after n years
- **Present value** of FV to be received in n years:

$$PV = \frac{FV}{(1+r)^n}$$

  - Crucially important formula in economics and finance
  - Allows us to evaluate how much a future payment is worth today

Bonds and bond prices

- **Bond** = promise to pay specified amounts on specified dates
- PV of each promised payment can be evaluated
  - Bond price is sum of PVs of all payments
- Typical n-year "coupon" bond with coupon interest rate c and face value (repayment amount) F
  - Annual interest coupons redeemed for cF for n years
  - Principal F is repaid after n years
- **Price of bond** = present discounted value of all payments:

$$PV = \frac{cF}{1+r} + \frac{cF}{(1+r)^2} + \ldots + \frac{cF}{(1+r)^n} + \frac{F}{(1+r)^n}$$

- Price of bond with given c goes down if market r goes up

Bonds with no coupons and consols

- For Treasury bills and some other bonds, $c = 0$
  - In this case, we get only PV of final repayment:

$$PV = \frac{F}{(1+r)^n}$$

  - Bond sells at discount below F depending on market r
- **Consol** has no final repayment, just each cF each year
  - Price of consol is

$$PV = \frac{cF}{1+r} + \frac{cF}{(1+r)^2} + \ldots = \frac{cF}{r}$$

Interest rates and investment

Net present value of capital project

- Investment projects usually involve up-front costs and future benefits
  - Let the stream of benefits be B_0, B_1, …, B_n and the stream of costs be C_0, C_1, …, C_n from now (0) to n years into the future
- **Net present value** of project is

$$\text{NPV} = B_0 - C_0 + \sum_t \frac{B_t - C_t}{(1+r)^t}$$

- Firm should undertake project if NPV > 0
- Usually, C is high early and B is large late
  - Increase in r would lower NPV, make project less profitable

Rate of return on capital investment project

- **Net rate of return** (R) is discount (interest) rate at which NPV = 0

$$0 = B_0 - C_0 + \sum_t \frac{B_t - C_t}{(1+R)^t}$$

- NPV > 0 if and only if $R > r$
- $R > r$ means that capital project earns higher rate of return than using money to buy bond (lend)
  - Also means that project would return enough to more than repay interest and principle on bond if firm borrows to finance the project
- Higher market interest rate means fewer projects have R that is high enough to be profitable → real investment falls

Inflation

- **Inflation**: increase in all (or average) prices over time

$$\pi = \frac{P_{t+1} - P_t}{P_t}, \text{ so } P_{t+1} - P_t = \pi P_t, \text{ and } P_{t+1} = (1+\pi)P_t, \text{ or } \frac{P_{t+1}}{P_t} = 1 + \pi$$

- Example: Current widget price = \$100 and next year's widget price is \$104, then π = (\$104 – \$100)/\$100 = 0.04 = 4%
- People care about purchasing power, not dollars
  - We must account for inflation in thinking about borrowing, lending, and investing
- If I lend 1 widget's worth of money now, how many widgets' worth of money do I get back in one year?

Nominal and real interest rates and returns

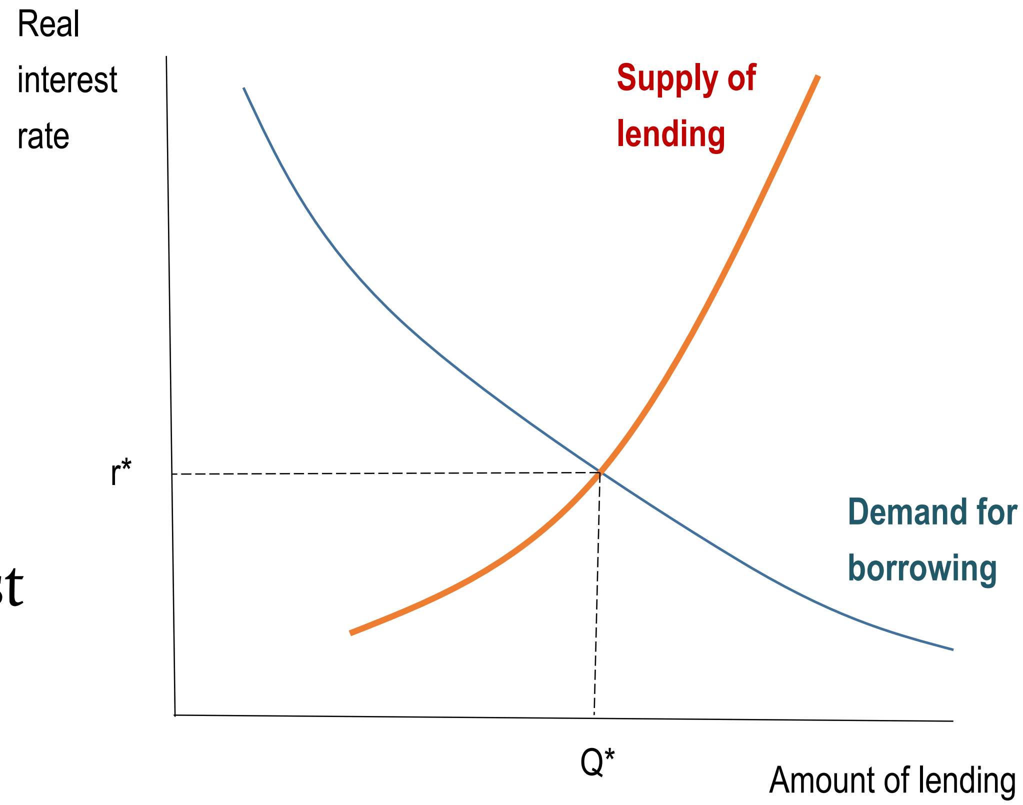
- **Nominal (dollar) interest rate** is i, so \$1 lent now gets \$(1 + i) back in one year
- Lend one widget now = \$$P_t$
- Get back \$$P_t \times (1 + i)$ next year
- Each \$1 next year buys $1/P_{t+1}$ widgets, so can your return can buy

$$(1+i)\frac{P_t}{P_{t+1}} = \frac{1+i}{1+\pi} = 1+r$$

- Your **real interest rate** is r, which is approximately $\boldsymbol{r = i - \pi}$
  - For example, if inflation is 4%, then 6% nominal interest rate corresponds to a 2% real interest rate
- ***Ex-ante*** (expected) real rate vs. ***ex-post*** real rate

Loanable-funds market

- Real interest rate should matter for both borrowers and lenders
- Real interest rates are determined as long-run equilibrium in **loanable-funds market**
  - Demand for borrowing is downward-sloping function of *r* because at higher *r* fewer investment projects have positive NPV (or rate of return exceeding interest rate)
  - Supply of lending (saving) is upward-sloping function of *r*
- Equilibrium real interest rate equates flows of borrowing and lending

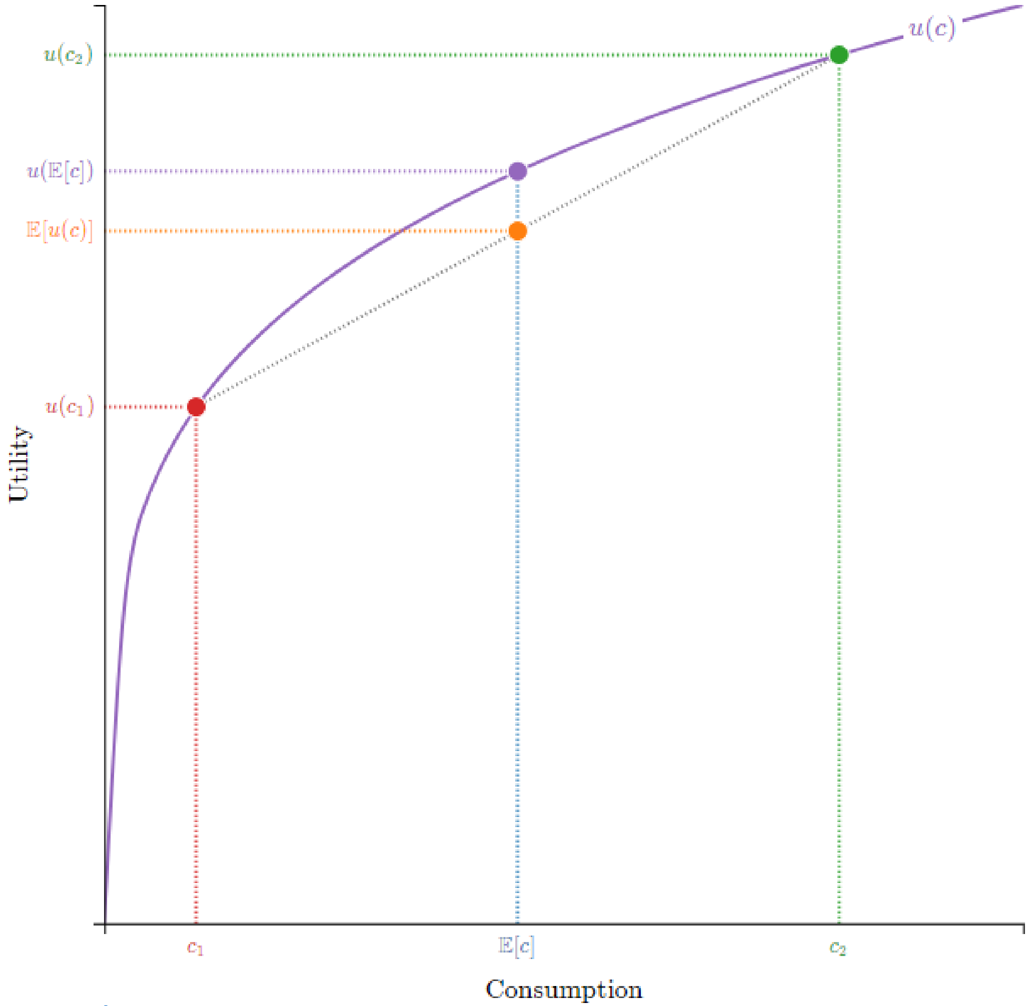


Introducing uncertainty and risk

- All of our analysis so far has ignored **uncertainty** and **risk**
- We introduce risk using cardinal utility function based on real goods consumption or real income
- Utility function of goods $u(c)$ or of income $u(I)$
- Key statistical concepts:
  - **Expected value** = average outcome of many random trials = sum of possible outcomes weighted by their probabilities of occurring
  - **Variance** measures how much the actual outcome is likely to deviate from the expected value
  - High variance = high risk

Utility functions, risk, and expected utility

- **Marginal utility** = $\Delta u / \Delta c$ declines with increasing c
  - Utility function is concave down
- Maximize expected utility
- In diagram, c_1 and c_2 occur with equal probability
  - $E(c) = ½ (c_1 + c_2)$
- $u[E(c)] > E[u(c)]$
  - **Risk aversion**: prefer average outcome with certainty to risky bet



https://www.econgraphs.org/graphs/micro/exchange/risk_aversion/ec_vs_eu_vs_uec

Risk and financial markets

- Financial (and real) investments are always risky
- Ideal asset: high return and low risk
  - Everyone wants them, so their price is bid upward
  - Higher price will lower rate of return
  - Low-risk assets generally bear lower equilibrium rates of return than high-risk assets
  - Savers face tradeoff between low-risk-low-return (Treasury bills) and high-risk-high-return assets (junk bonds)
- **Insurance markets**: Why do people buy insurance?
- **Lotteries and gambling**: Why do people gamble?
  - Betting against favorite team to lower utility risk?

Review

- Financial capital markets involve borrowing and lending
  - Finance durable assets (real capital)
- Present value allows us to compare present vs. future
- We can calculate net present value of a capital investment project based on interest rate and expected costs and benefits
  - Rate of return on project is another way of expressing this
- Real interest rates matter to borrowers and lenders
- Equilibrium real interest rate comes from loanable-funds market
- We model uncertainty and risk aversion using expected utility

Daily diversion: Another bad economist joke

An economist was crossing a road one day when a frog called out to him and said, "If you kiss me, I'll turn into a beautiful princess." He bent over, picked up the frog, and put it in his pocket.

The frog spoke up again and said, "If you kiss me and turn me back into a beautiful princess, I will stay with you for one week." The economist took the frog out of his pocket, smiled at it, and returned it to his pocket.

The frog then cried out, "If you kiss me and turn me back into a princess, I'll stay with you for a week and do ***anything*** you want." Again the economist took the frog out, smiled at it and put it back into his pocket.

Finally, the frog asked, "What's the matter with you? I've told you I'm a beautiful princess, and that I'll stay with you for a week, and do anything you want. Why won't you kiss me?"

The man said, "Look, I'm an economist. I don't have time for a girlfriend … But a talking frog is cool!"

What comes next?

- Friday’s class considers equilibrium and efficient resource allocation in the economy as a whole
- No case study (and no conference meeting) on Friday
- Problem Set #6 is due next Wednesday and covers material we have completed
- Next week’s classes discuss “market failures”