Economics 2
Fall 2023

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LECTURE 16

Saving and Investment in the Long Run

I. Introduction

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

Capital and Investment

- Capital: The accumulated ***stock*** of aids to the production process that were created in the past.
- Investment:
  - ***Changes*** in the capital stock.
  - That is, the construction or purchases of ***new*** machines and structures.

Other Reasons for Being Interested in These Issues

- Helps us understand the determination of the long-run or normal real interest rate.
- Helps us understand the determination of capital income.
- The investment demand function is important to understanding short-run macroeconomic fluctuations.

II. Saving and Investment

The Uses of Potential Output

- Consumption (C*) [65-70% of US GDP]
- Investment (I*) [15-20% of US GDP]
- Government purchases (G) [15-20%]
- Net Exports = Exports - Imports (NX*) [-3%]

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:

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

- I^* is normal investment demand.
- $Y^* - C^* - G$ is normal national saving supply (S^*).
- Thus, equilibrium requires $S^* = I^*$.
  - Simplest example for intuition: economy is one farm producing wheat: wheat is consumed or saved as seeds for next year crop

Private and Public Saving

- If we want, we can decompose saving into public and private saving:

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

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

(where T is net tax revenue=taxes-transfers)

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

3 Different Ways of Writing the Equilibrium Condition

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

The Role of the Real Interest Rate

- The key variable that equilibrates national saving and investment in the long run is the real interest rate.

The Nominal vs. the Real Interest Rate

- The ***nominal*** interest rate is just the stated interest rate—the interest rate measured in terms of dollars, with no adjustment for changes in prices.
    - We denote it by i.
- The ***real*** interest rate is interest rate measured in terms of purchasing power—that is, adjusted for changes in prices.
    - We denote it by r.

The Relation between the Real Interest Rate (r) and the Nominal Interest Rate (i)

- The nominal interest rate has two components, compensation for inflation and the real interest rate:

$$i = r + \pi,$$

where π is the inflation rate.

- If we like, we can rearrange this as:

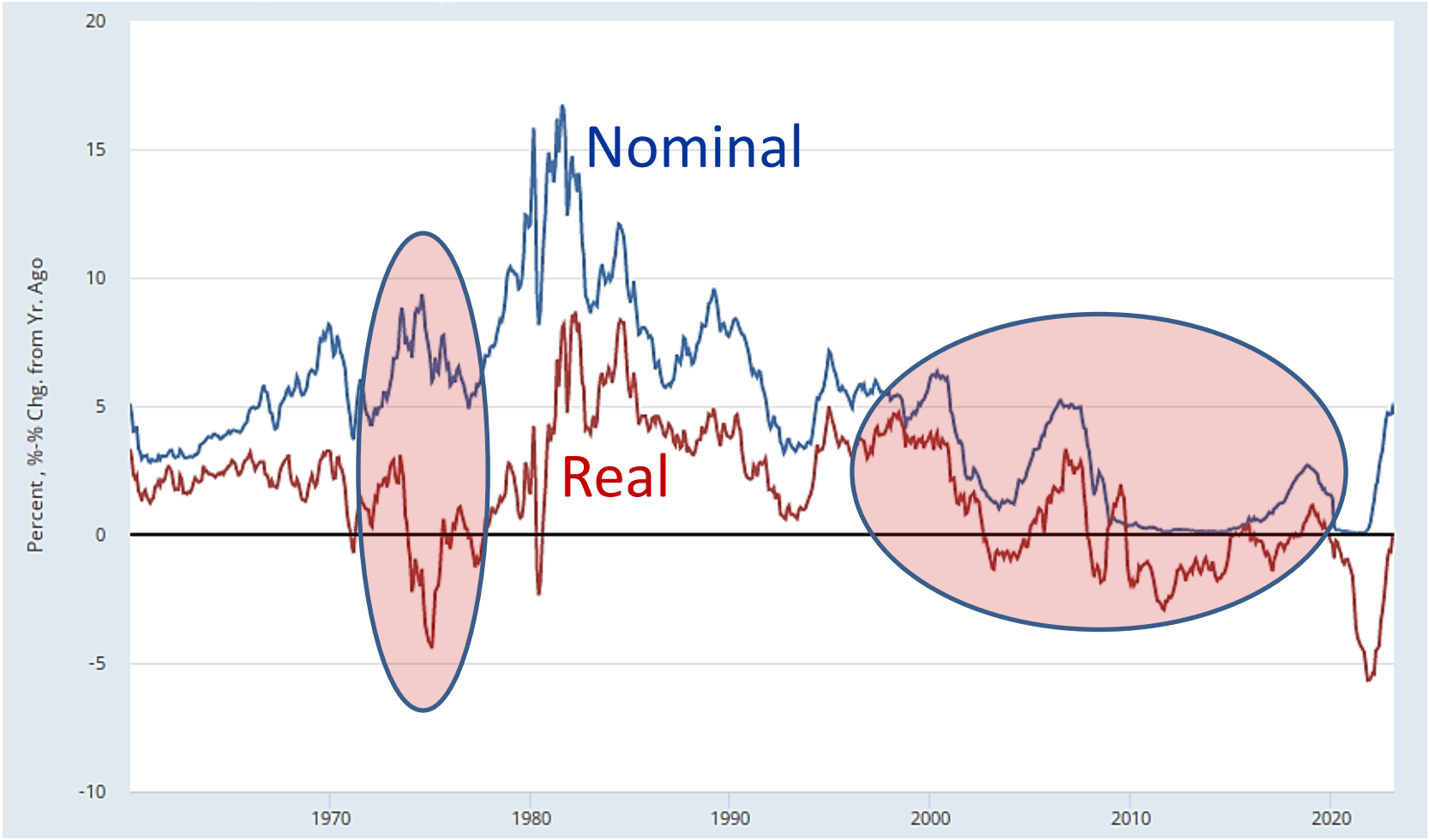
$$r = i - \pi.$$

- Aside: If we want to be precise, the relevant inflation variable is the expected rate of inflation, not the actual rate of inflation.

The Relation between the Real Interest Rate (r) and the Nominal Interest Rate (i)—Example

- Suppose i = 10% and π = 10%.
- Then the nominal interest rate (the percent return you get in dollars) is 10%.
- But the real interest rate (the percent return you get in terms of the purchasing power of what you saved) is 0.

Nominal and Real Interest Rates (1-year nominal interest rate, and 1-year nominal rate minus 1-year inflation rate)



Source: FRED.

III. 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^*.
- How do people make decisions about consuming, saving, or borrowing?

Quiz

How do you think about how much of your monthly income you decide to spend vs. save and how does this relate to the interest rate to get on your savings?

- A. I don't care about the interest rate, I just spend all the income I have, and can't afford to save anything.
- B. I can save some of my income but how much I save has nothing to do with the interest rate
- C. If the interest rate is higher, I cut down my consumption and save more.
- D. If the interest rate is higher, I increase my consumption and save less.

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.

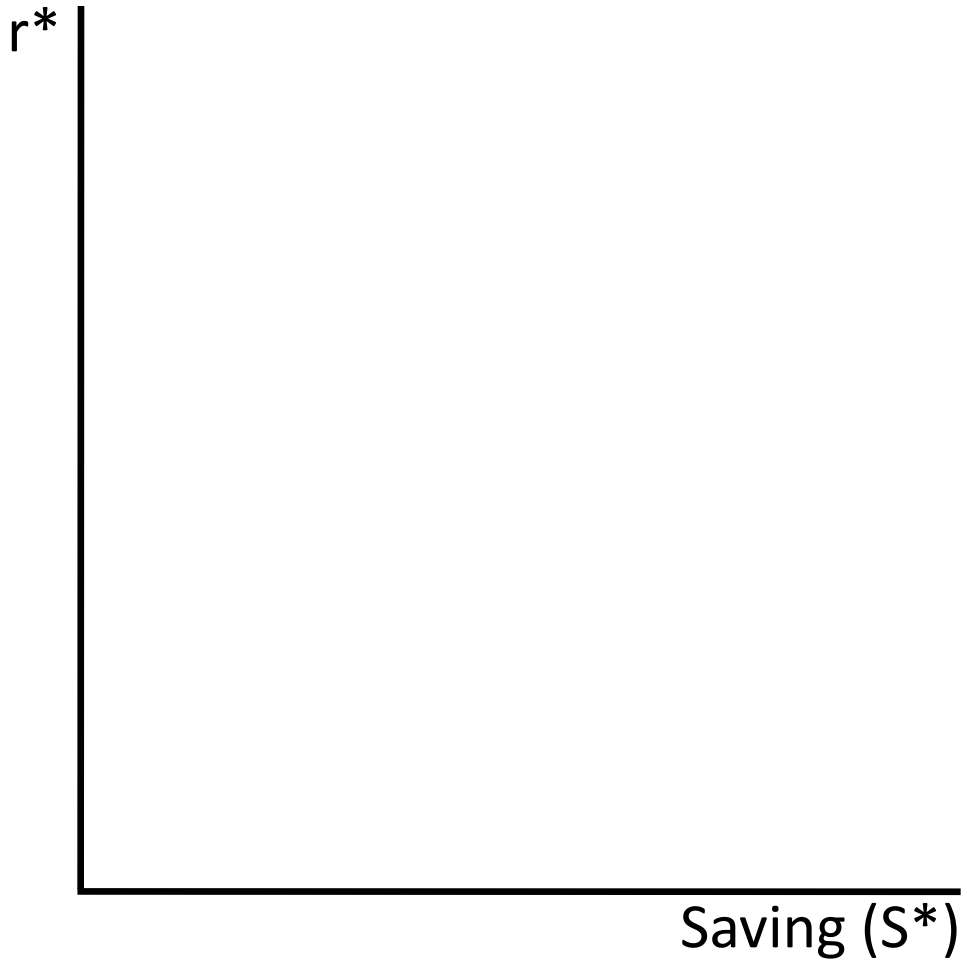
The Real Interest Rate and Saving

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

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

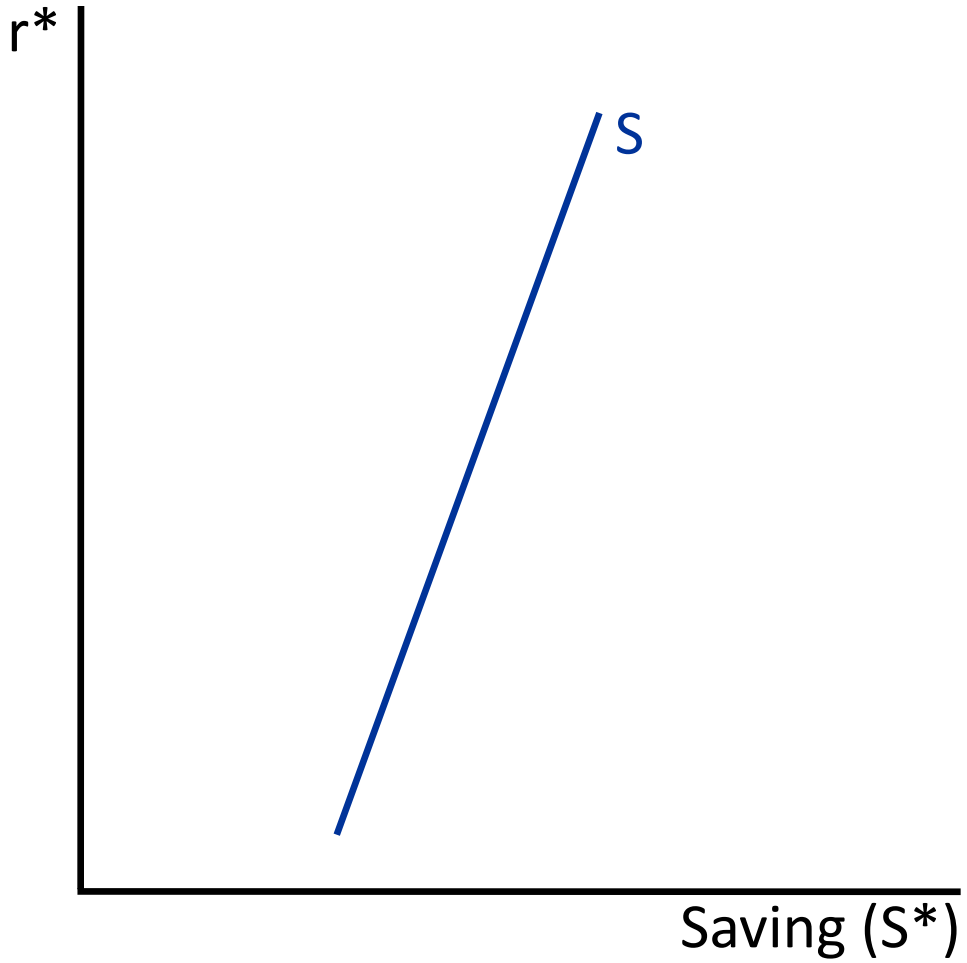
- If the real interest rate rises, the relative price (opportunity cost) of current consumption rises.
- To maximize utility, the household therefore needs to consume less today.
- That is, it needs to save more.

The Supply of Saving



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

The Supply of Saving



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

Quiz

How does the interest rate on your student loans will affect your spending after your graduate?

- A. It won't affect my spending because I don't have student loans
- B. Higher student loan payments will force me to cut down my other spending
- C. Higher student loan payments won't affect my spending, I'll just save less and spend the same
- D. Higher student loan payments won't affect my spending, I'll just borrow more on my credit card

Why does the interest rate affect macro spending and saving in practice?

- Borrowers are low income while lenders are high income
- Low income people tend to spend everything they earn (can't afford to save)
- High income people tend to save a large fraction of any extra income they make
- A higher interest rate gives more income to lenders and correspondingly less to borrowers
- Borrowers cut spending by more than lenders increase their spending => macro spending goes down and macro saving goes up

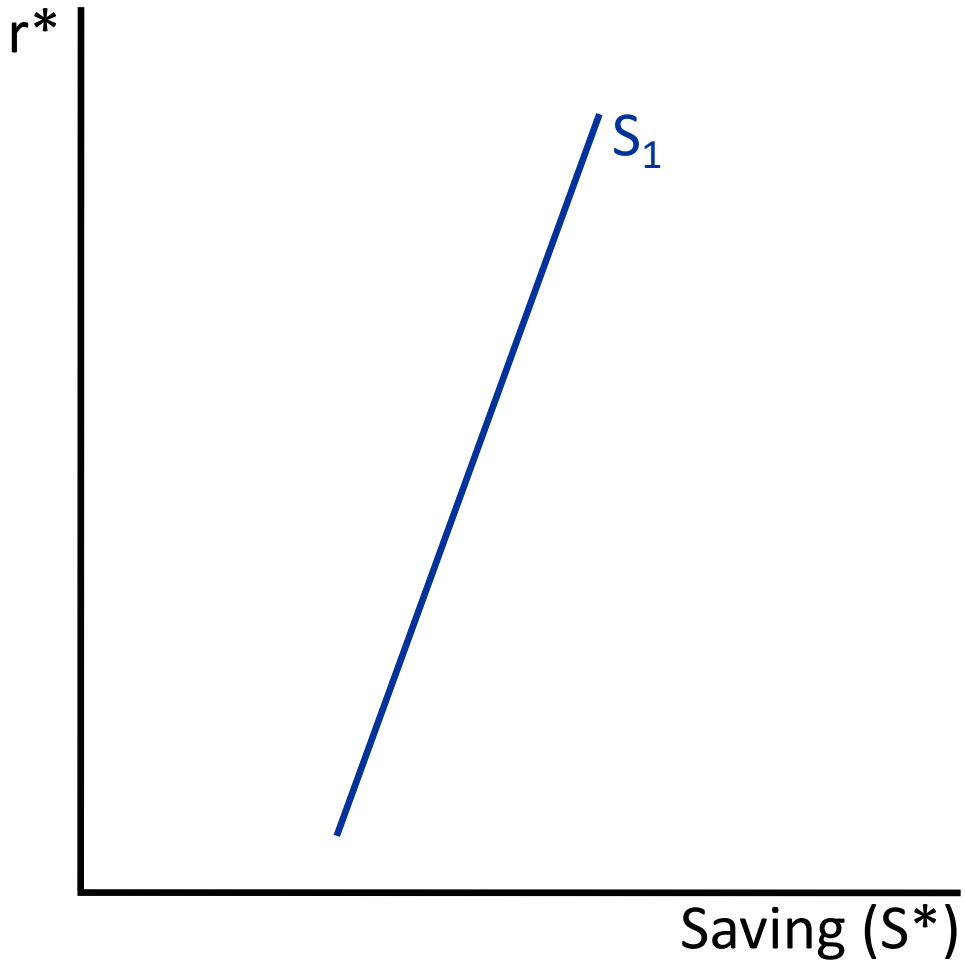
How a Change in Y* — T Affects Consumption and ***Private*** Saving

- When a household's current Y* – T rises by $1, it typically will spend part of the $1 and save the rest
- Typically, a poor household will spend the full $1, a rich household will save a large fraction of it.
- So, at the macro level, total household's saving rises, but by less than the $1 increase in Y* – T.
- Note: This is just about the behavior of ***private*** saving.

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

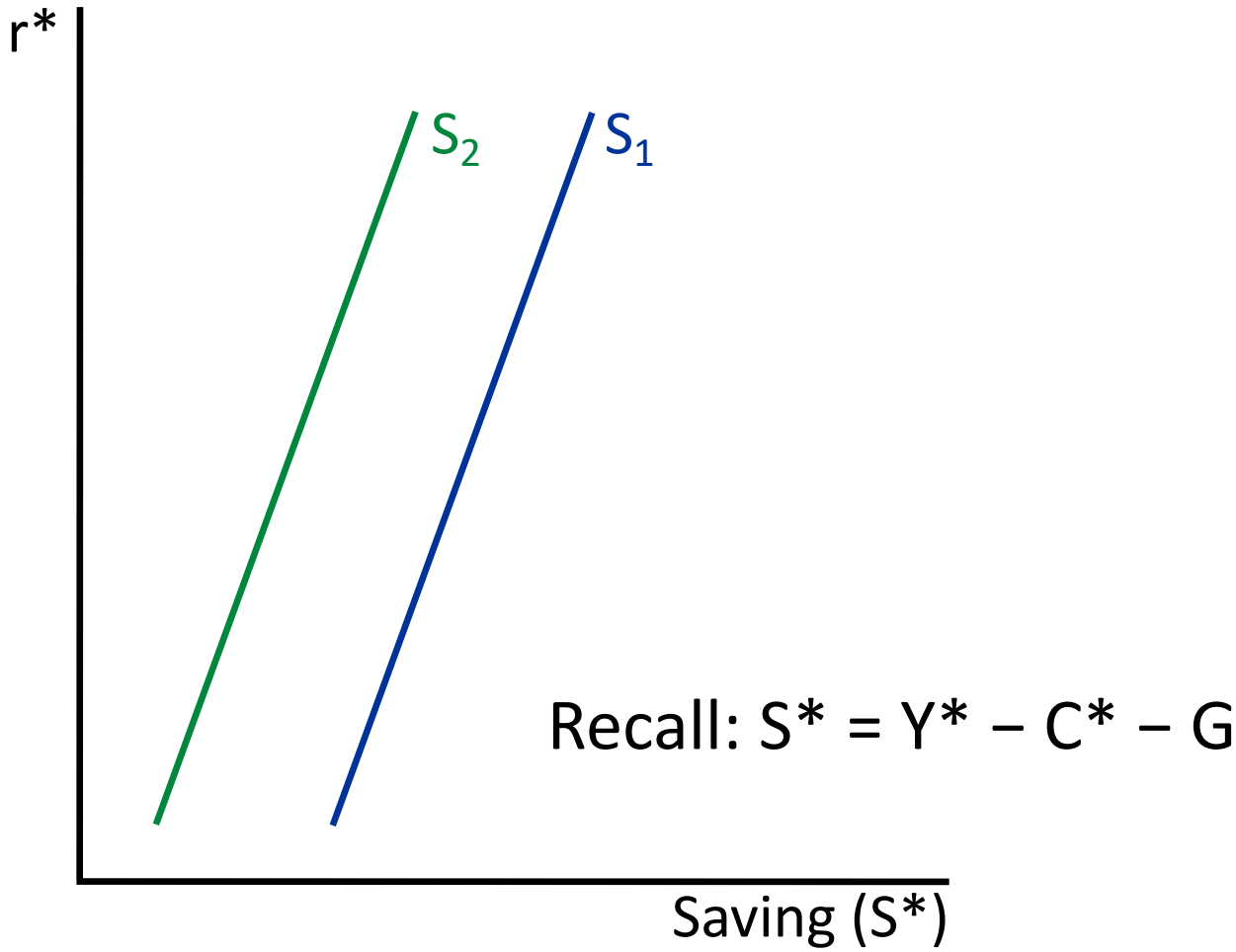


Recall: $S^* = Y^* - C^* - G$

Private and Public Saving and a Tax Cut

- 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 as part of the tax cut is saved but by less than the amount of the tax cut
  - So S^* falls at a given r^*.

Example: A Tax Cut



Tax cut reduces public saving 1-1 but reduces private saving less than 1-1: total savings S* falls

IV. Investment Demand and the Real Interest Rate

Profit Maximization and Investment Demand

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

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

- Because a rise in the interest rate reduces PV(Stream of MRP_K's), it reduces the profit-maximizing amount of purchases of new capital goods.

- That is, investment demand is a decreasing function of the interest rate.

Why Investment Demand Depends on the ***Real*** Interest Rate: A Rise in Expected Inflation

- Recall: The firm buys new capital until:

  PV(Stream of MRP_K's) = Purchase Price

- Suppose the nominal interest rate (i) rises only because expected inflation rises.
- The denominators in PV(Stream of MRP_K's) are higher.
- But, because future MRP_K's depend on future prices, the numerators are also correspondingly larger.
- As a result, PV(Stream of MRP_K's) doesn't fall, and so the firm's investment demand doesn't change.

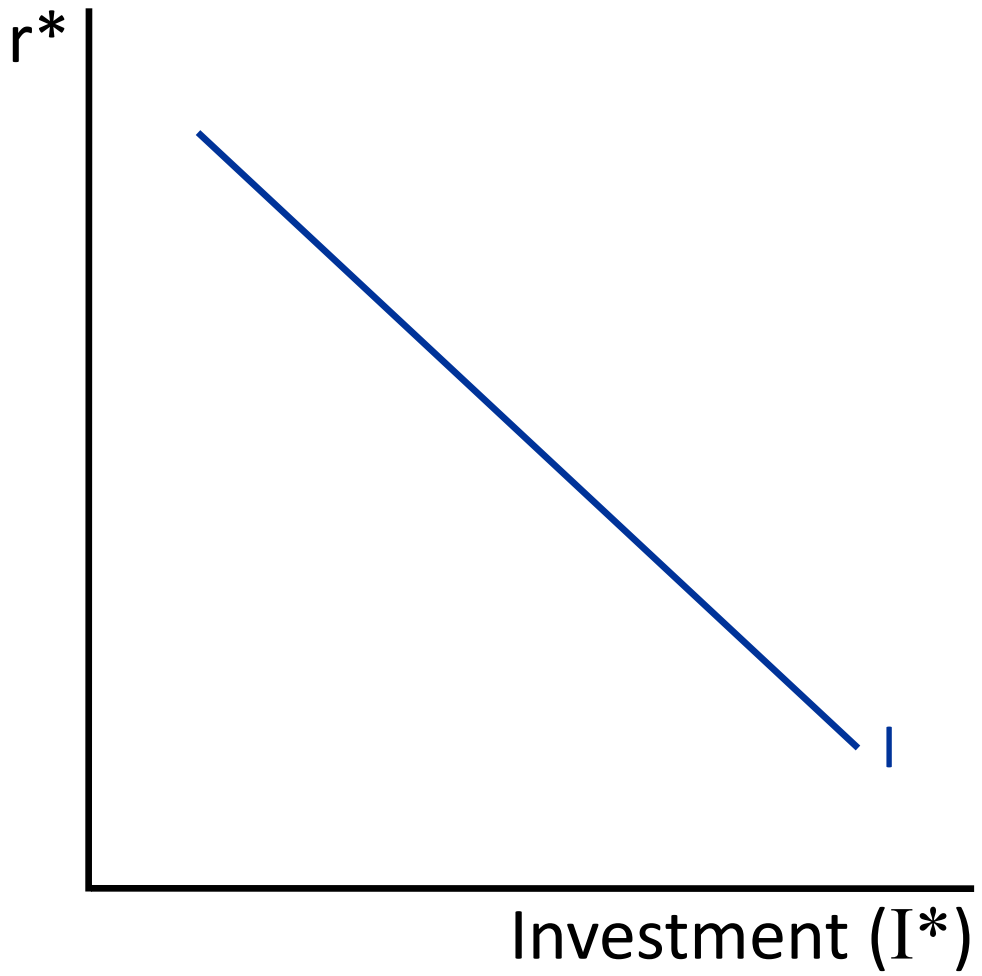
Why Investment Demand Depends on the ***Real*** Interest Rate: A Rise in the Real Interest Rate

- The firm buys new capital until:

  PV(Stream of MRP_K's) = Purchase Price

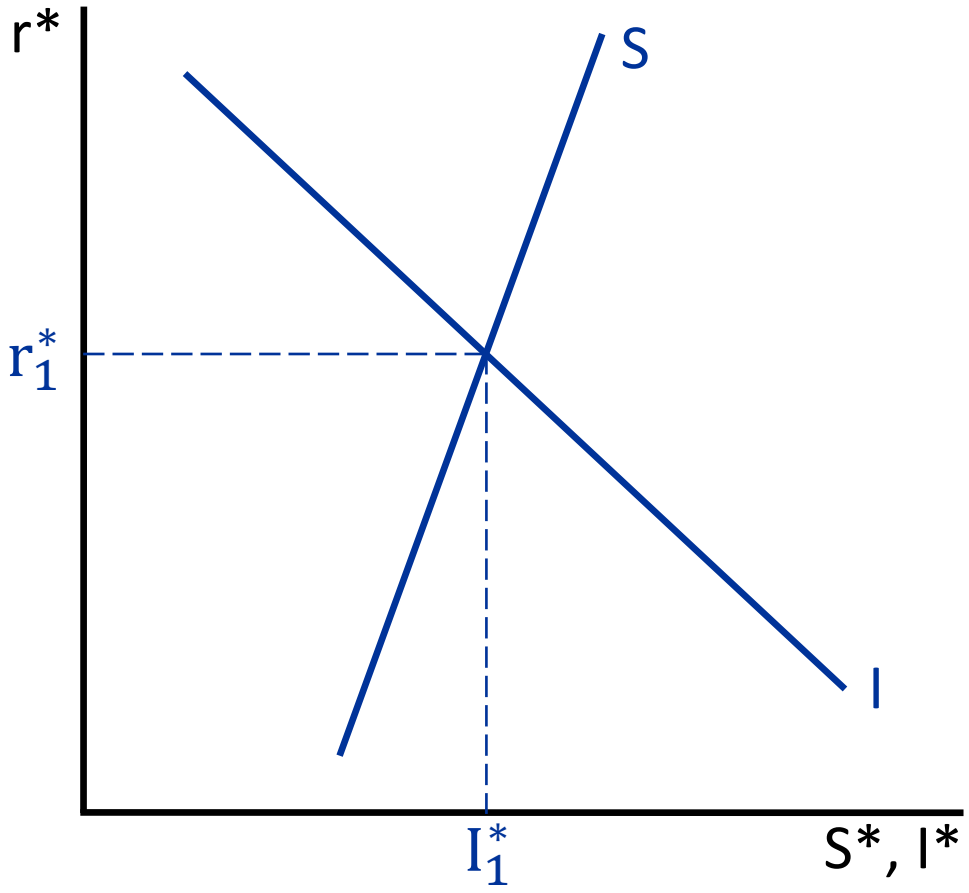
- Suppose i rises because r rises, with no change in expected inflation.
- The denominators in PV(Stream of MRP_K's) are higher.
- There's no compensating effect on future MRP_K's.
- As a result, PV(Stream of MRP_K's) at a given amount of investment falls, and so the firm's investment demand falls.

Investment Demand Curve



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

The Long-Run Saving and Investment Diagram

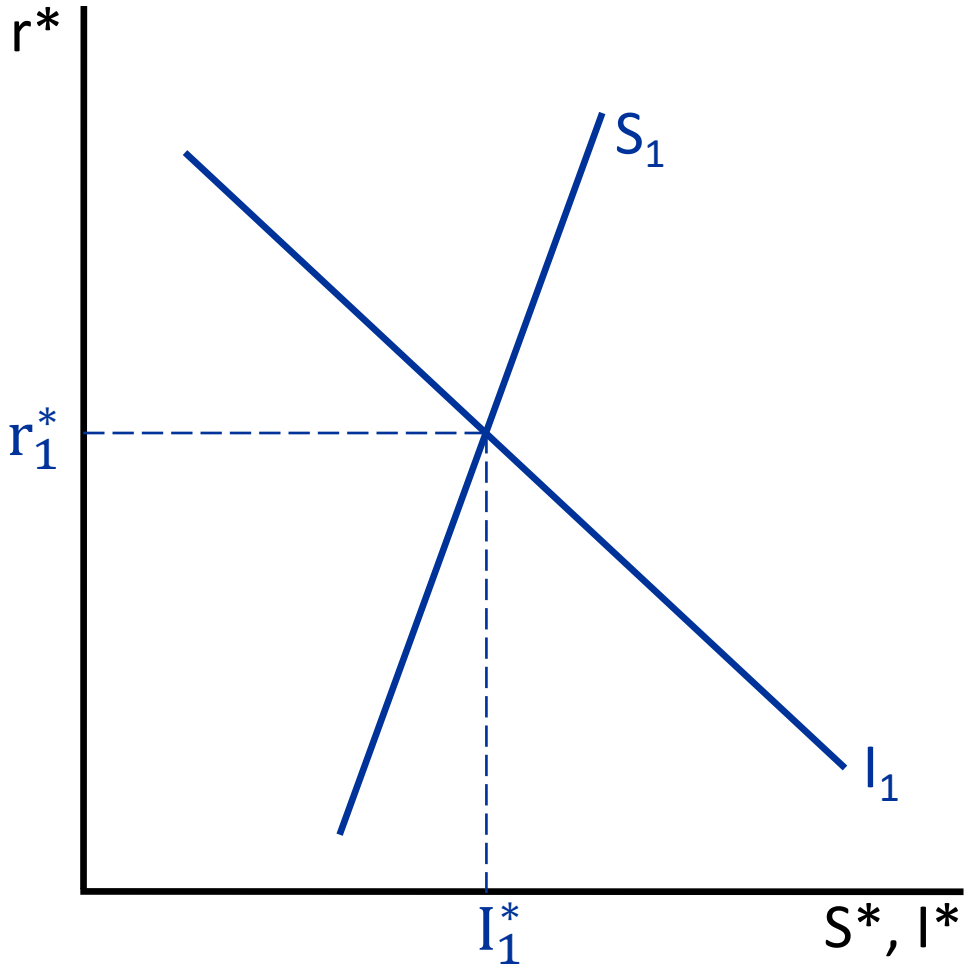


The U.S. Budget Deficit in Recent Years (Excluding 2020–2021)

Year	% of GDP
2016	3.1
2017	3.4
2018	3.8
2019	4.6
2020	----
2021	----
2022	5.4

Source: FRED.

A Tax Cut and "Crowding Out"



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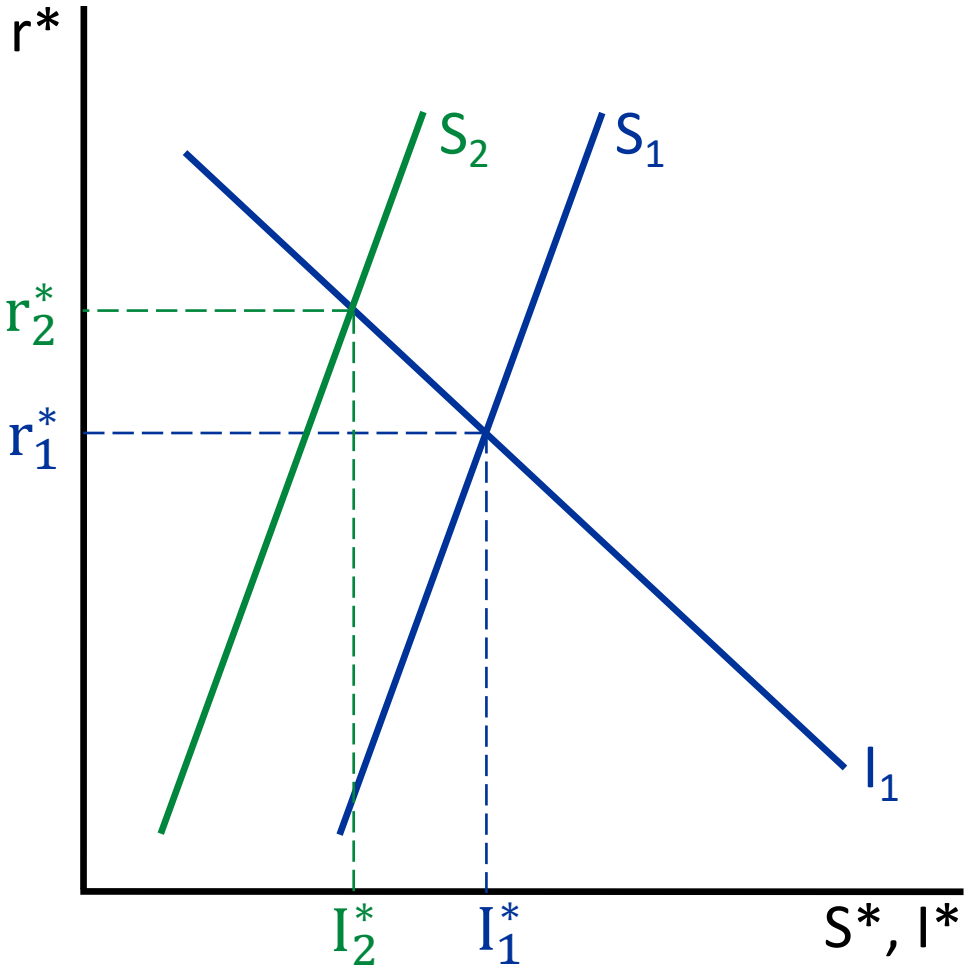
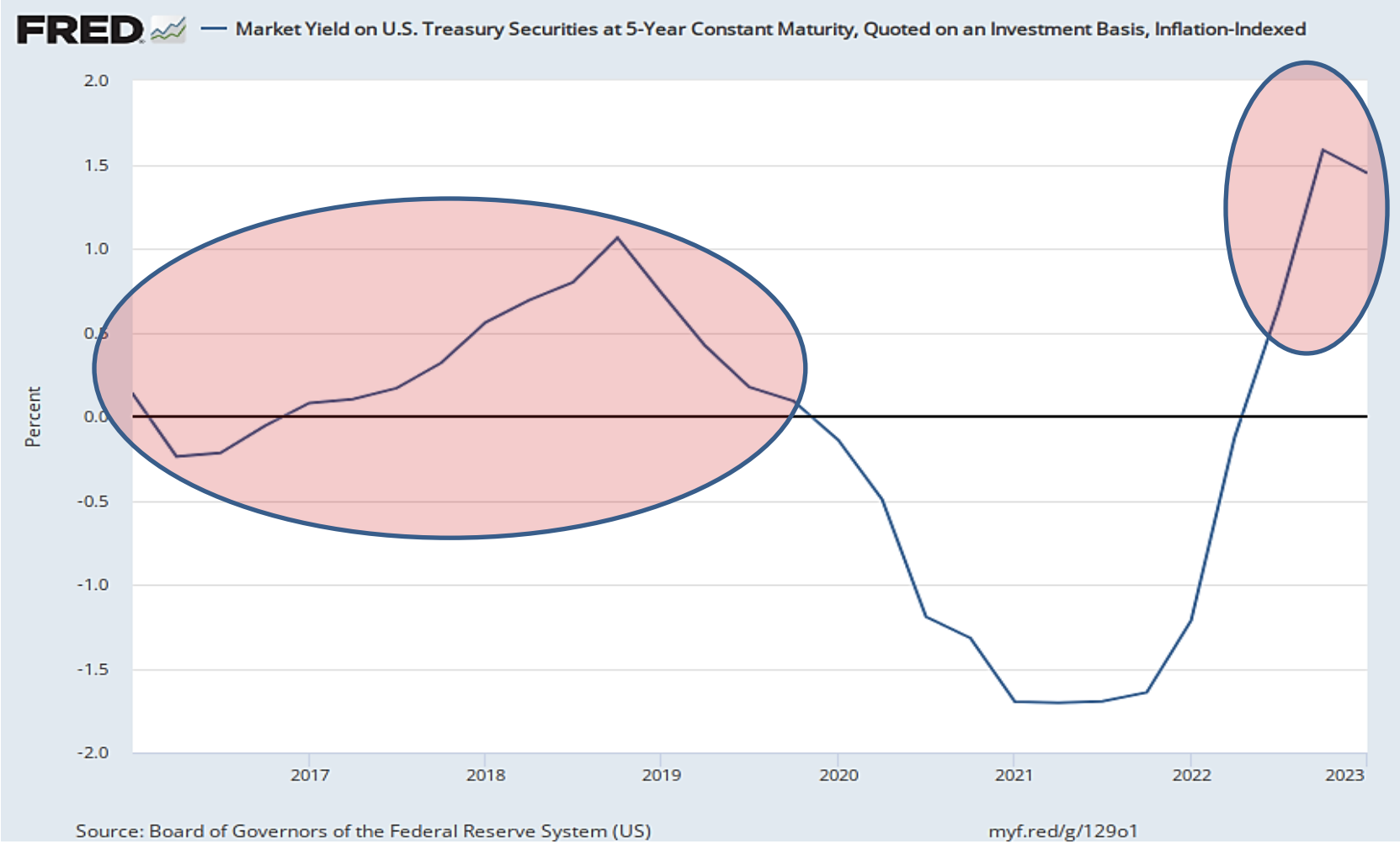
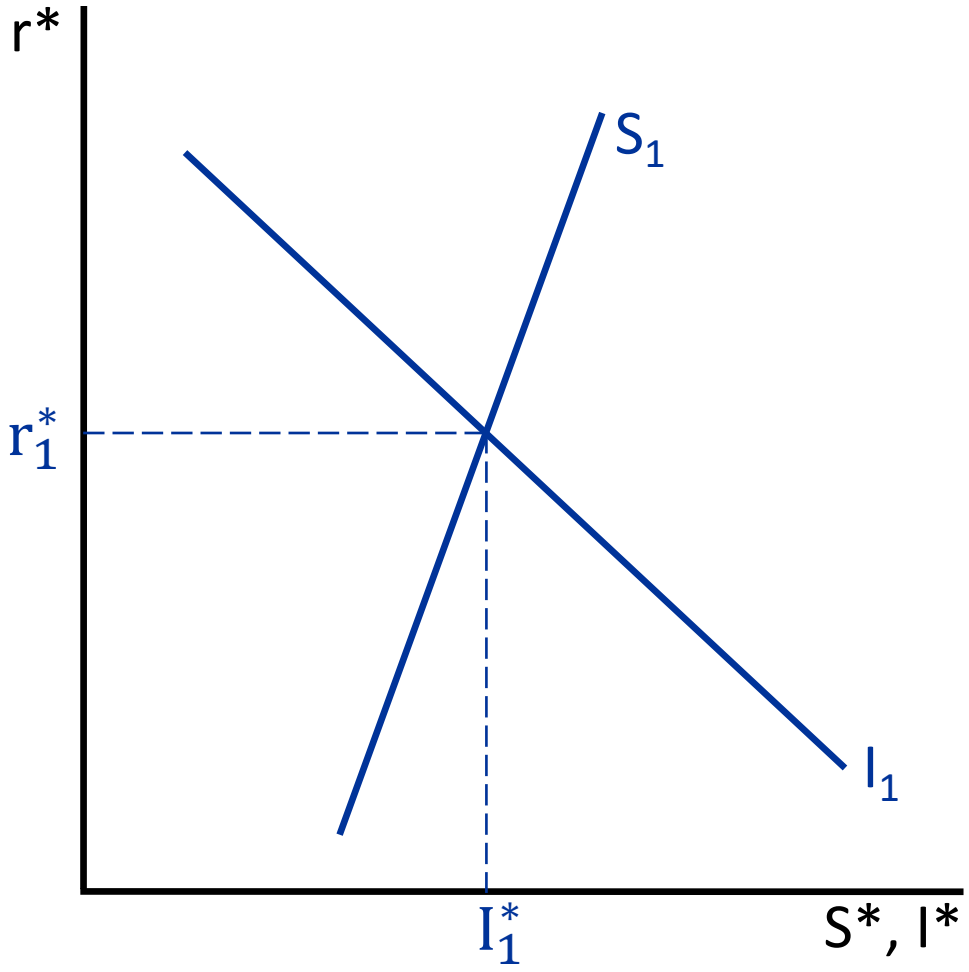


An Estimate of the Real Interest Rate, 2016–present



Source: FRED.

A New Technology That Raises Future MRP_K's



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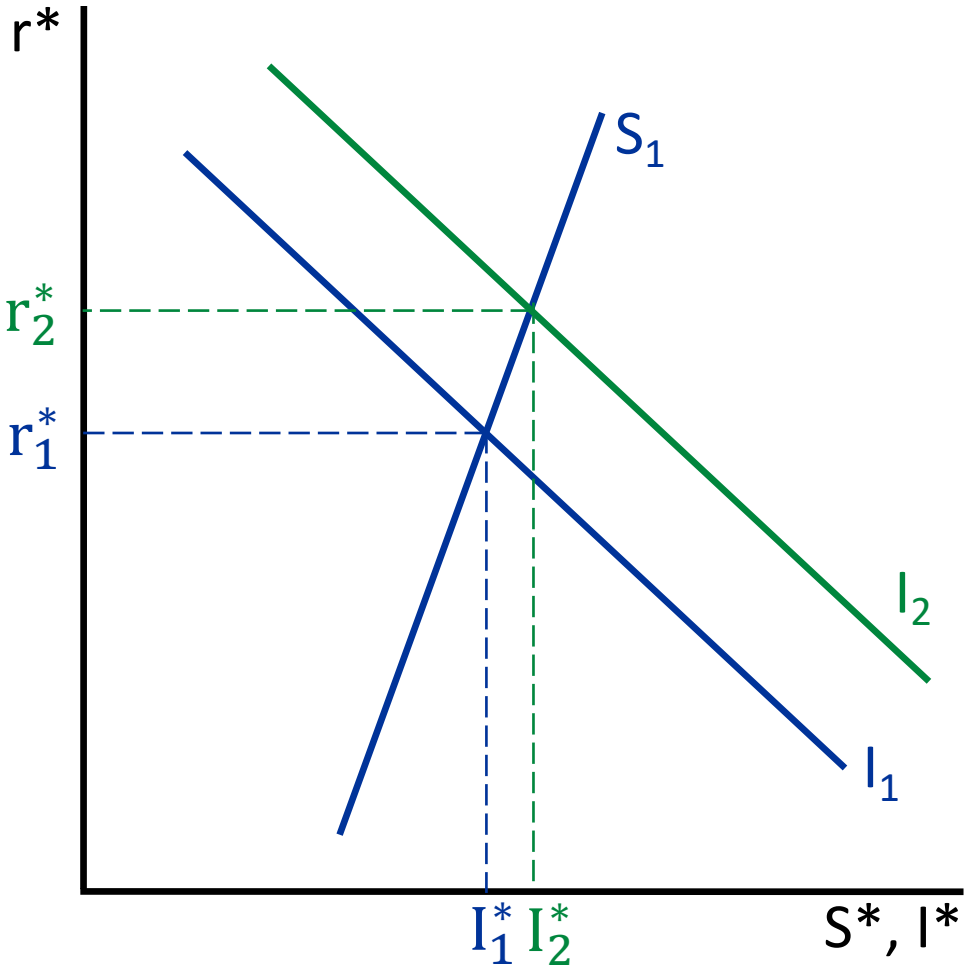

References

- CORE-The Economy, Chapter 16.
- Principles of Economics, Chapter 21.