Economics 2 Professor Christina Romer
Spring 2019 Professor David Romer

LECTURE 19
SAVING AND INVESTMENT IN THE LONG RUN
April 4, 2019

I. OVERVIEW

II. REVIEW OF THE INVESTMENT DEMAND CURVE

III. SAVING AND INVESTMENT
- A. The uses of Y*
- B. Equilibrium
- C. Decomposing national saving into private and public saving

IV. NATIONAL SAVING AND THE REAL INTEREST RATE
- A. Utility maximization
- B. The supply of saving curve
- C. Example: A tax cut

V. THE DETERMINANTS OF INVESTMENT AND THE REAL INTEREST RATE IN THE LONG RUN
- A. Equilibrium r* and I*
- B. Example: A tax cut revisited
- C. Example: A new technology that raises future MRP_K's

VI. STOCK PRICES
- A. Financial capital versus physical capital
- B. Stock price equals the PV of expected future dividends
- C. What affects stock prices?
- D. The efficient markets hypothesis

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Midterm 2 Reminders

- Tuesday, April 9th, 2:10–3:30.
- You do ***not*** need a blue book.
- If your GSI is Todd Messer (Sections 101 and 102), go to 60 Barrows; if your GSI is Priscila de Oliveira (Sections 103 and 104), go to 3108 Etcheverry; if your GSI is Vitaliia Yaremko (Sections 111 and 114), go to 170 Barrows.
- DSP Students: If you haven't received an email from Todd Messer about arrangements, please contact him (messertodd@berkeley.edu).
- Everyone else come to usual room (2050 VLSB).

Announcements

- The answer sheet to Problem Set 4 will be posted this evening.
- Review session: Friday, April 5, 6–8 p.m. in the usual lecture room (2050 VLSB).

I. Overview

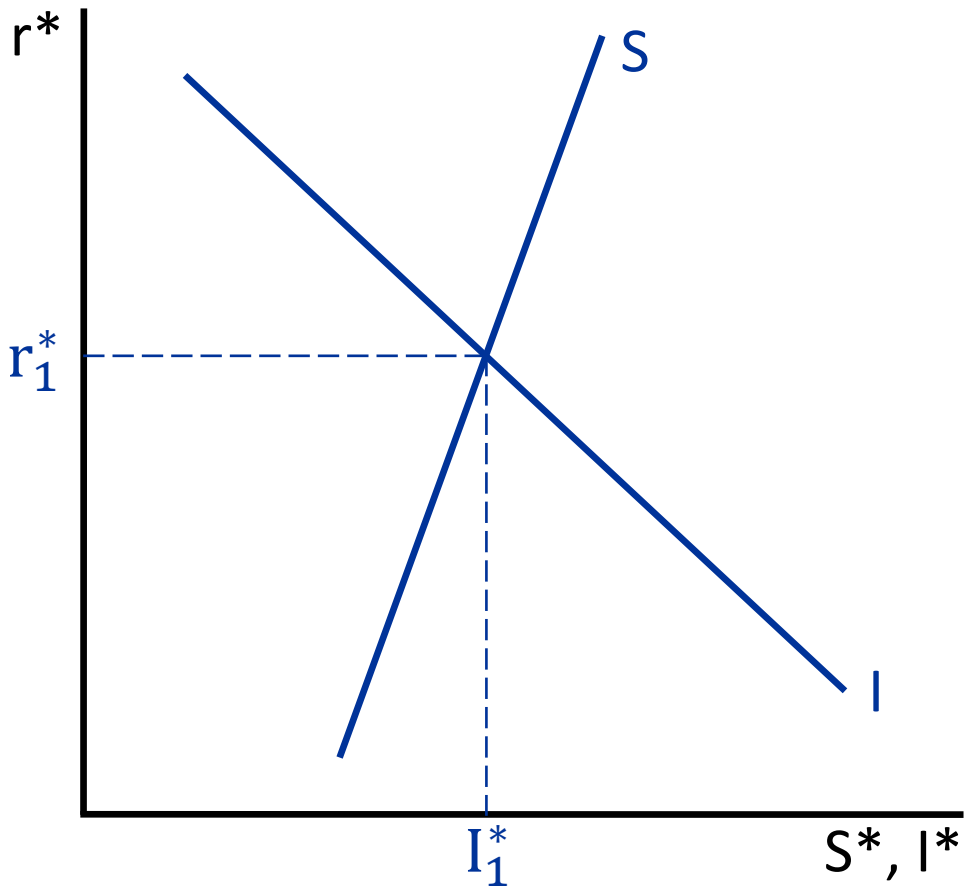
Aggregate Production Function

(1) $$\frac{Y^*}{POP} = \frac{Y^*}{N^*} \bullet \frac{N^*}{POP}$$

(2) $$\frac{Y^*}{N^*} = f\left(\frac{K^*}{N^*}, T\right)$$

(3) $$\frac{Y^*}{POP} = f\left(\frac{K^*}{N^*}, T\right) \bullet \frac{N^*}{POP}$$

Where We're Headed: The Long-Run Saving and Investment Diagram



Here S is saving, I is investment, and r is the real interest rate (and * denotes a long-run value).

II. Review of the Investment Demand Curve

The Condition for Profit Maximization

- Capital is an input into production, so one might think profit-maximization implies that a firm will buy new capital goods (that is, invest) to the point where MRP_K = Purchase Price of Capital Goods.
- But: The purchases price is paid immediately, and a capital good has a marginal revenue product for many years in the future.
- Thus, the condition for profit-maximization is:

$$PV(\text{Stream of } MRP_K\text{'s}) = \text{Purchase Price}$$

- Aside: If we want to be precise, it's really ***expectations*** of the stream of MRP_K's, not the actual MRP_K's.

Writing Out the Condition for Profit Maximization

$$\frac{MRP_{K1}}{(1+r)^1} + \frac{MRP_{K2}}{(1+r)^2} + \frac{MRP_{K3}}{(1+r)^3} + \ldots + \frac{MRP_{Kt}}{(1+r)^t}$$

$$= \text{Purchase Price},$$

where:

- MRP_{Kn} = Marginal revenue product in year n
- r = interest rate (expressed as a decimal)
- t = number of years in the future the piece of capital will have a marginal revenue product.

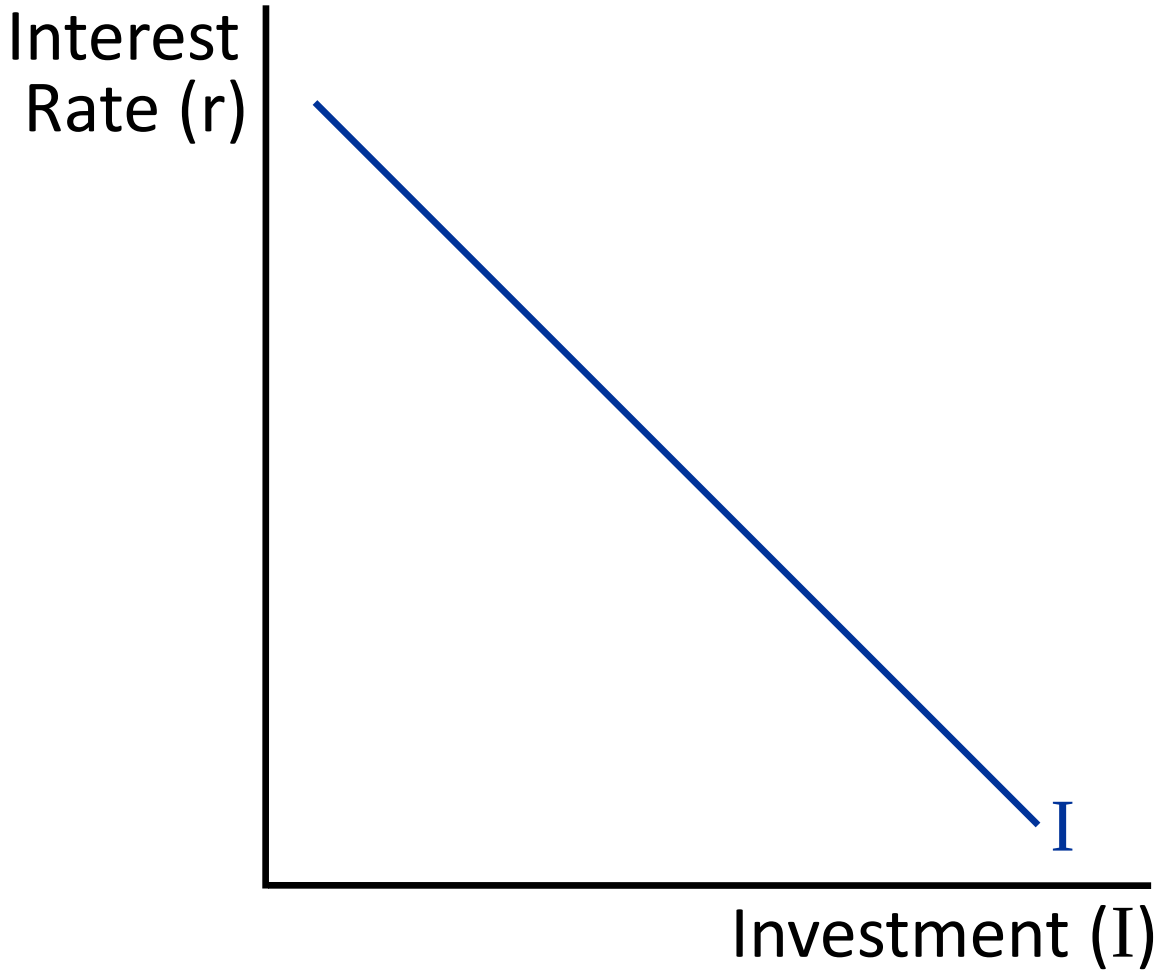
Why is there a negative relationship between purchase of new capital and the interest rate?

- Recall: A firm buys capital to the point where:

  PV(Stream of MRP_K's) = Purchase Price

- A term involving r appears in the denominator of expressions for present value: an amount to be received in the future is less valuable when the interest rate is higher.
- An increase in r therefore causes PV(Stream of MRP_K's) to fall.
- To restore the condition for profit-maximization, the firm reduces its investment (which increases MRP_K's).

Investment Demand Curve



Why Investment Demand Depends on the ***Real*** Interest Rate—Version 1

- Recall: the firm buys new capital until:

  PV(Stream of MRP_K's) = Purchase Price

- Think of measuring everything in real (that is, inflation adjusted) terms.
- Then, since we are computing prevent values of real amounts, the right interest rate to use in computing present values is the real interest rate.
- Thus, if i rises only because π rises, nothing in this expression changes, and so investment demand does not change. So, investment demand depends on the ***real*** interest rate.

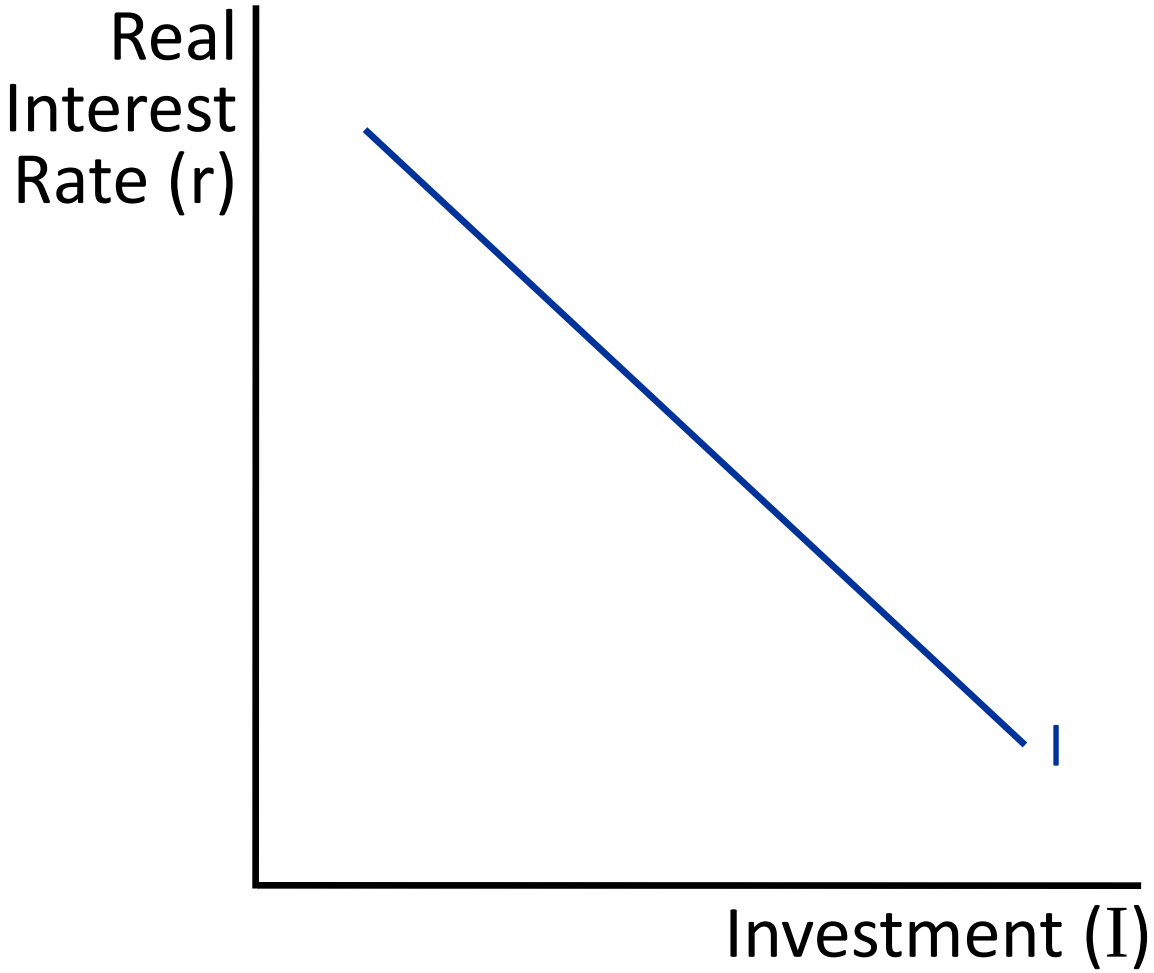
Why Investment Demand Depends on the ***Real*** Interest Rate—Version 2

- For a competitive firm, PV(Stream of Future MRP_K's)

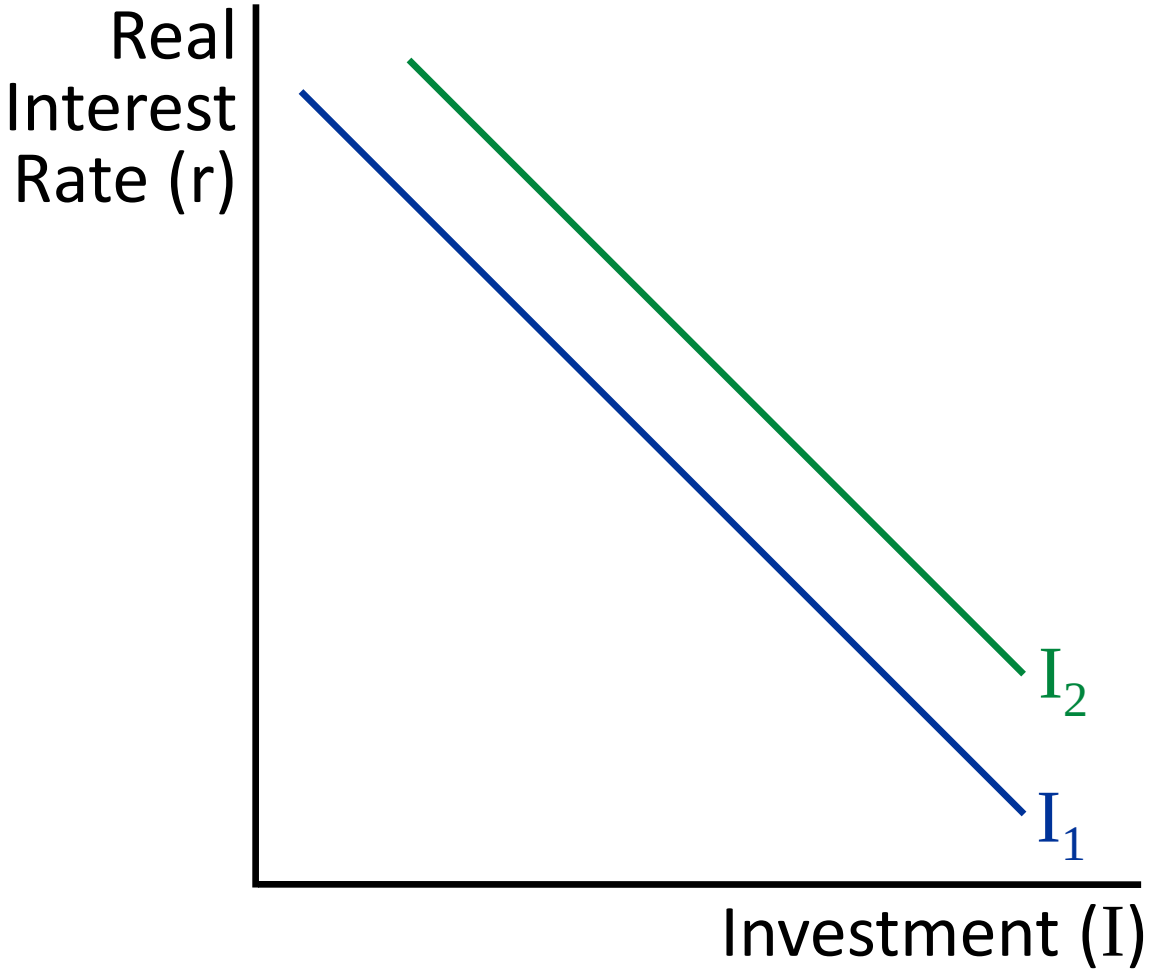
$$= \frac{MP_K \bullet P_1}{(1+i)^1} + \frac{MP_K \bullet P_2}{(1+i)^2} + \frac{MP_K \bullet P_3}{(1+i)^3} + \ldots + \frac{MP_K \bullet P_t}{(1+i)^t}$$

- Recall that $i = r + \pi$.
- If i rises only because π rises, PV won't change because the P's will also rise, and so investment demand does not change.
- If i rises because r rises, PV will fall, and so investment demand falls. So, investment demand depends on the ***real*** interest rate.

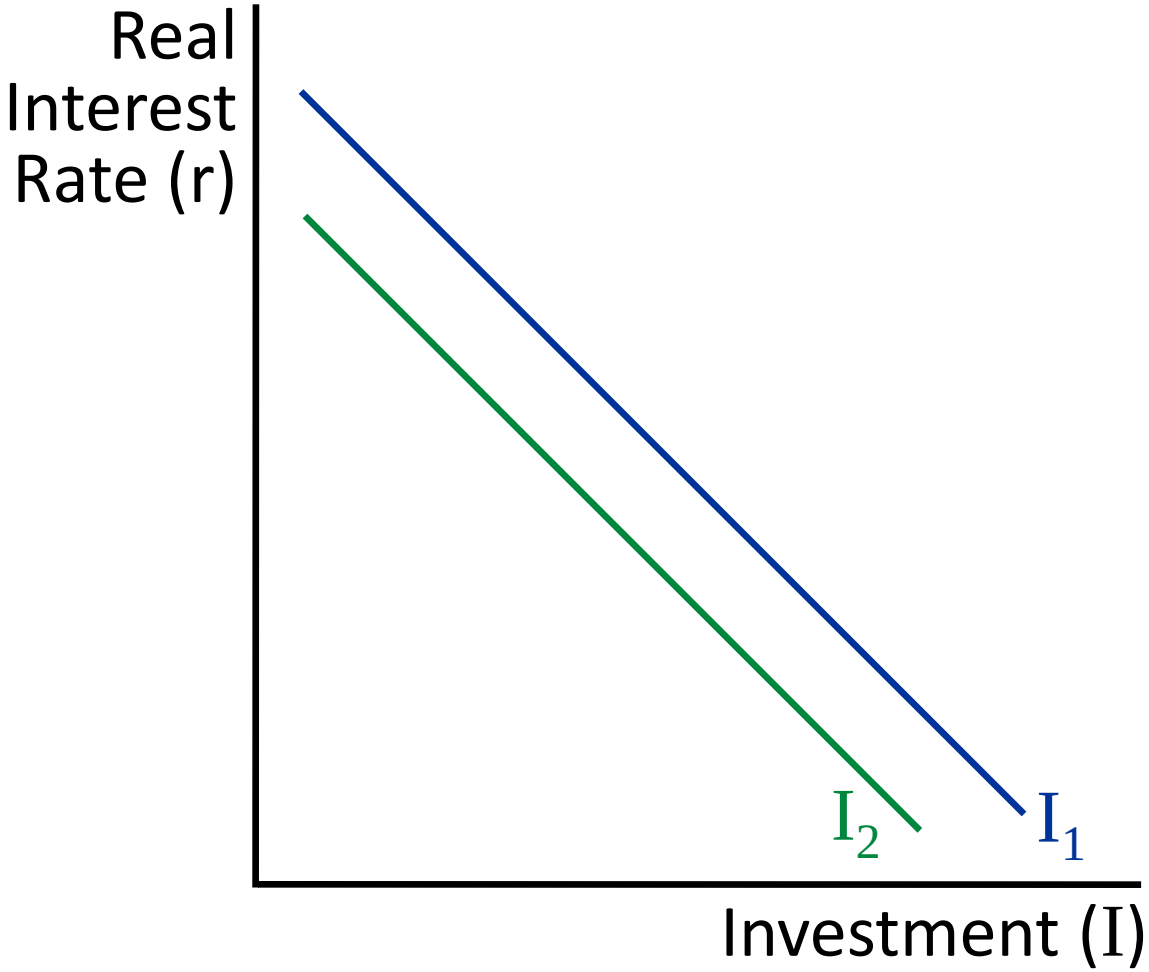
Investment Demand Curve



Shifts in the Investment Demand Curve (Fall in the Purchase Price of Capital)

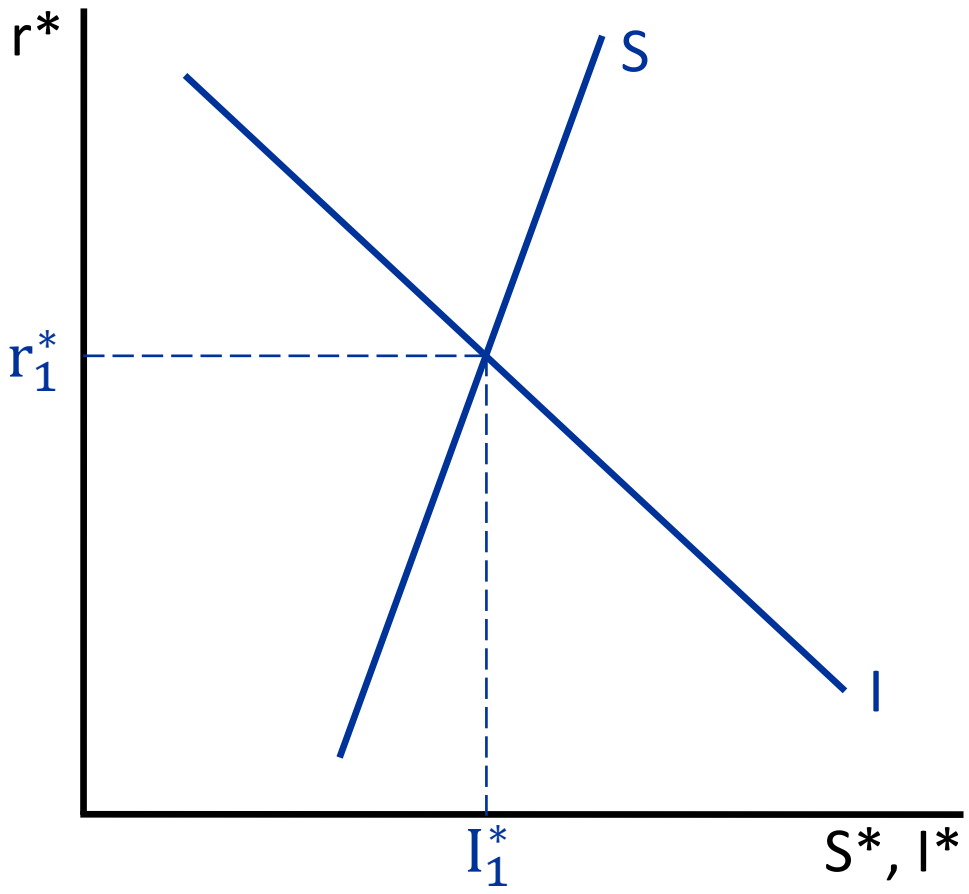


Shifts in the Investment Demand Curve (Pessimism about Future MRP_K's)



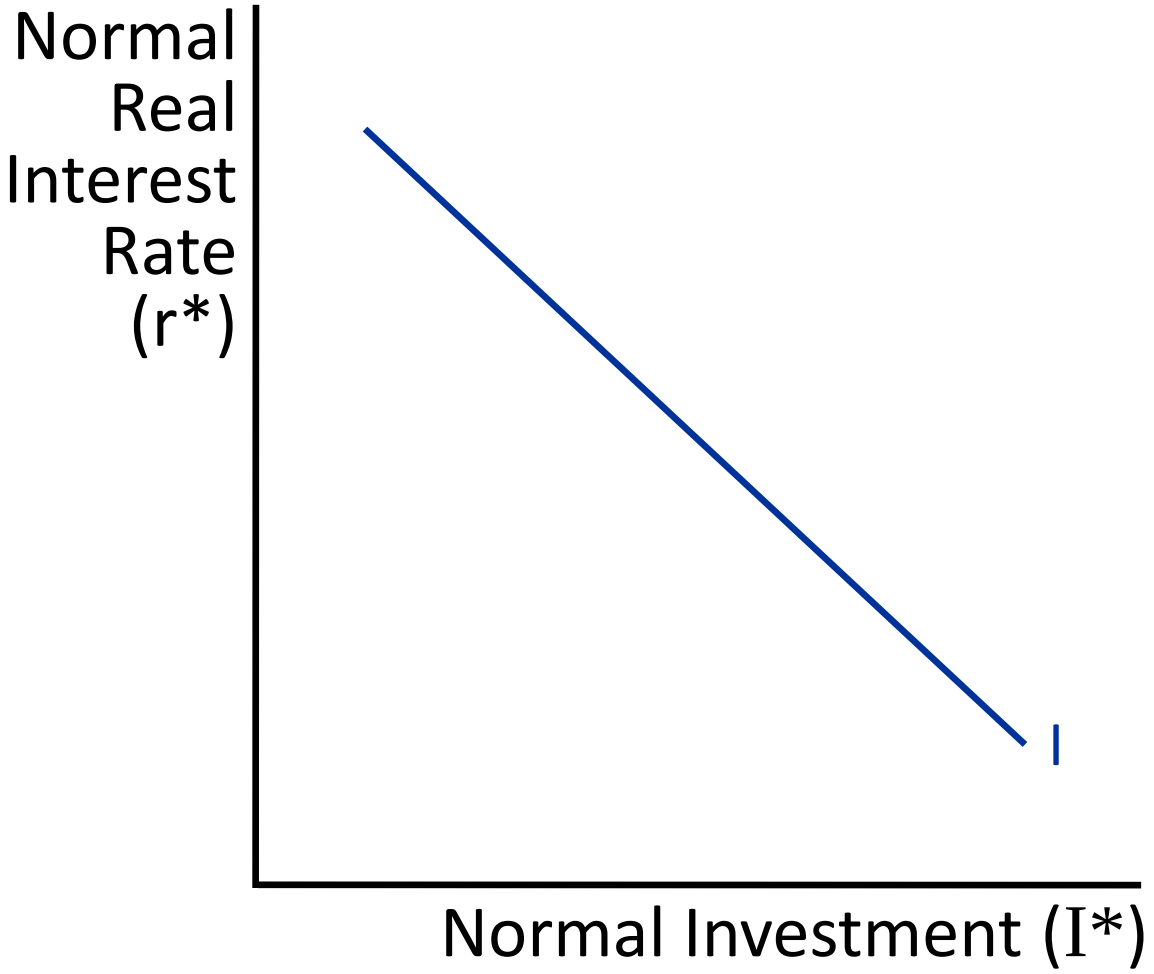
III. Saving and Investment

Where We're Headed: The Long-Run Saving and Investment Diagram



Here S is saving, I is investment, and r is the real interest rate (and * denotes a long-run value).

The Relationship between Normal Investment and the Normal Real Interest Rate



The Uses of Potential Output

- Consumption (C*)
- Investment (I*)
- Government purchases (G*)
- Net Exports (NX*)

For now, we will assume that NX* = 0.

Stars denote normal, long-run values.

Equilibrium Condition

$$Y^* = C^* + I^* + G^*$$

We can rearrange this as:

$$Y^* - C^* - G^* = I^*$$

- $Y^* - C^* - G^*$ is normal national saving supply (S^*).
- I^* is normal investment demand.
- Thus, equilibrium requires $S^* = I^*$.

Private and Public Saving

$$S^* = Y^* - C^* - G^*$$

$$= Y^* - C^* - G^* + (T^* - T^*)$$

(where T^* is normal tax revenue)

$$= \underbrace{(Y^* - T^* - C^*)}_{\text{Private Saving}} + \underbrace{(T^* - G^*)}_{\text{Public Saving}}$$

- Thus, we can write the equilibrium condition as:
  - $S^* = I^*$; or as
  - $Y^* - C^* - G^* = I^*$; or as
  - $(Y^* - T^* - C^*) + (T^* - G^*) = I^*$.

IV. National Saving and the Real Interest Rate

The Supply of Saving

- Recall: Normal national saving (S^*) = $Y^* - C^* - G^*$.
- Y^* is determined by K^*/N^*, technology, and N^*/POP.
- We take G^* as given.
- So: To understand what determines S^*, we need to understand what determines C^*.

The Real Interest Rate and the Opportunity Cost of Current Consumption

- Think of a household trying to maximize its utility from consumption today and consumption in the future.
- If the real interest rate rises, the opportunity cost of consuming today rises: What you give up to consume today is higher because the real return you would earn on saving is higher than before.
- That is, the real interest rate is a component of the opportunity cost of current consumption.

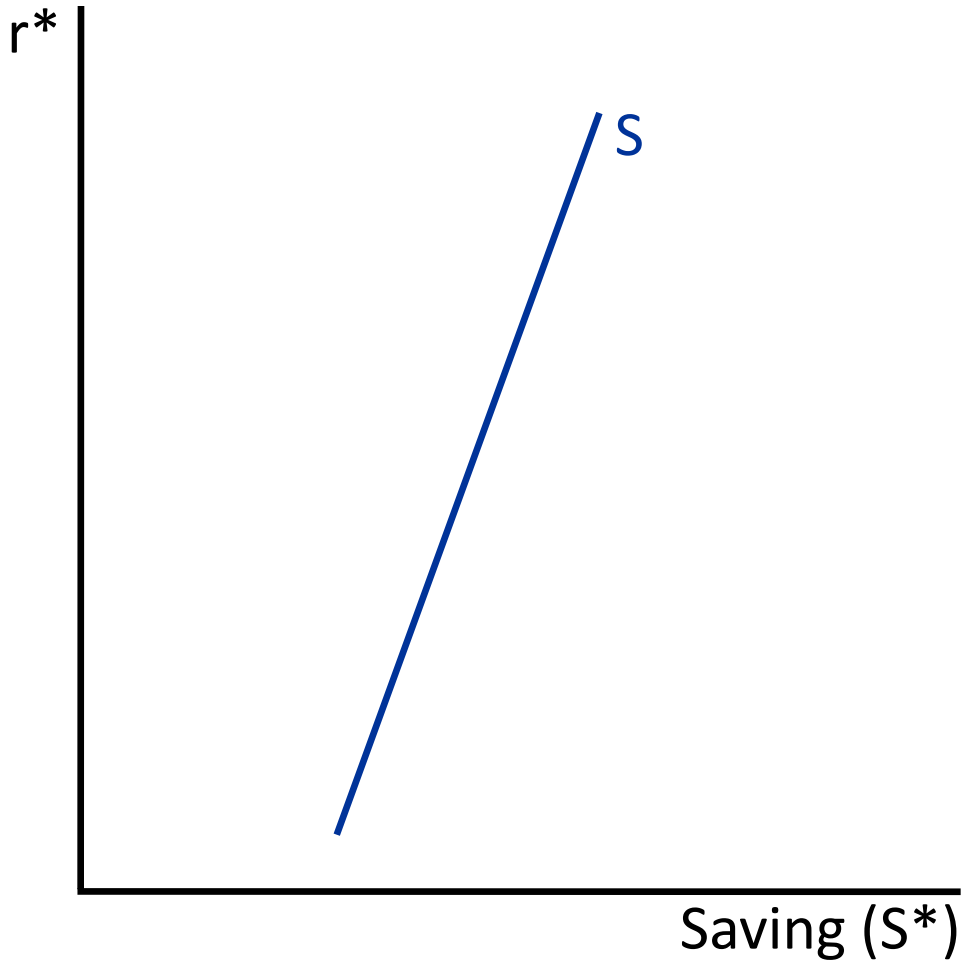
The Real Interest Rate and Saving

- The condition for utility maximization between consumption today and consumption in the future:

$$\frac{\mathrm{MU}_{\mathrm{current}}}{\mathrm{P}_{\mathrm{current}}} = \frac{\mathrm{MU}_{\mathrm{future}}}{\mathrm{P}_{\mathrm{future}}}$$

- If the real interest rate rises, the relative price (opportunity cost) of current consumption rises.
- To maximize utility, the household therefore needs to consume less today.
- That is, it needs to save more.

The Supply of Saving

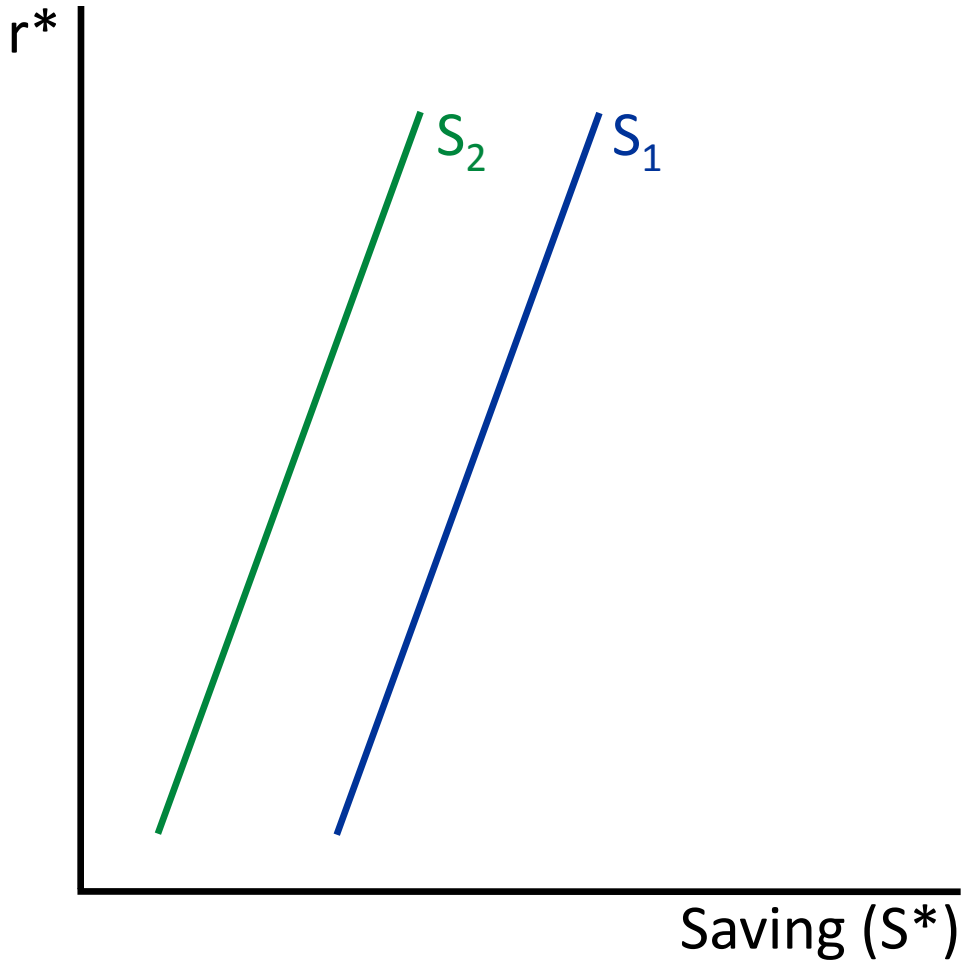


Recall: $S^* = Y^* - C^* - G^*$

A Note on How We Model the Government

- Recall: We take G* as given.
- This means that we assume it doesn't respond to other variables.
- So, for example, when we consider the effects of a change in T*, we assume G* doesn't change.
- Aside: This is just a specific example of *ceteris paribus* from early in the semester.

Example: A Tax Cut



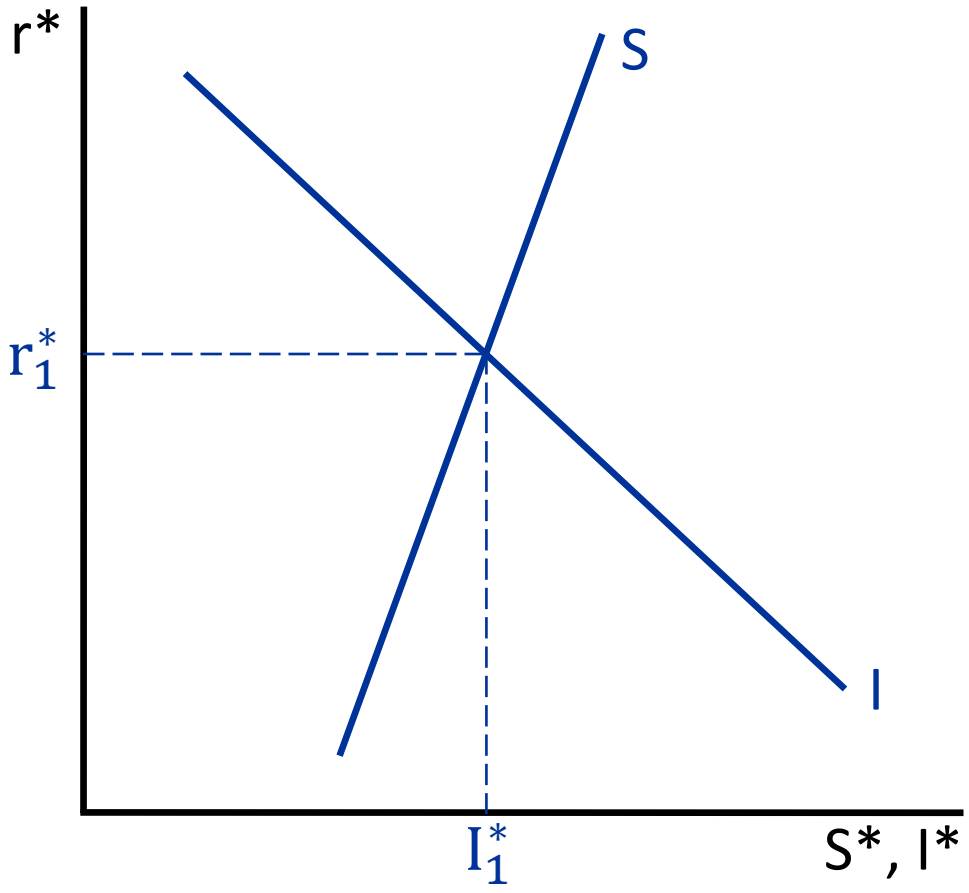
Recall: $S^* = Y^* - C^* - G^*$

Private and Public Saving and a Tax Cut

- We assume that when $Y^* - T^*$ rises, C^* is higher at a given r, but by less than the amount of the rise in $Y^* - T^*$.
- Recall: $S^* = \underbrace{(Y^* - T^* - C^*)}_{\text{Private Saving}} + \underbrace{(T^* - G^*)}_{\text{Public Saving}}$
- Suppose there is a tax cut. At a given r:
  - $T^* - G^*$ falls by the full amount of the tax cut.
  - $Y^* - T^* - C^*$ rises, but by less than the amount of the tax cut (because C^* rises).
  - So S^* falls at a given r.

V. The Determinants of Investment and the Real Interest Rate in the Long Run

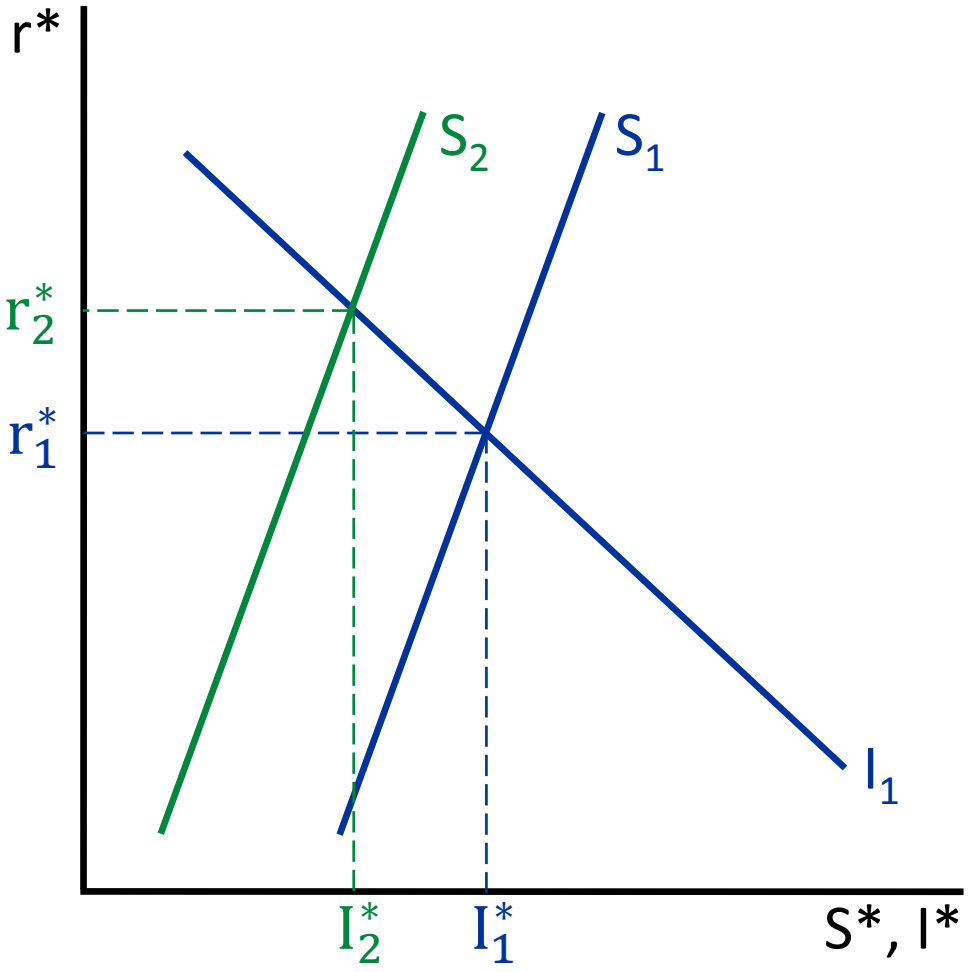
The Long-Run Saving and Investment Diagram



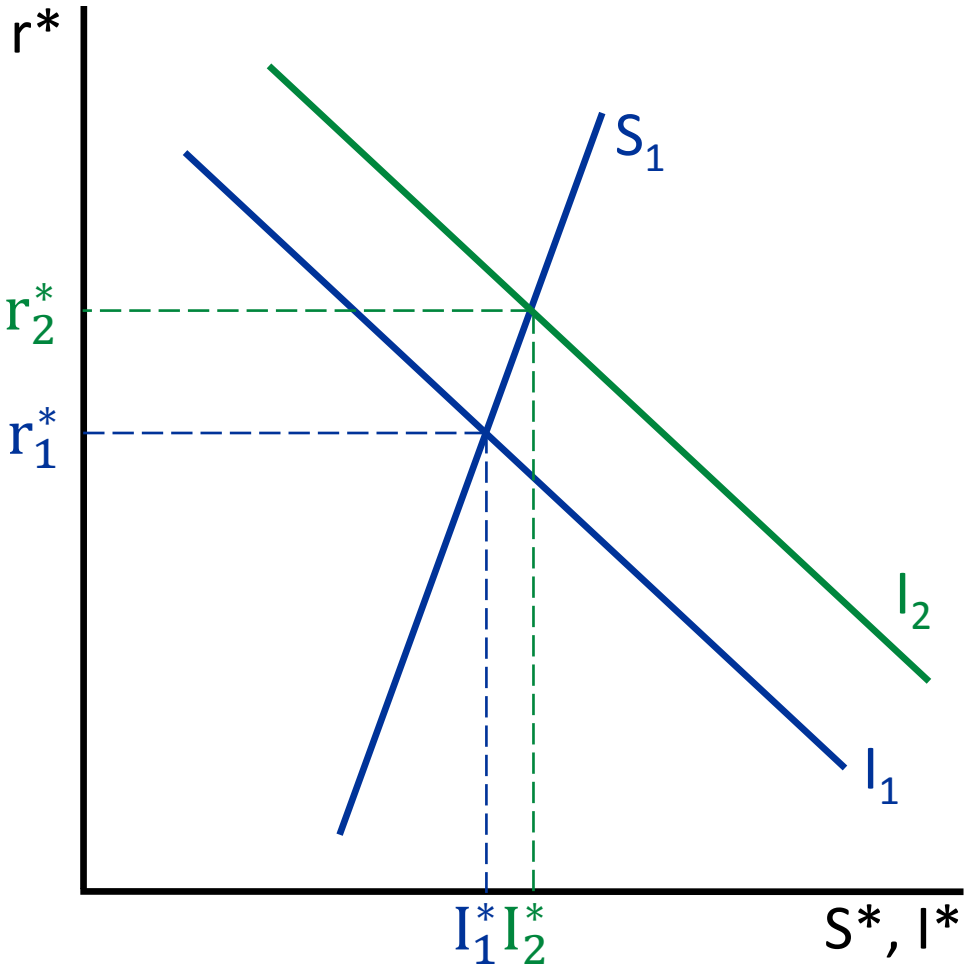
Recent U.S. Fiscal Developments

- In the past year and a half, there has been a large tax cut and a large increase in government purchases.
- Most observers think that output is currently close to potential ($Y \approx Y^*$).

A Tax Cut and "Crowding Out"



A New Technology That Raises Future MRP_K's



VI. Stock Prices

Physical Capital versus Financial Capital

- Physical capital refers to aids to the production process that were made in the past: machines, buildings, trucks, computers.
- Financial capital refers to the funds used to purchase, rent or build physical capital.

Two Ways to Raise Financial Capital

- Issue bonds: borrow funds in return for a promise to repay later with interest.
- Issue stocks: sell people a share of the company. In return, they are entitled to a share of future profits (that is what a dividend is).

What should someone be willing to pay for a stock?

Stock price =

PV(Stream of Expected Future Dividends)

What moves stock prices?

- A change in the interest rate.
  - Lower interest rates, all else equal, are likely to be associated with higher stock prices.
- A change in expected future dividends.
  - If something makes people expect higher future dividends, that should be associated with a higher stock price.
  - The higher expected dividends could apply to a particular firm or to firms in general.

Facebook Stock Price and News of Privacy Breach

Market summary > Facebook, Inc. Common Stock

NASDAQ: FB - Mar 19, 7:59 PM EDT

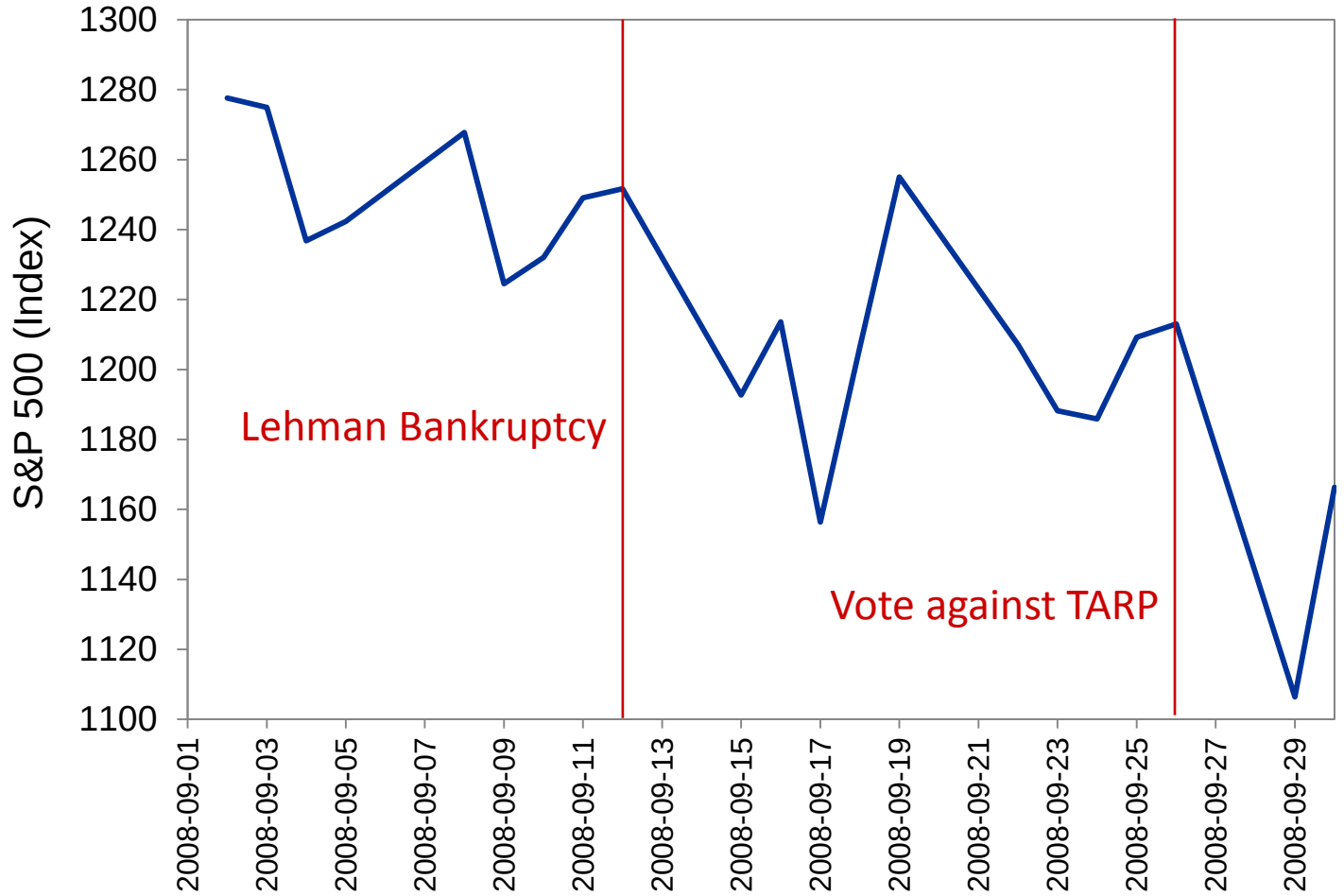
172.56 USD ↓12.53 (6.77%)

After-hours: 170.00 ↓1.48%

1 day | 5 day | 1 month | 3 month | 1 year | 5 year | max

Google Finance - Yahoo Finance - MSN Money

S&P 500 and News about the Financial Crisis



Source: FRED, Federal Reserve Bank of St. Louis.

Efficient Markets Hypothesis

- It is difficult to make money off news in the stock market because information is processed very quickly.