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Macroeconomics

Week 4

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The IS Curve

The Aggregate Demand (AD)

- Recall that *expenditure approach to GDP*: its components are exactly the **Aggregate Demand**

$$\boxed{D = C + G + I + NX}$$

- But now we turn to each element and try to explain how is it determined

Disclosing the AD

$$\boxed{D = C + G + I + NX}$$

The complete model of the AD

$$\boxed{D = C + I + G + NX}$$

$$C = \overline{C} + c \times (Y - T) - b \times r$$

$$I = \overline{I} - d \times \left(r + \overline{f}\right)$$

$$G = \overline{G}$$

$$NX = \overline{NX} - x \times r$$

- Why r is *negatively everywhere*?
  - It is the opportunity cost of **consuming today**
  - It is the financial cost of **borrowing**
  - It is the "exchange cost" of **becoming attractive**
- A word on **taxes**: $T = \overline{T} - t \times Y$. To simplify we will assume: $T = \overline{T}$.

The Equilibrium in the Goods and Services (G&S) Market

An equilibrium requires:

$$\boxed{Y = D} \Rightarrow Y = C + I + G + NX \Leftrightarrow$$

$$\Leftrightarrow Y = \overline{A} + c \times Y - (b + d + x) \times r$$

where $\overline{A}$ being the **Autonomous AD** given by:

$$\boxed{\overline{A} = \overline{C} + \overline{I} - d \times \overline{f} + \overline{G} + \overline{NX} - c \times \overline{T}}$$

Deriving the IS Curve

Solving the previous equation for Y, we get the **IS Curve**:

$$Y = \frac{1}{1-c} \times \overline{A} - \frac{b+d+x}{1-c} \times r \Leftrightarrow$$

$$\Leftrightarrow \boxed{Y = m \times \overline{A} - m \times \phi \times r}$$

an *equilibrium path*, with:

$$m \equiv \frac{1}{1-c} > 1 \qquad \phi \equiv b + d + x > 0$$

Exercises

Exercise 1. Aggregate demand: basic concepts

From the textbook.

The Bureau of Economic Analysis valued nominal U.S. gross domestic product (i.e.,actual expenditure) at $16,420 billion at the end of 2012. Suppose that consumption expenditure was $12,210 billion, planned investment spending was $1,680 billion, and government spending was $2,970 billion.

a. Assuming the goods market is in equilibrium, calculate spending on net exports.

b. If U.S. imports are valued at $2,100 billion, calculate spending on U.S. exports.

Exercise 1. Solution

Remember that:

$$Y = C + I + G + NX \Leftrightarrow$$
$$\Leftrightarrow NX = Y - (C + I + G)$$

$$NX = X - M$$

```
begin
    Y1 = 16420; C1 = 12210; I1 = 1680; G1 = 2970; IMP1 = 2100;
    NX1 = Y1 - (C1 + I1 + G1)
    EXP1 = NX1 + IMP1
    Print("NX = $(NX1) and EXP = $(EXP1)")
end
```

$$NX = -440 \qquad M = 1.660$$

Exercise 2. Marginal propensity to consume

From the textbook. This question in the textbook is a bit confusing; we changed it slightly. We ask to calculate the marginal propensity to consume, not the level of consumption, which we can not find because r *and* b *are not known.*

Assume the following estimates:

- Autonomous consumption is $1,625 billion
- Disposable income is equal $11,500 billion.

Using the consumption function in Equation 2 (textbook/slides), calculate the value of the marginal propensity to consume if an increase of $1,000 in disposable income leads to an increase of $750 in consumption expenditure.

Exercise 2. Solution

Equation (2) in the textbook and in the slides is given by:

$$C = \overline{C} + c \cdot \underbrace{(Y - T)}_{=Y_D} - b \cdot r$$

which, if $\Delta r = 0$, implies:

$$\Delta C = c \cdot \Delta Y_D \Leftrightarrow c = \frac{\Delta C}{\Delta Y_D}$$

```
1 begin
2     ΔC2 = 750;  ΔYD2 = 1000;
3     c2 = ΔC2 / ΔYD2
4     Print("c = $(c2)")
5 end
```

$$c = 0{,}75$$

Exercise 3. The Consumption function

From the textbook.

Calculate consumption expenditure using the consumption function (as described by Equation 2) and the following estimates:

- Autonomous consumption: $1,450 billion
- Income: $14,000 billion
- Income taxes: $3,000 billion
- Marginal propensity to consume: 0.8

Exercise 3. Solution

$$C = \overline{C} + c \times (Y - T) - b \times r \Leftrightarrow$$
$$C = 1.450 + 0.8 \times (14.000 - 3.000) - b \times r \Leftrightarrow$$
$$C = 10.250 - b \times r$$

Exercise 4. The IS Curve

Numerical example included in Chapter 9 of the textbook (in the main text, not in the problems section).

We can better understand the IS curve with the following numerical example, in which we attribute specific values for the exogenous variables and the parameters in Equation 13 (slides/textbook). The exogenous variables and parameters are as follows:

$$\overline{C} = \$1.3 \text{ trillion} \qquad \overline{f} = 1$$

$$\overline{I} = \$1.2 \text{ trillion} \qquad c = 0.6$$

$$\overline{G} = \$3.0 \text{ trillion} \qquad b = 0.1$$

$$\overline{T} = \$3.0 \text{ trillion} \qquad d = 0.2$$

$$\overline{NX} = \$1.3 \text{ trillion} \qquad x = 0.1$$

Exercise 4 a. The IS Curve

> **a.** Obtain the expression of the IS curve (equation 13 in the slides/textbook).

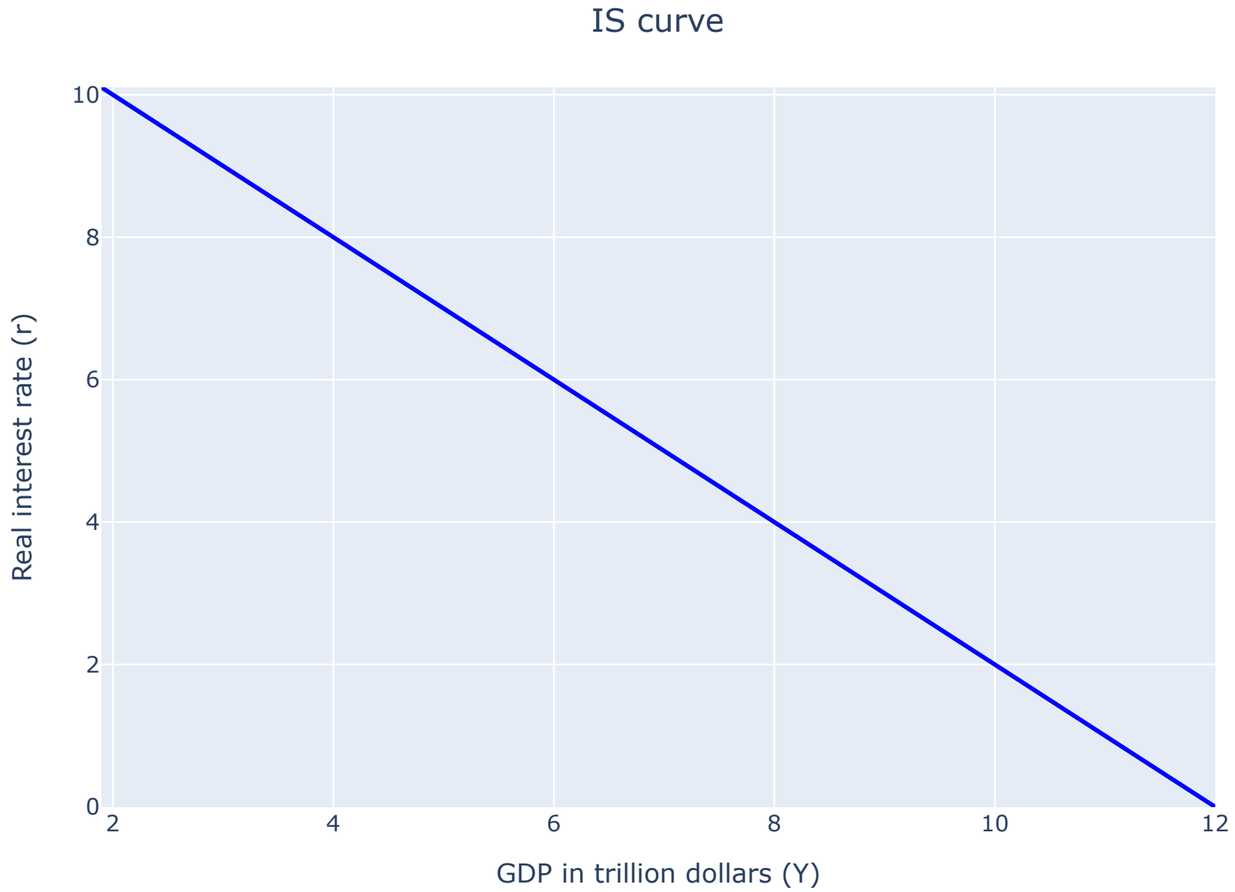
```
begin
    C̄5 = 1.3; Ī5 = 1.2; Ḡ5 = 3.0; T̄5 = 3.0; N̄X̄5 = 1.3;
    f̄5 = 1.0; c5 = 0.6; b5 = 0.1; d5 = 0.2; x5 = 0.1;
    Ā5 = C̄5 + Ī5 - d5*f̄5 + Ḡ5 + N̄X̄5 - c5*T̄5
    m5 = 1/(1-c5)
    ϕ5 = b5 + d5 + x5
    Print("Ā5 = $(Ā5) ,  m5 = $(m5) , ϕ5 = $(ϕ5)")
end
```

Then, the IS Curve expression is:

$$Y = m \times \overline{A} - m \times \phi \times r \Leftrightarrow$$
$$Y = 12 - 1 \times r$$

Exercise 4 b. The IS Curve

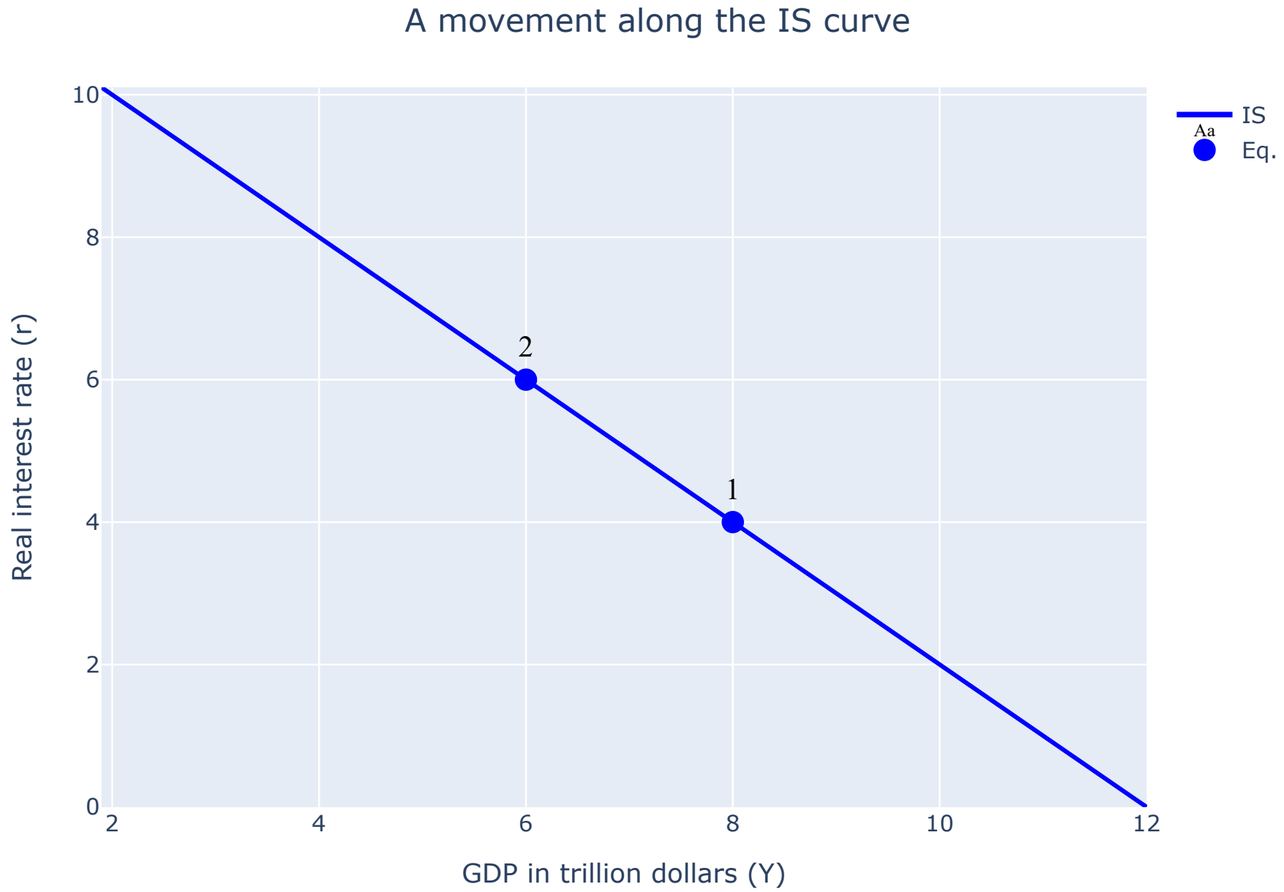
b. The IS curve is represented on the plane (Y, r) in the figure below. At a real interest rate $r = 4\%$, equilibrium GDP will be equal to?



$$r = 4 \Rightarrow Y = 8$$

Exercise 4 c. The IS Curve

c. Using the following figure, “A movement along the IS curve”, what happens to equilibrium GDP if the real interest rate increases to $r = 6\%$?

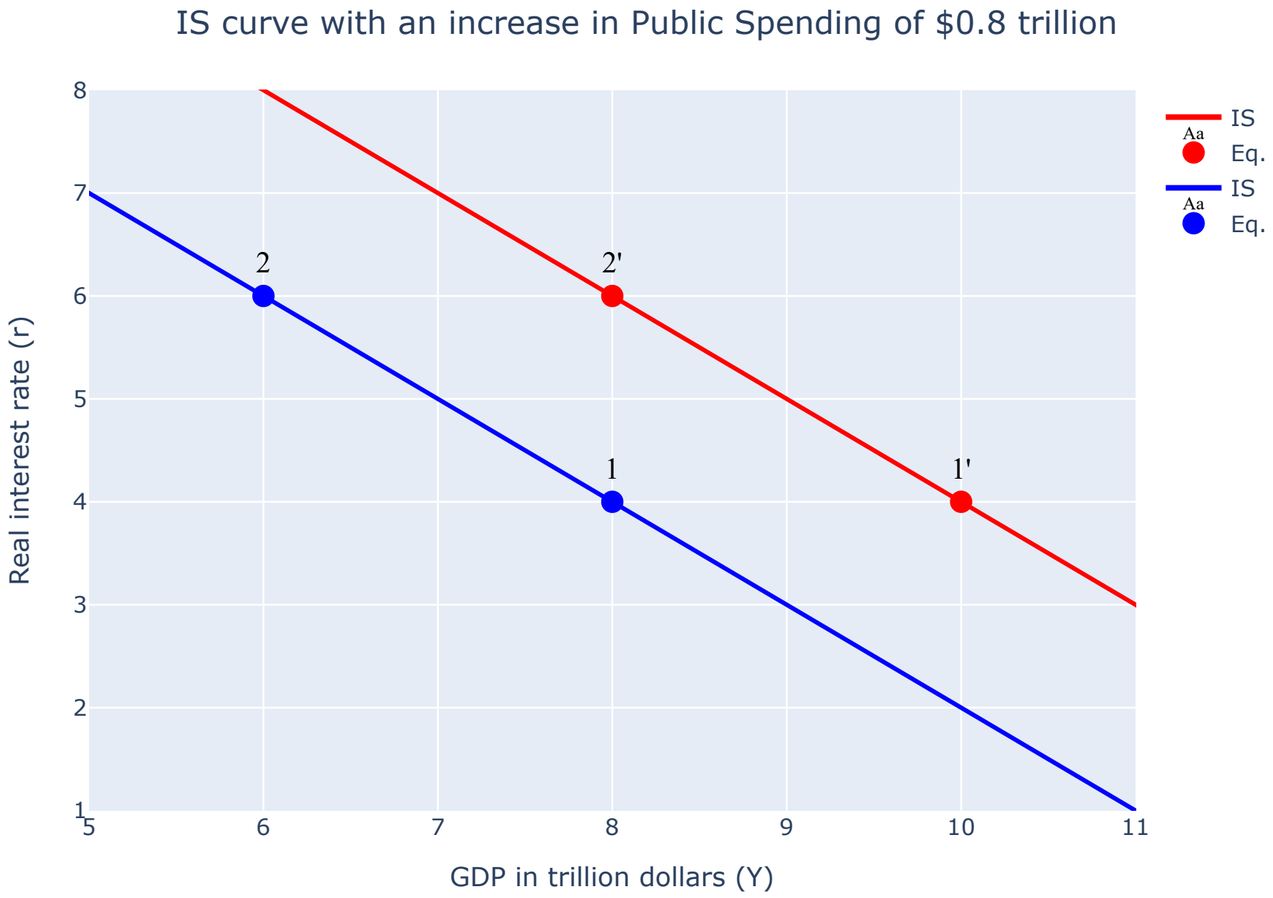


$$r = 6 \Rightarrow Y = 6$$

$$\Delta Y = -2$$

Exercise 4 d. The IS Curve

d. What happens to equilibrium GDP if $\overline{G}$ increases to \$3.8 trillion?



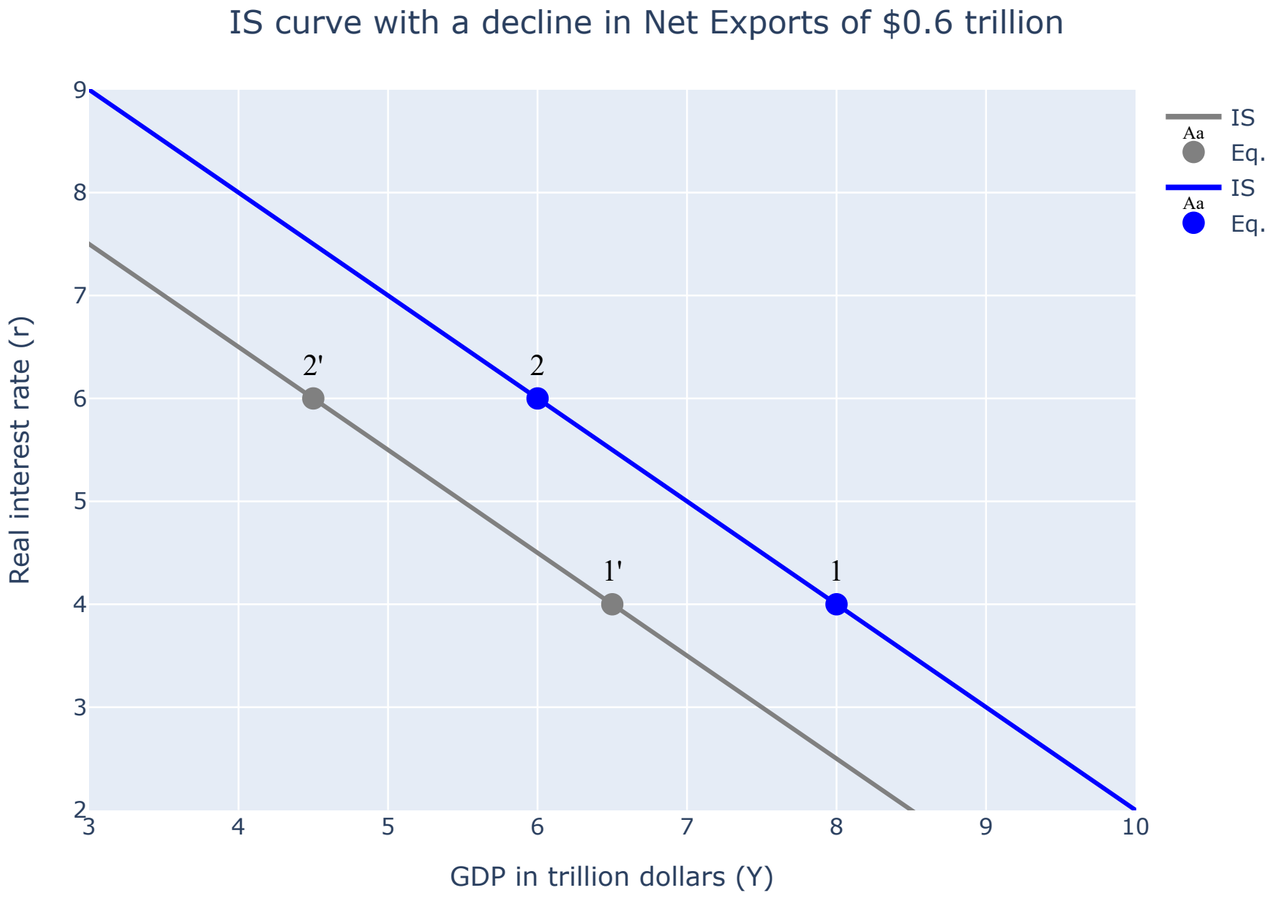
$$\Delta\overline{G} = 0.8 \Rightarrow \Delta\overline{A} = 0.8$$

Expression of the new IS:

$$Y = 14 - 1 \times r$$

Exercise 4 e. The IS Curve

e. What happens to equilibrium GDP if $\overline{NX}$ goes down to \$0.7 trillion?



$$\Delta\overline{NX} = -0.6 \Rightarrow$$

$$\Rightarrow \Delta\overline{A} = -0.6$$

Expression of the new IS:

$$Y = 10{,}5 - 1 \times r$$

Exercise 5. Exports and the IS curve

From the textbook

Suppose the U.S. Congress declares China a “currency manipulator” and legislates a tariff on Chinese goods. These tariffs lead to a decrease in imports of 0.8 trillion dollars:

a. What is the impact of such a measure on the level of GDP in the US?
b. Using the figure below, manipulate the slider ΔÑX̄6 to show your answer graphically.

Exercise 5. Solution

- Higher tariffs shrink the demand of Chinese goods
- $\overline{M} \downarrow \Rightarrow \overline{NX} \uparrow \Rightarrow \overline{A} \uparrow, \forall r$
- Then the IS will move upwards

Exercise 6. Stock prices & a stronger dollar

From the textbook

Suppose you read in the newspaper that prospects for stronger future economic growth will lead the dollar to strengthen and stock prices to increase.

a. Comment only on the effect of the strengthened dollar on the IS curve.

b. Comment only on the effect of the increase in stock prices on the IS curve.

Solution:

a. $\overline{X} \downarrow, \overline{M} \uparrow \Rightarrow \overline{NX} \downarrow \Rightarrow \overline{A} \downarrow$
Graphically, the IS curve shifts to the left

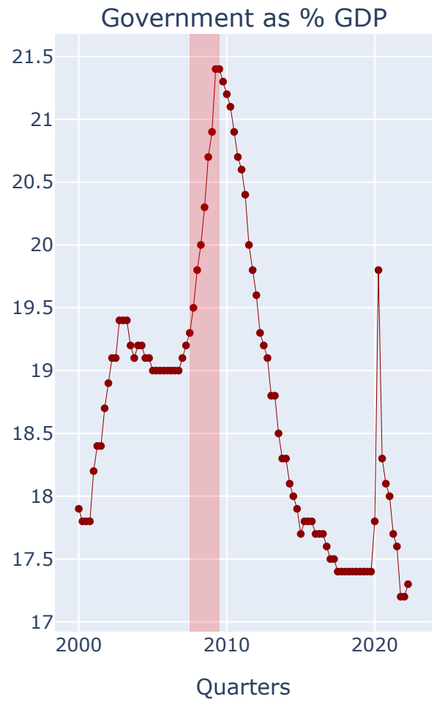
b. Higher stock prices value private investment (more confidence in future results): $\overline{I} \uparrow \Rightarrow \overline{A} \uparrow$
The IS curve shifts to the right

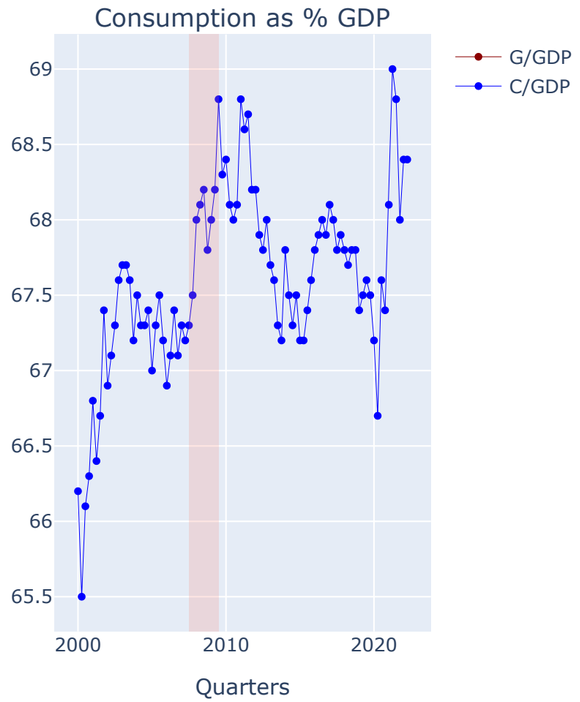
Exercise 7. Recessions and GDP components

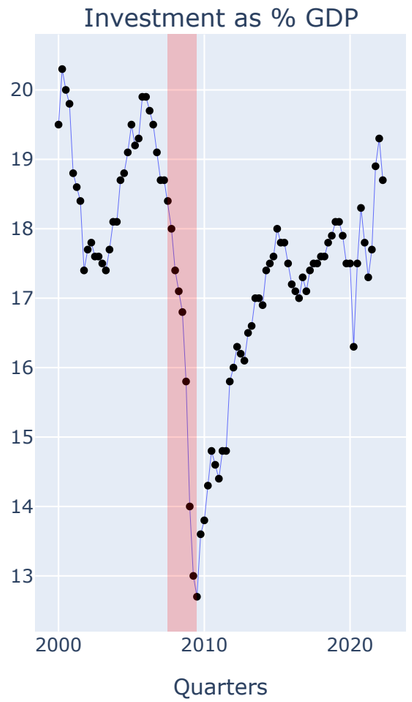
The figures below plot quarterly data for the USA concerning the four basic components of GDP (consumption, investment, government expenditures, and net exports) between 2000-2020. The recession that became known as “The Great Recession” is represented by the shaded area.

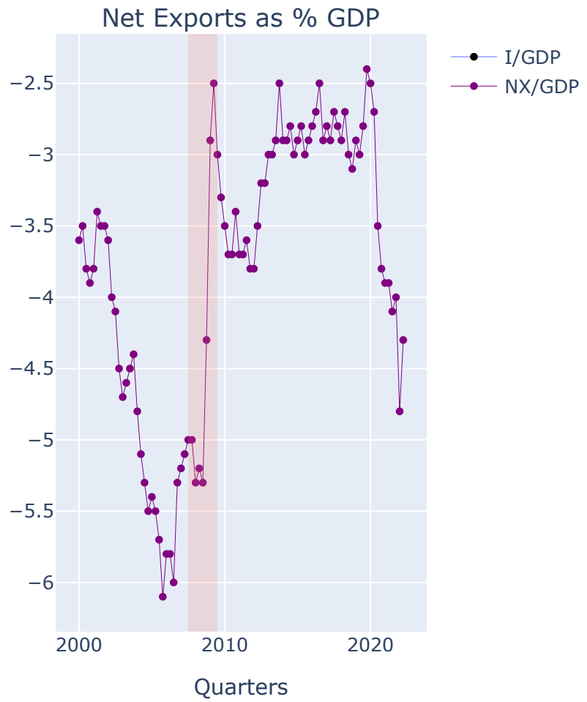
a. Why did government expenditures (as a percentage of GDP) increase during the Great Recession? And what happened during 2020?
b. Despite a deep recession, consumption expenditures as a percentage of GDP did not decline during the “Great Recession”. What may explain this behavior?
c. Why do you think net exports suffered a sharp increase during this recession?
d. What happened to investment during this recession?

Exercise 7. Recessions and GDP components









Exercise 8. The financial friction & investment

We saw in the previous week that in the USA, the real interest rate reached substantial negative values when the “Great Recession” of 2007 hit the economy. With negative real interest rates, we would expect investment to increase significantly. However, as we witnessed in the previous exercise (exercise 8), investment collapsed in that same period. Why did this happen? This week’s theory explains the demand for investment goods based on the real interest rate, exogenous forces, and the *financial friction*.

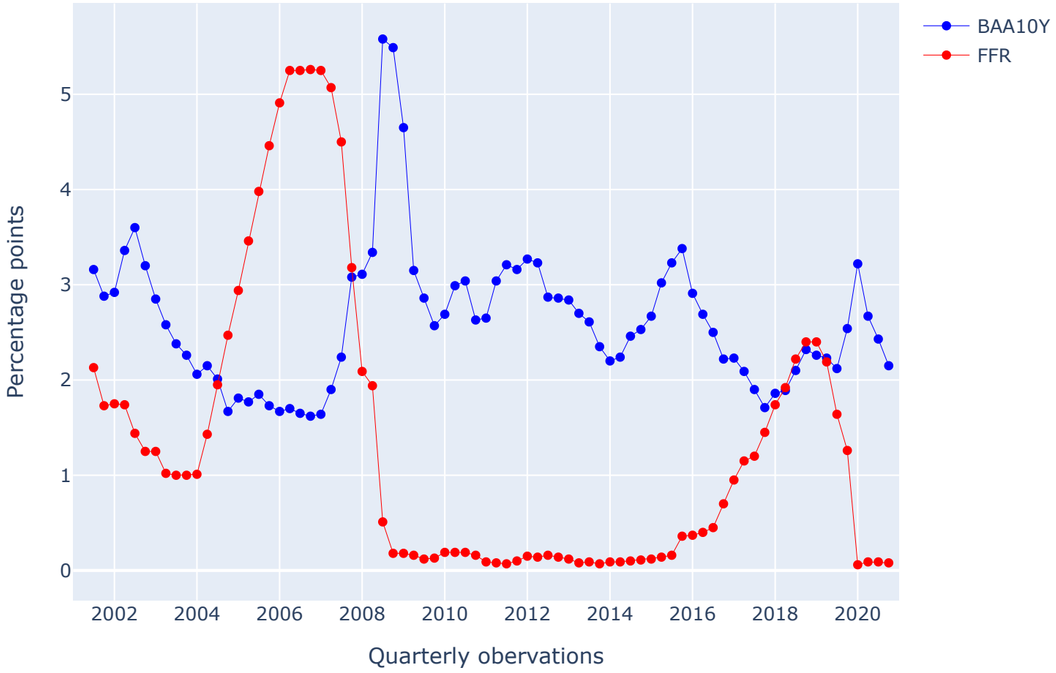
Exercise 8. The financial friction & investment

Below, we present evidence for the USA about the evolution of three significant variables:

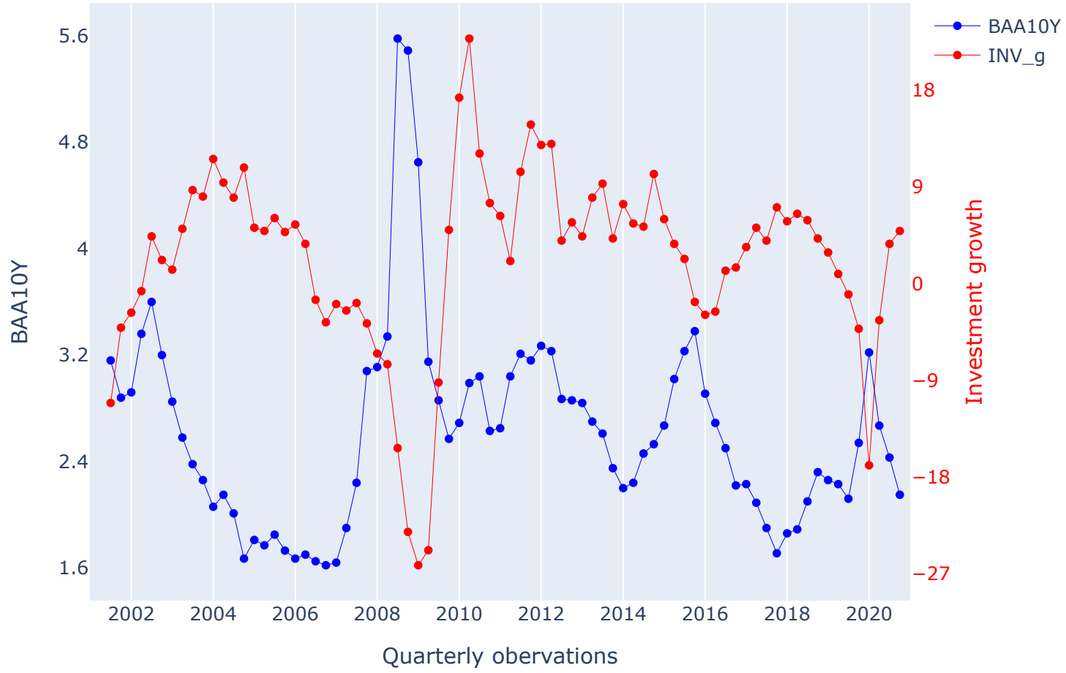
- the Federal Funds Rate (FFR),
- the Moody's Seasoned Baa Corporate Bond Yield Relative to Yield on 10-Year Treasury Constant Maturity (BAA10Y), which is a good indicator of the financial friction in the economy.
- The rate of growth of investment demand (INV_g).

Exercise 8. The financial friction & investment

BAA10Y vs FFR for the USA: (2001.Q3--2020.Q4)



BAA10Y and Investment growth USA: (2001.Q3--2020.Q4)



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Exercise 8. The financial friction & investment

a. Do you consider that the financial friction as an element of the theory of investment demand is supported (or refuted) by the evidence below?

b. How do you translate this dramatic increase in the financial friction during the "Great Recession" into the IS curve?

a. *Real interest rates went up*, due to the financial friction. The *growth rate of investment shows a high negative correlation* with the financial friction. The theory of investment demand seems supported by this evidence.

b. The IS curve shifted to the left

Exercise 9. Public spending vs Investment

From the textbook

Part of the US 2009 stimulus package was paid out in the form of tax credits. However, even though interest rates did not change significantly during that year, aggregate output did not increase. Using the same parameters as in our exercise 4 above:

$$\overline{C} = \$1.3 \text{ trillion} \qquad \overline{f} = 1$$
$$\overline{I} = \$1.2 \text{ trillion} \qquad c = 0.6$$
$$\overline{G} = \$3.0 \text{ trillion} \qquad b = 0.1$$
$$\overline{T} = \$3.0 \text{ trillion} \qquad d = 0.2$$
$$\overline{NX} = \$1.3 \text{ trillion} \qquad x = 0.1$$

Exercise 9 a. Public spending vs Investment

a. Suppose the amount of tax credits is $0.5 trillion. Calculate the decrease in autonomous investment expenditure necessary to offset that cut.

b. Show your answer graphically.

Remember that:

$$\overline{A} = \overline{C} + \overline{I} - d \times \overline{f} + \overline{G} + \overline{NX} - c \times \overline{T}$$

Then:

$$\Delta\overline{A} = \Delta\overline{I} - c \times \Delta\overline{T} \Rightarrow$$

$$\Rightarrow 0 = \Delta\overline{I} - 0{,}6 \times (-0{,}5) \Leftrightarrow$$

$$\Leftrightarrow \Delta\overline{I} = -0{,}3$$

Exercise 9 c. Public spending vs Investment

c. By how much would GDP increase due to the single impact of the tax credit measure?

Remember that the IS is given by:

$$Y = m \times \overline{A} - m \times \phi \times r$$

Then:

$$\begin{aligned} \Delta\overline{Y} &= m \times \Delta\overline{A} = \\ &= 2{,}5 \times 0{,}3 = \\ &= 0{,}75 \end{aligned}$$

Exercise 10. The crowding-out effect (controversies)

Using the data of exercise 8, we can analyze a huge controversy in macroeconomics: the crowding-out effect of public expenditures on private investment expenditures. In the following figure, we present a cross plot of the behavior of these two aggregates for the USA economy between 2000 and 2022. By inspecting this figure, what can we say about this crowding-out effect?

Exercise 10. The crowding-out effect (controversies)

Exercise 10. The crowding-out effect (controversies)

- **Crowding-out effect**: government spending is done at expenses of private investment (negative relationship)
- This empirical fact is the basic argument of *Classical macroeconomists*: increasing public spending to fight a recession is a mistake

Exercise 10. The crowding-out effect (controversies)

- The *Keynesian macroeconomists* will say that the Classical argument is based on a problem of reverse causality
  - Firstly, the recession will hurt investment; then, government intervenes
  - When the recession is over, investment will increase, while the government will cut down spending
- **Choose your side!**

Exercise 11 c. Inventories

> What happens to inventory spending during the early stages of an economic recession?

Solution:

- As soon as households' income starts to fall, inventories rise
- Firms will quickly cut production, trying to sell inventories
- As the recession deepens, production reduces and so do inventories, leading to a drastic reduction in investment

Exercise 12. Yield curve and short-term interest rates

From the textbook.

After the press conference that followed the Federal Open Market Committee meeting on June 19, 2013, there were reports in the media that Chairman Bernanke's comments were a signal that the Fed would raise interest rates sooner than expected.

As a result, the yield on 10-year U.S. Treasury notes rose to almost 2.6%, the highest level since August 2011.

a. Comment on how this would affect the IS curve.
b. Show your answer graphically.

Exercise 12. Solution

- If inflation is steady, the increase in nominal interest rates will rise real interest rates
- This will negatively affect all the components of Demand
- The IS curve **will not** shift, but there will be a *change along the curve*
- *The equilibrium where the economy is changes* to one with higher r and lower Y (see solution to Exercise 4. c)