Economics 2 | Professor Christina Romer
Spring 2020 | Professor David Romer

LECTURE 19

SAVING AND INVESTMENT IN THE LONG RUN

April 2, 2020

I. <u>OVERVIEW</u>

II. <u>REVIEW OF THE INVESTMENT DEMAND CURVE</u>

  A. The Nominal vs. the Real Interest Rate
  B. Why Investment Demand Depends on the Real Interest Rate
    1. General
    2. Example
  C. The Real Interest Rate and Investment
  D. Example

III. <u>SAVING AND INVESTMENT</u>

  A. The uses of Y*
  B. Equilibrium
  C. Decomposing national saving into private and public saving

IV. <u>NATIONAL SAVING AND THE REAL INTEREST RATE</u>

  A. Utility maximization
  B. The supply of saving curve
  C. Example: A tax cut

V. <u>THE DETERMINANTS OF INVESTMENT AND THE REAL INTEREST RATE IN THE LONG RUN</u>

  A. Equilibrium r* and I*
  B. Example: A tax cut revisited
  C. Example: A new technology that raises future MRP_K's

VI. <u>STOCK PRICES</u>

  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

- Please make sure you've read the long email we sent last Sunday (the slides at the start of Lecture 18 and the recording of the Q&A at the end of that lecture may also be useful).
- Tuesday, April 7, 2:00–3:30 p.m. (PDT).
- If you would prefer to take it 10:00 – 11:30 p.m. (PDT), email Todd Messer (messertodd@berkeley.edu) ***by 5 p.m (PDT) tomorrow (April 3)***.

Midterm 2 Reminders

- The exam will be distributed and submitted through Gradescope.
- We will do a trial run this weekend: We will distribute a short assignment through Gradescope. You need to do the assignment and upload it to Gradescope by 5 p.m. (PDT) Monday (April 6).
- Doing the trial run is required!
- DSP students: If you do not receive an email from Todd Messer by April 3, please contact him.

Midterm 2 Ground Rules

- Open book and open note: You may use official class resources (book, slides, problem set answer sheets, and your notes).
- Not open internet: You may not use anything else—you may not confer with other students in any way, or use any non-class-provided resources.
- ***Study and prepare just as you would for a traditional, closed-note exam!***

Announcements

- The answer sheet to Problem Set 4, Part 2 will be posted this evening.

I. Overview

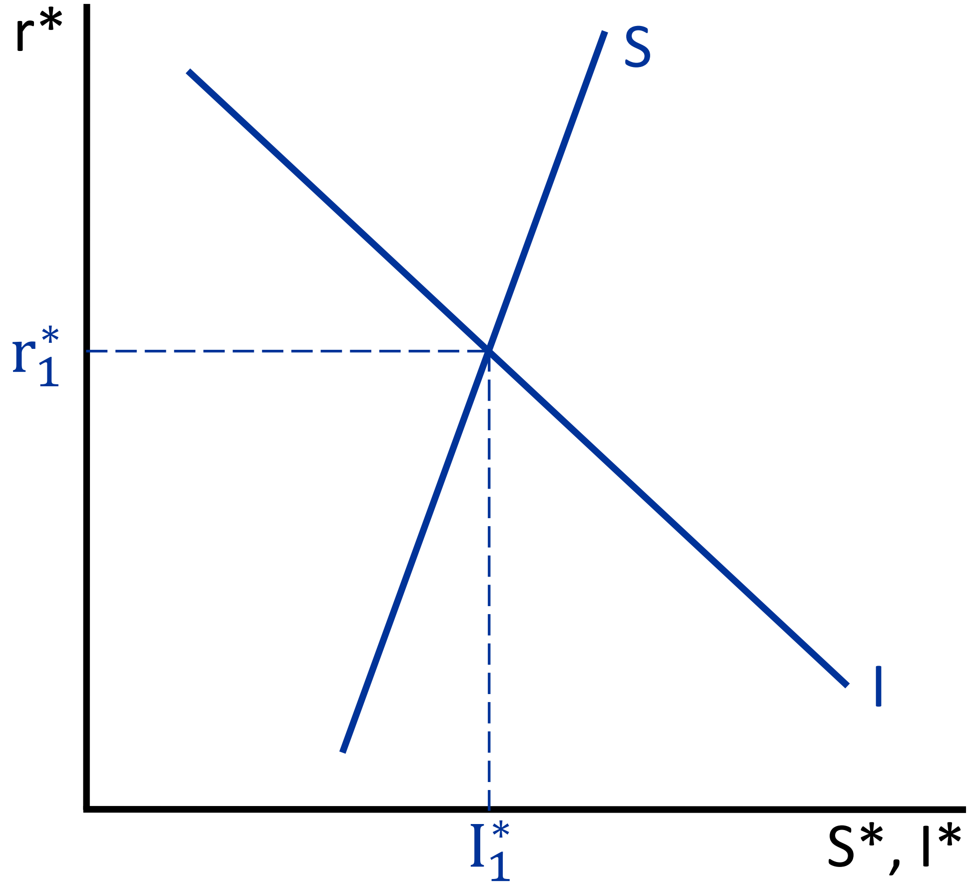
Aggregate Production Function

(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 Nominal vs. the Real Interest Rate

- Recall: The interest rate is the percentage increase in your balance if you didn't make any deposits or withdrawals.

- The ***nominal*** interest rate is just the conventional or stated interest rate—the percentage increase in the balance in dollars.

- The ***real*** interest rate is the percentage increase in your balance ***measured in terms of purchasing power (that is, adjusted for changes in prices)*** if you didn't make any deposits or withdrawals.

The Nominal vs. the Real Interest Rate (cont.)

- If the inflation rate is π percent, the first π percentage points of whatever the nominal interest rate is just makes up for inflation. Only the remainder increases the real value of your balance.

- Thus, the real interest rate (r) satisfies:

$$r = i - \pi$$

- Example: If inflation is 2% and the nominal interest rate is 3%, the real interest rate is:

$$r = 3\% - 2\%$$

$$= 1\%$$

The Profit-Maximizing Level of Investment

- Firms want to purchase capital up to the point where:

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

- Why it's the ***present value*** of the Stream of MRP_K's: the firm receives the MRP_K's in the future.

- Why the firm needs to use the ***real*** interest rate to compute the present value: think of measuring the MRP_K's in real (or inflation-adjusted) terms.

Why It's the Real Interest Rate That Affects Investment Demand—Example

- A competitive firm in year t is thinking of buying a machine that will have a marginal physical product of 1 in year t+1 and in year t+2, and 0 thereafter.
- Suppose, π and r are both 0.
- Then i = 0.
- π = 0 implies $P_{t+2} = P_{t+1} = P_t$. (P_t is the price of the good sold by the firm in period t.)
- So, PV(Stream of MRP_K's) $= \frac{P_{t+1}}{1+i} + \frac{P_{t+2}}{(1+i)^2}$

$$= P_t + P_t.$$

Why It's the Real Interest Rate That Affects Investment Demand—Example (continued)

- Suppose instead inflation is 100%, still with r = 0.
- Then i = 100%.
- π = 100% implies $P_{t+1} = (1 + \pi)P_t = 2P_t$, and $P_{t+2} = (1 + \pi)^2 P_t = 2^2 = 4P_t$.
- So, PV(Stream of MRP_K's) $= \frac{P_{t+1}}{1+i} + \frac{P_{t+2}}{(1+i)^2}$

$$= \frac{2P_t}{2} + \frac{4P_t}{2^2}$$

$$= P_t + P_t.$$

Why It's the Real Interest Rate That Affects Investment Demand—Example (continued)

- Suppose instead r is 100%, with $\pi = 0$.
- Then i = 100%.
- $\pi = 0$ implies $P_{t+2} = P_{t+1} = P_t$.
- So, PV(Stream of MRP_K's) $= \frac{P_{t+1}}{1+i} + \frac{P_{t+2}}{(1+i)^2}$

$$= \frac{P_t}{2} + \frac{P_t}{2^2}$$

$$= \frac{3}{4} P_t.$$

Why It's the Real Interest Rate That Affects Investment Demand—Example (concluded)

- The first case (a different i, but the same r) did not affect PV(Stream of MRP_K's).

- The second case (a different r) did affect PV(Stream of MRP_K's).

- These two cases illustrate the general point: We need to use the real interest rate to compute PV(Stream of MRP_K's).

The Real Interest Rate and Investment

- The firm purchases capital up to the point where:

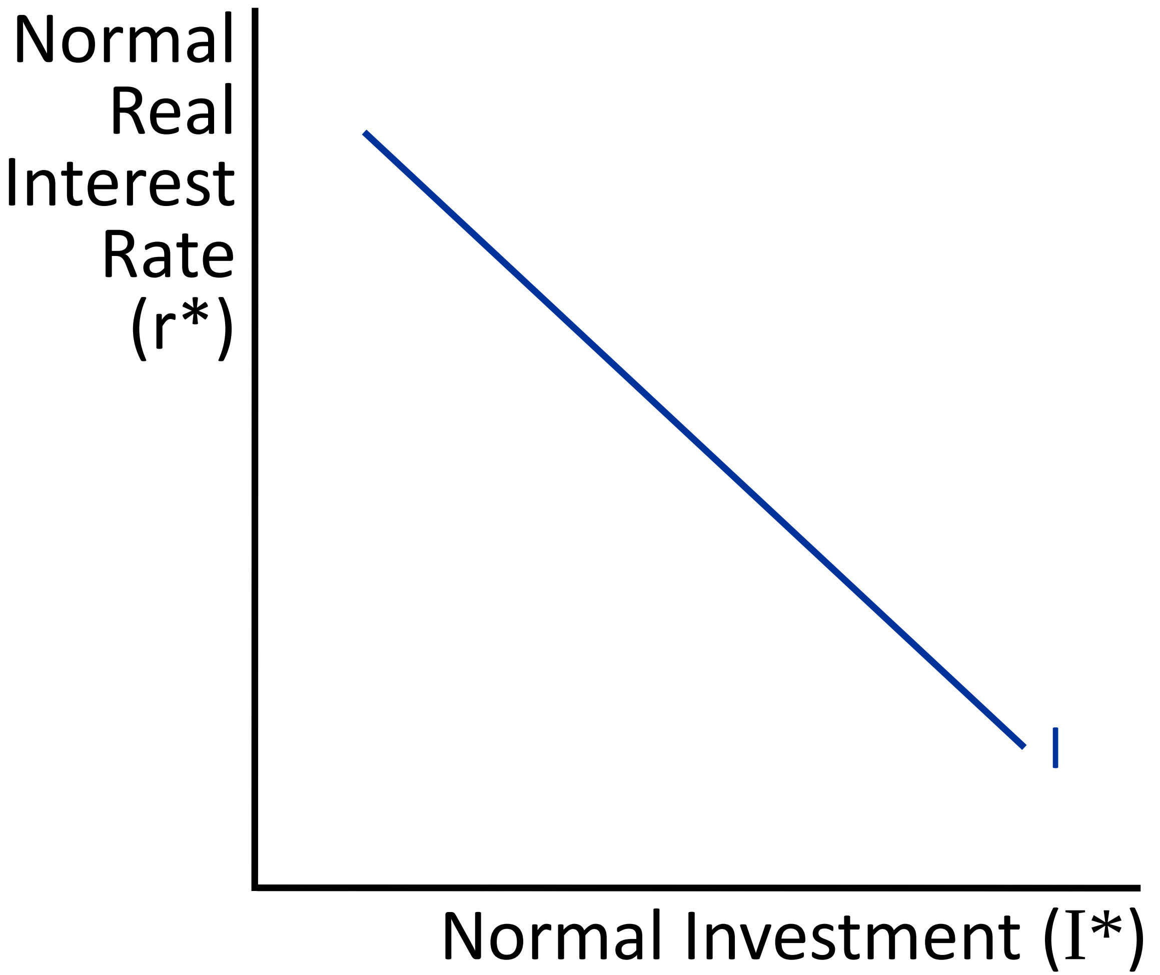
$$\frac{\text{Real MRP}_{\text{K1}}}{(1+\text{r})^{1}} + \frac{\text{Real MRP}_{\text{K2}}}{(1+\text{r})^{2}} + \cdots + \frac{\text{Real MRP}_{\text{Kn}}}{(1+\text{r})^{\text{n}}}$$

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

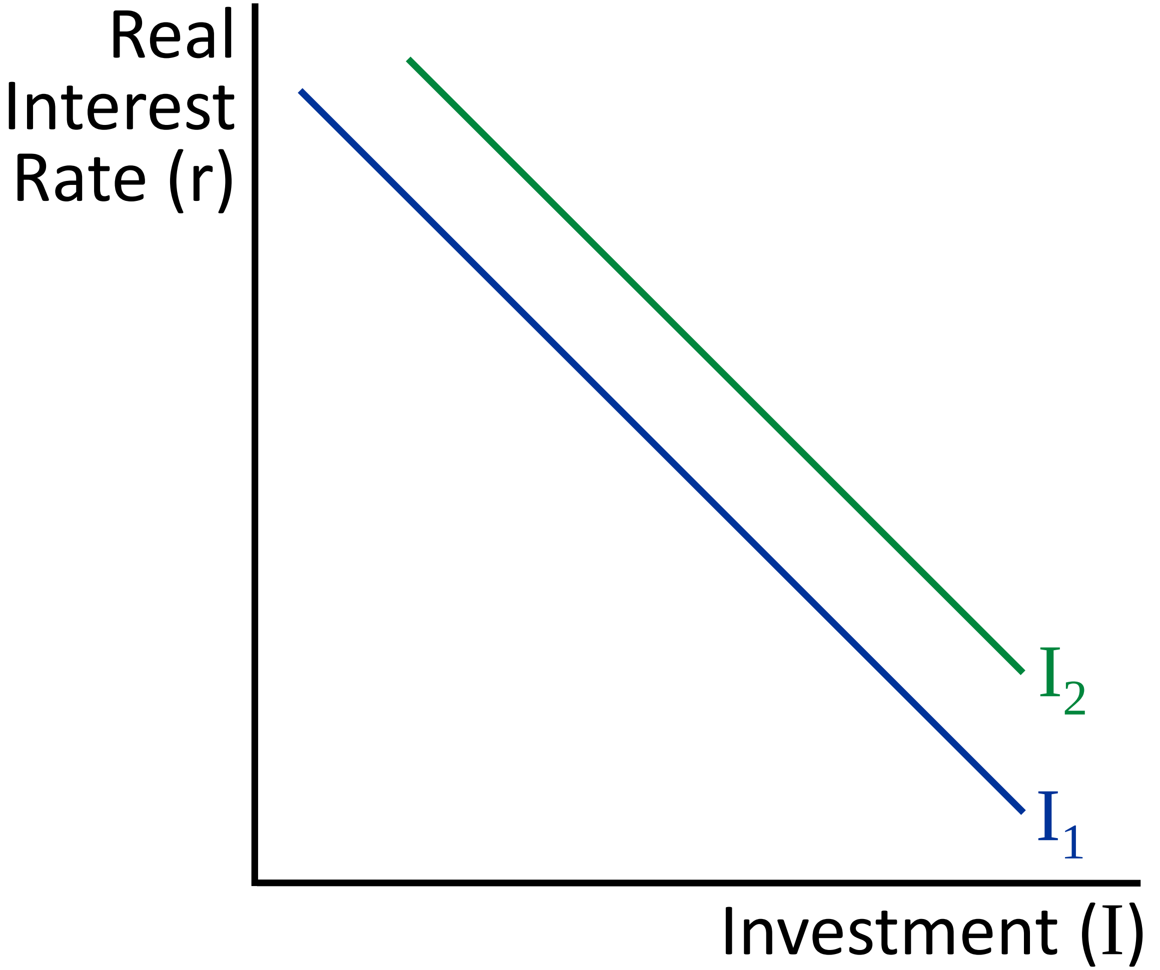
where r is the real interest rate (and n is the lifespan of the capital good).

- If r rises, PV(Stream of MRP_K's) falls.
- To restore the condition for profit-maximization, the firm reduces its investment (which increases MRP_K's).

The Relationship between Normal Investment and the Normal Real Interest Rate

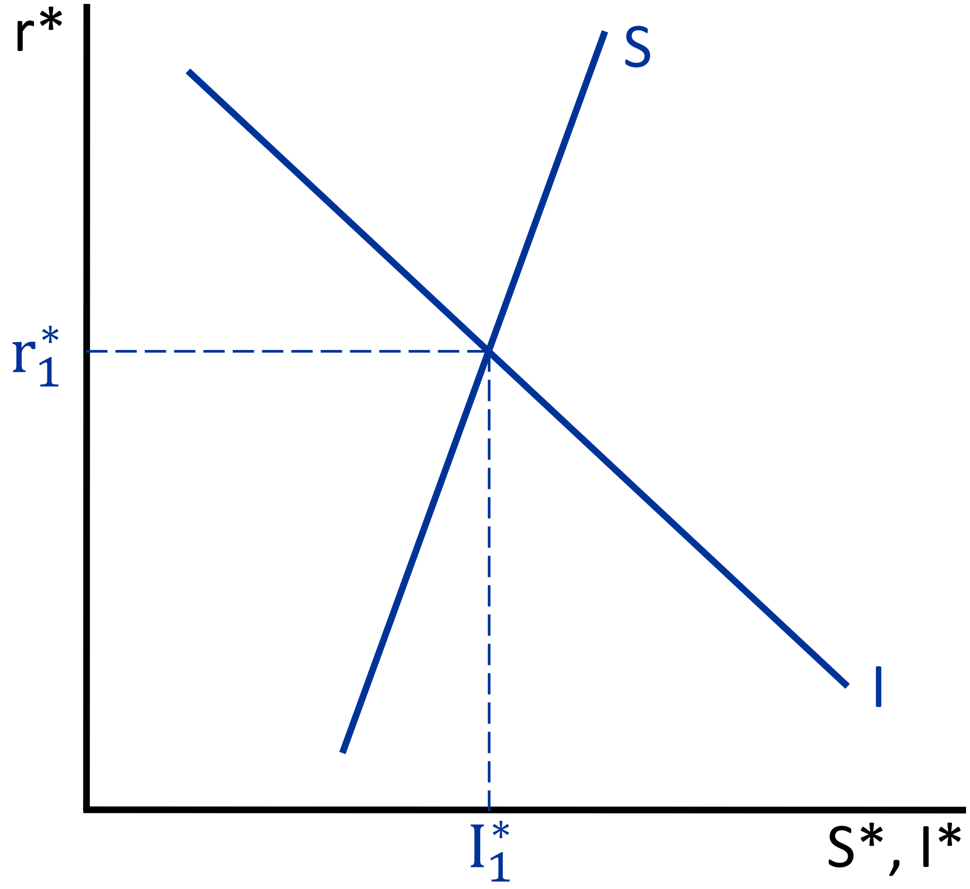


Example: New Investment Goods Are More Productive



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 Uses of Potential Output

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

Stars denote normal, long-run values.

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

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 tax revenue)

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

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

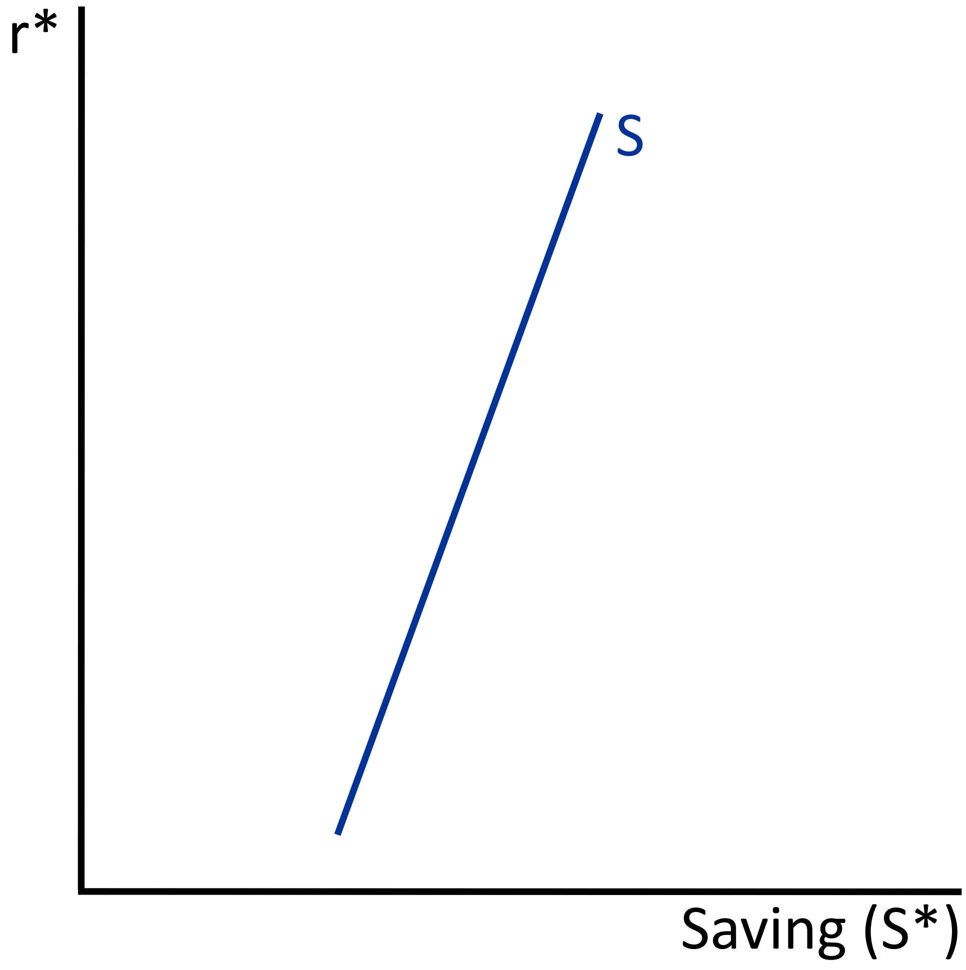
The Real Interest Rate and Saving

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

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

- 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

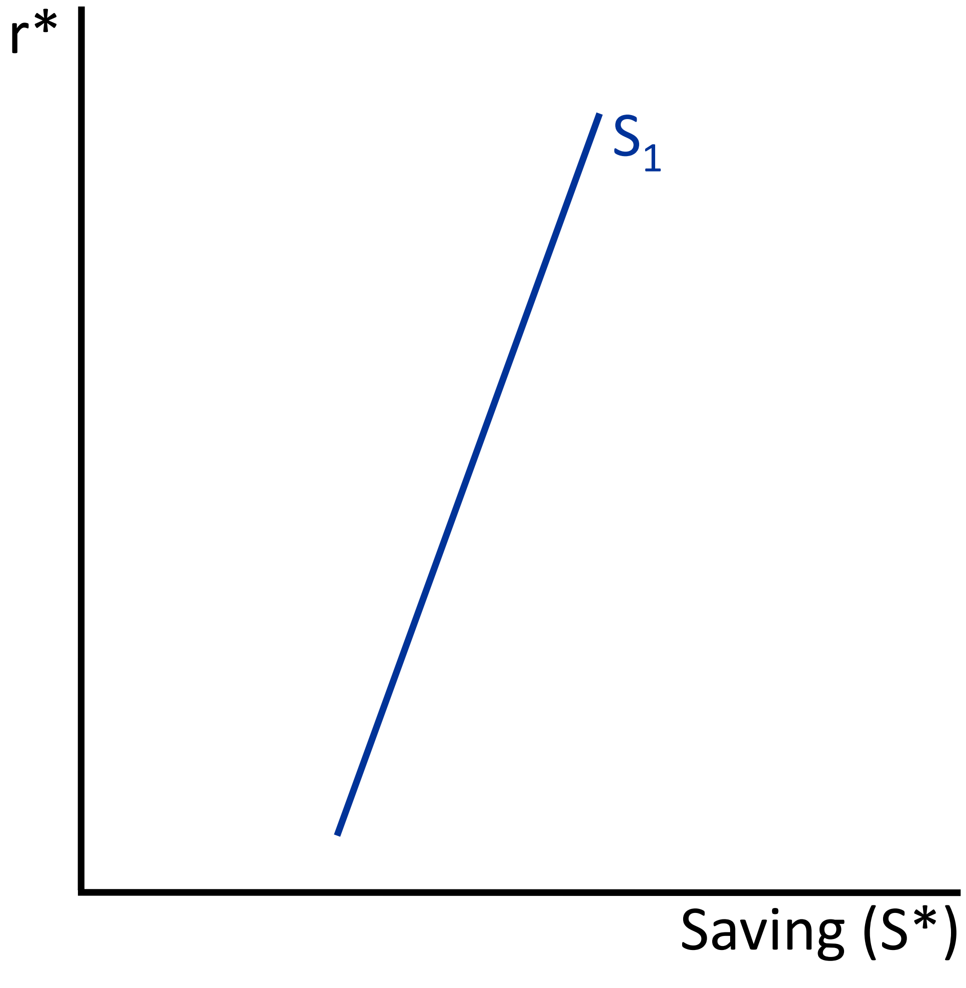


Recall: $S^* = Y^* - C^* - G$

How a Change in Y* — T Affects Consumption and Private Saving

- When a household's current Y* – T rises, its budget constraint between current and future consumption shifts out.
- A utility-maximizing household will therefore increase both its current and future consumption.
- To increase its future consumption, it needs to increase its saving.
- So, the household's saving rises, but by less than the increase in Y* – T.
- Note: This is just about the behavior of ***private*** saving.

Example: A Tax Cut

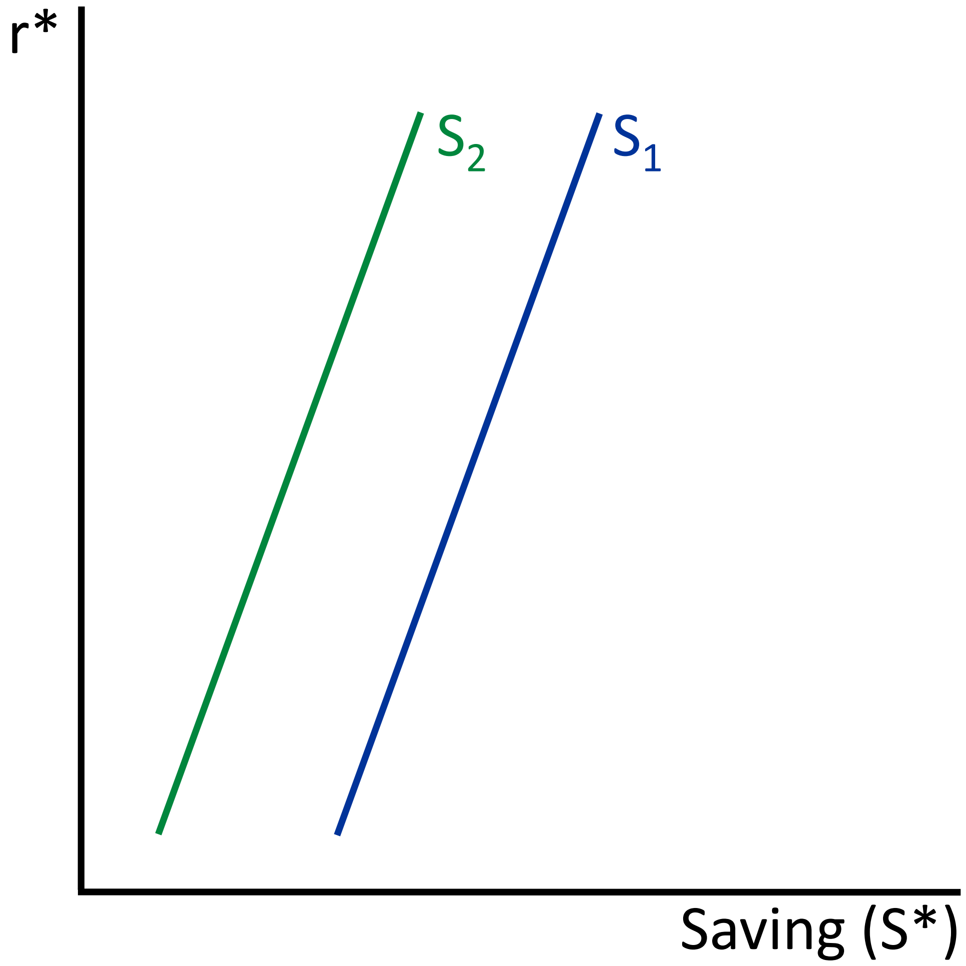


Recall: $S^* = Y^* - C^* - G$

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



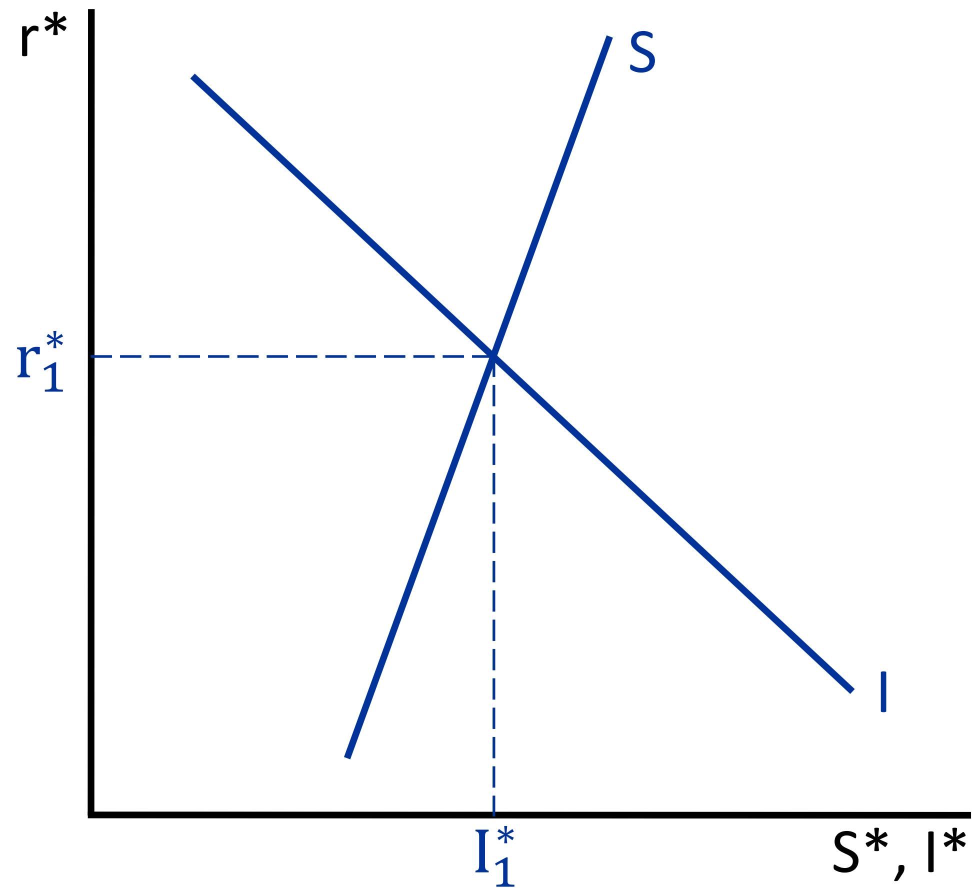
Recall: $S^* = Y^* - C^* - G$

Private and Public Saving and a Tax Cut

- 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

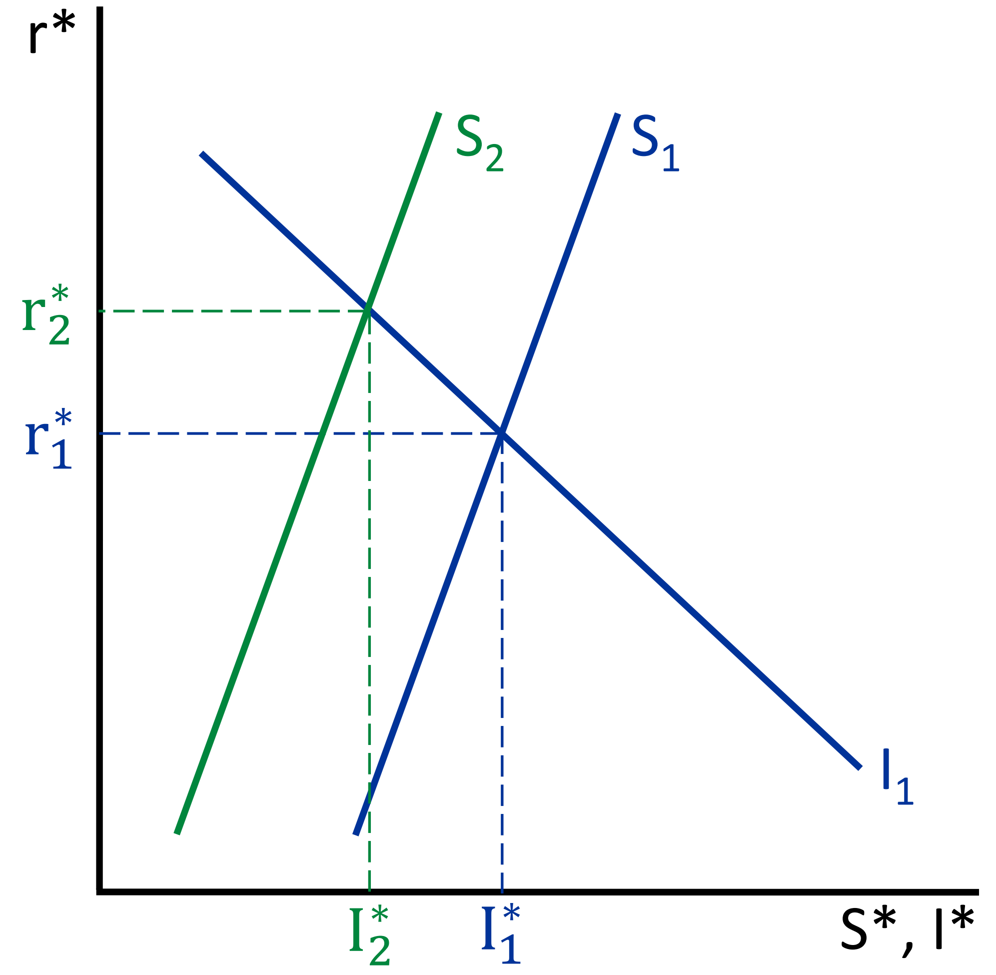
The Long-Run Saving and Investment Diagram



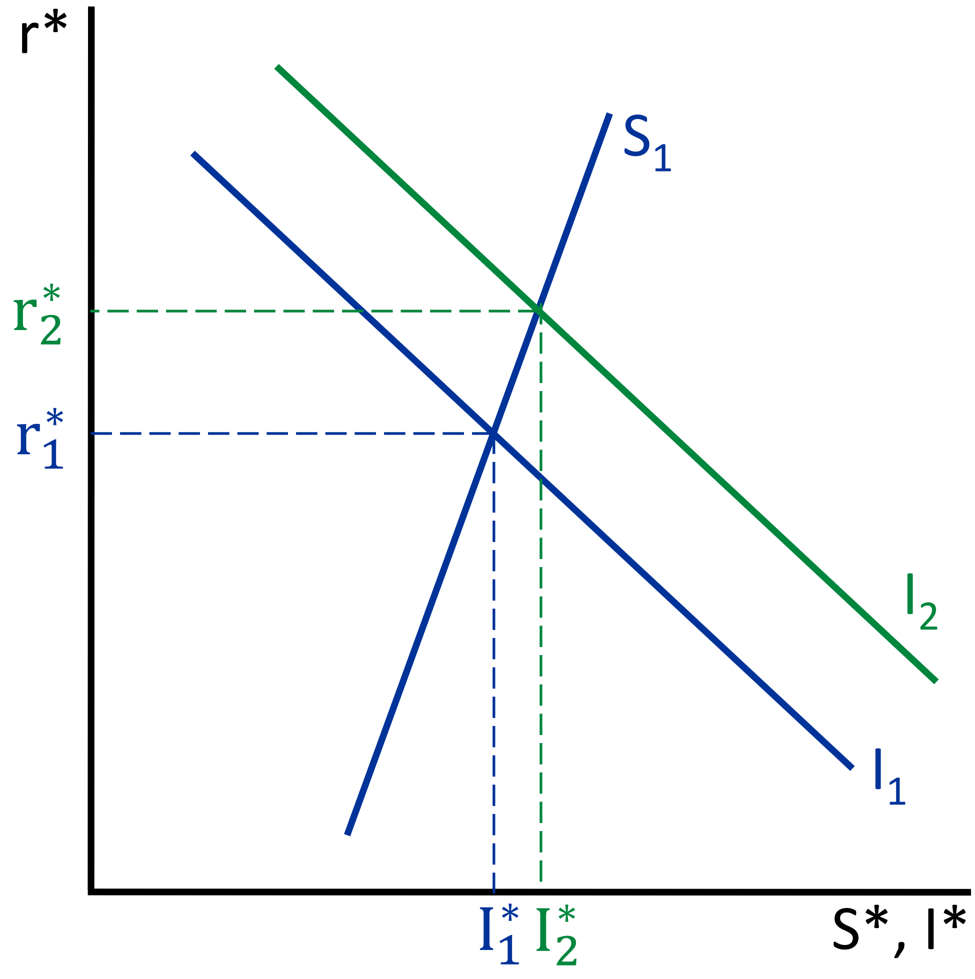
U.S. Fiscal Developments in 2018 and 2019

- There was a large tax cut and a large increase in government purchases.
- Most observers think that output was close to potential ($Y \approx Y^*$) when those changes occurred.

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?

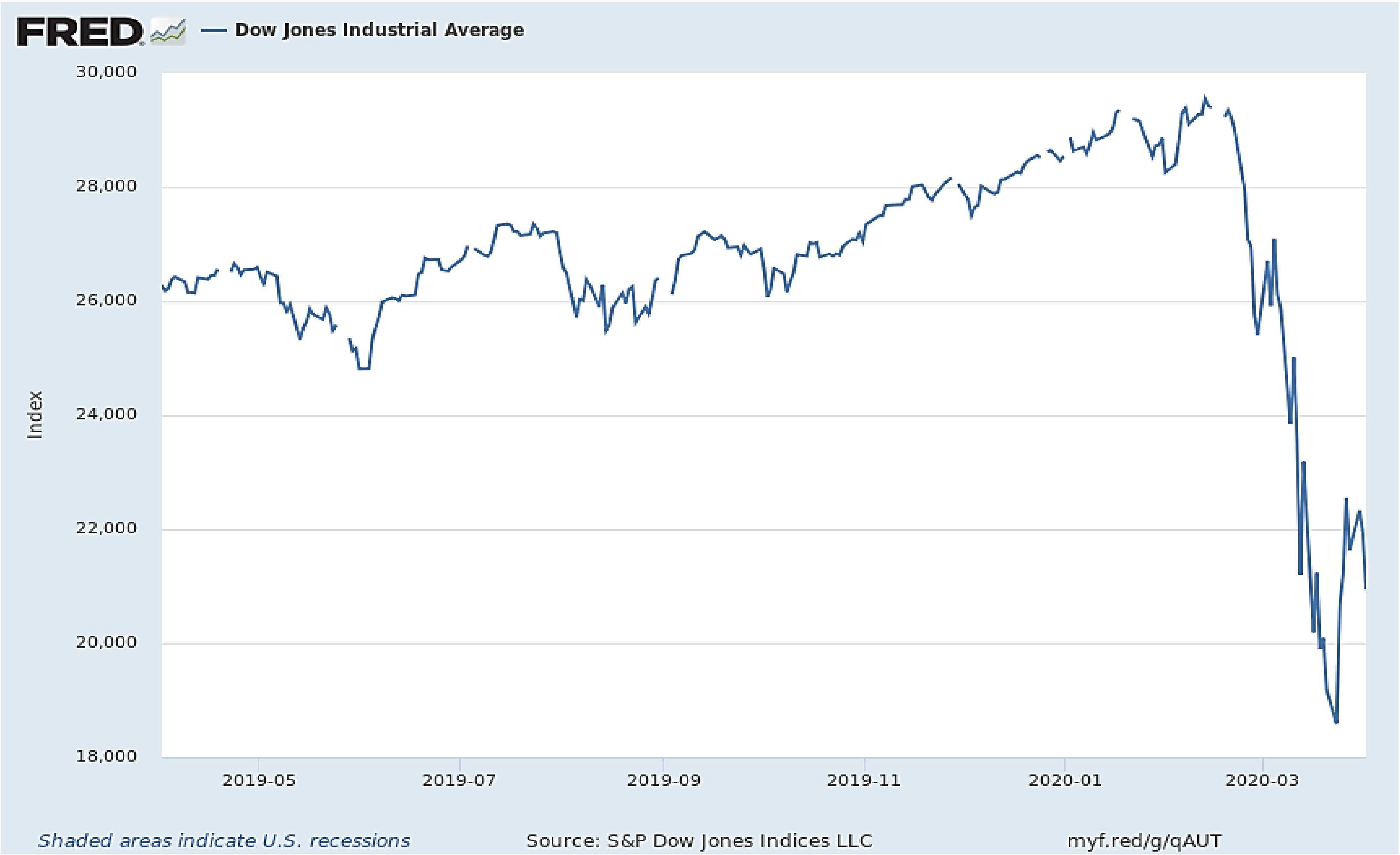
Stock price =

PV(Stream of Expected Future Dividends)

What moves stock prices?

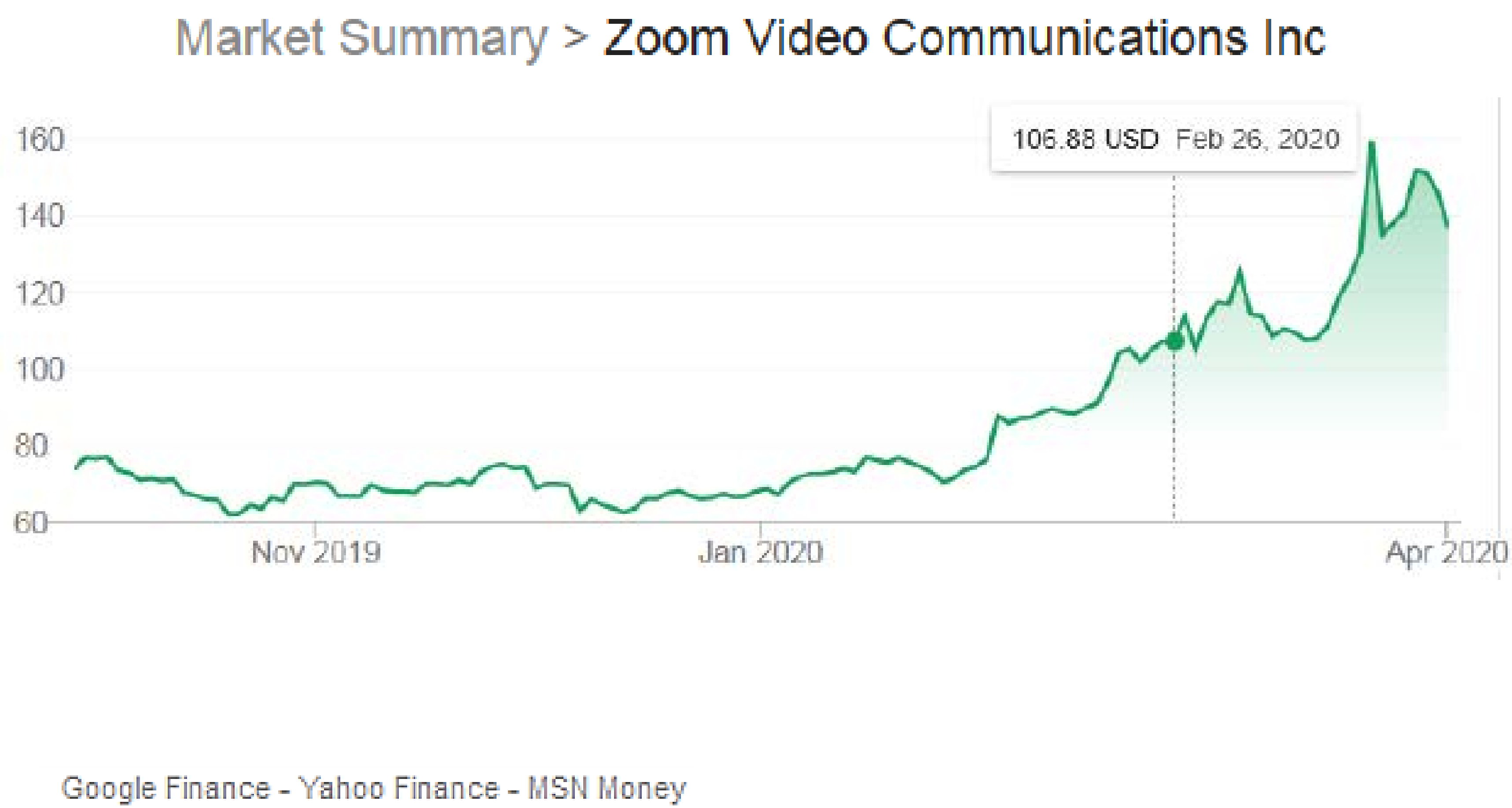
- A change in the interest rate.
    - Lower interest rates, all else equal, are likely to be associated with higher stock prices.
- A change in expected future dividends.
    - If something makes people expect lower future dividends, that should be associated with a lower stock price.
    - The lower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

The Recent Behavior of Stock Prices



Source: FRED.

What Firms' Stock Prices Might Have Gone Up Recently?



Stock Prices Respond Almost Instantly to News

Facebook stock price and news of privacy breach

Google Finance - Yahoo Finance - MSN Money

Efficient Markets Hypothesis

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