

# Macroeconomics

## Week 3

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Undergraduate in Economics

1st Semester 2023-24

# Measuring Macroeconomic Data

# Introduction

- **GDP** is perhaps the most important macroeconomic aggregate. **Why?** 🤔
- Recall that GDP measures **the value** of economic activity during a period of time, in a geographic area.
- Economic activity is a flux of value circulating inside a system
  - It is produced by **Firms**
  - Consumed by **Consumers**
  - Earned in the form of **wages, interests** and **dividends**

# Three ways to calculate GDP:

## Production approach

$$Y = \sum_i GVA$$

- **Gross added value** by each producing agent avoids double accounting
- Some special cases included:
  - Implicit rents
  - Public services (via Government Budget)
  - Inventories

# Three ways to calculate GDP:

## Income approach

$$Y = NI + Dep + NFI$$

- $NI$  is **National Income**, which, in turn, is  $NI = W + RI + \Pi$
- $Dep$  is **depreciation** (a sort of *artificial cost*)
- $NFI$  is **net factor income** (income outflow - income inflow)
- Furthermore, notice that  $GNP = NI + Dep$

# Three ways to calculate GDP: Expenditure approach

$$Y = C + G + I + NX$$

- $C$  is private consumption
- $G$  is public consumption
- $I$  is investment
- $NX$  is net exports, i.e.,  $X - M$

# Exercises

# Exercise 1: What counts as GDP (I)?

By how much does GDP rise in each of the following scenarios? Explain.

- a.** You spend \$5,000 on college tuition this semester.
- b.** You buy a used car from a friend for \$2,500.
- c.** The government spends \$100 million to build a dam.
- d.** Foreign graduate students work as teaching assistants at the local university and earn \$5,000 each.

Solution:

- a.**  $\Delta GDP = \$5,000$
- b.**  $\Delta GDP = \$0$
- c.**  $\Delta GDP = \text{M}\$100$
- d.**  $\Delta GDP = \$5,000$  per student



# Exercise 2: What counts as GDP (II)?

By how much does GDP rise in each of the following scenarios? Explain.

- a.** A computer company buys parts from a local distributor for \$1 million, assembles the parts, and sells the resulting computers for \$2 million.
- b.** A real estate agent sells a house for \$200,000 that the previous owners had bought 10 years earlier for \$100,000. The agent earns a commission of \$6,000.
- c.** During a recession, the government raises unemployment benefits by \$100 million.

Solution:

**a.**  $\Delta GDP = M\$2$

**b.**  $\Delta GDP = \$6.000$

**c.**  $\Delta GDP = \$0$

# Exercise 2: What counts as GDP (II)?

By how much does GDP rise in each of the following scenarios? Explain.

- d.** A new U.S. airline purchases and imports \$50 million worth of airplanes from the European company Airbus.
- e.** A new European airline purchases \$50 million worth of airplanes from the American company Boeing.
- f.** A store buys \$100.000 of chocolate from Belgium and sells it to consumers in the United States for \$125.000.

Solution:

$$\mathbf{d. \Delta GDP = -M\$50 + M\$50 = \$0}$$

$$\mathbf{e. \Delta GDP = M\$50}$$

$$\mathbf{f. \Delta GDP = -\$100.000 + \$125.000 = \$25.000}$$

# Exercise 3. Approaches to estimate GDP

Consider a simple economy where there are two goods: wheat and bread. It is known that this economy produces \$500 of wheat and \$1.000 of bread, and bakers buy all the wheat for producing bread.

- a.** What approaches can be used to calculate the level of GDP in this economy?
- b.** What is the total amount of sales of final goods in this economy?
- c.** How much of intermediate goods are traded?

Solution:

- a.** Production and expenditure approaches
- b.** \$1.000
- c.** \$500

# Exercise 3. Approaches to estimate GDP

Consider a simple economy where there are two goods: wheat and bread. It is known that this economy produces \$500 of wheat and \$1.000 of bread, and bakers buy all the wheat for producing bread.

- d.** What is the amount of total sales in this economy?
- e.** What is the value-added produced by the bakers and by the farmers?

Solution:

**d.**  $\$500 + \$1.000 = \$1.500$

**e.** \$500 each

# Exercise 5. GDP and its shares

According to the Expenditure approach to measure the level of GDP, what do you think about the following sentence:

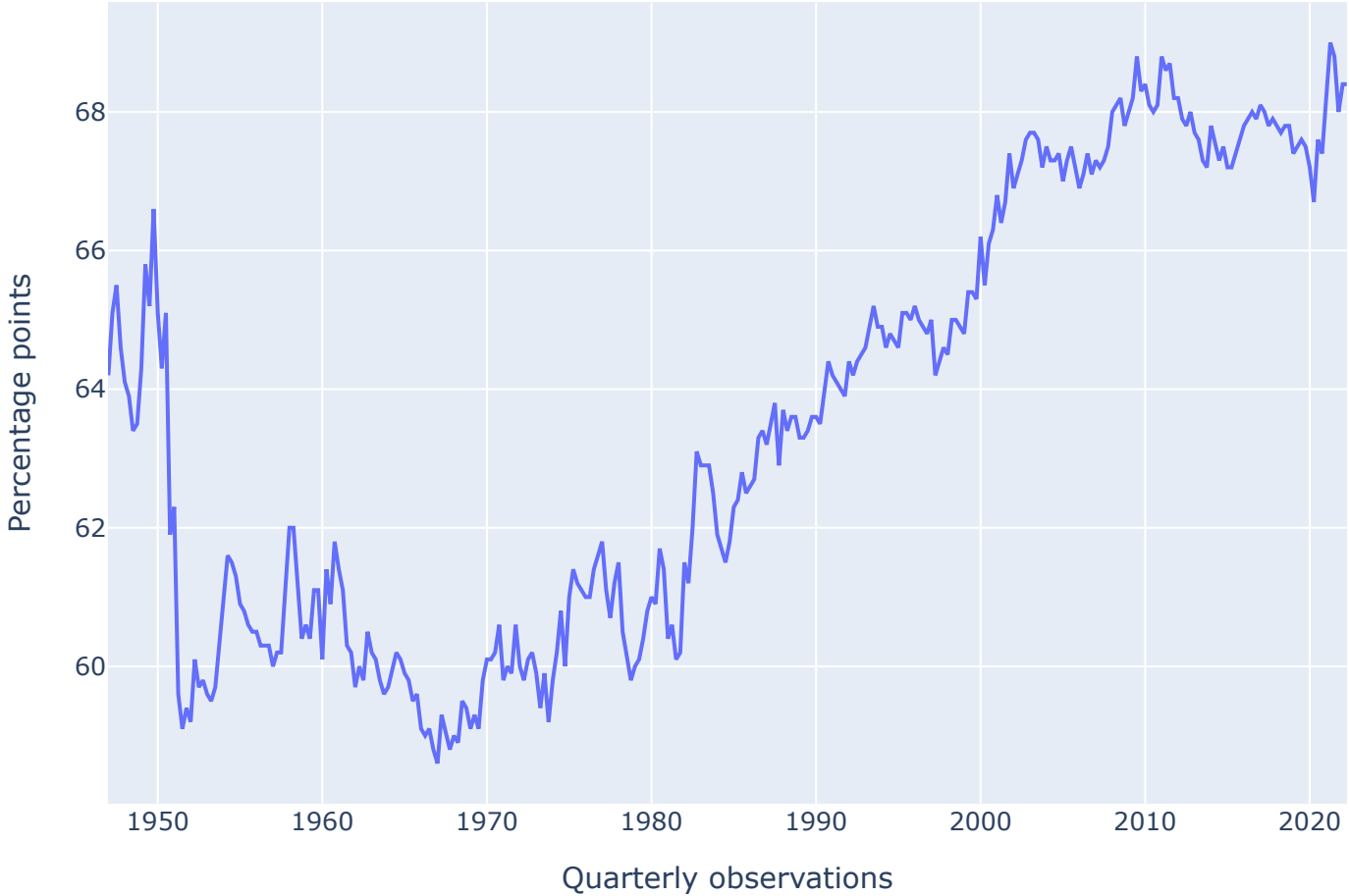
*“One of the themes in my new study, “Why the Federal Government Fails,” is that the federal government has grown too large to manage with any reasonable level of efficiency and competence. Even if politicians worked diligently to advance the general interest, and even if federal bureaucracies focused on delivering quality services, the vast size of the government would still generate failure after failure.”*

by Chris Edwards, “Federal Government: Too Big to Manage”, July 2015, [The Cato Institute](#).

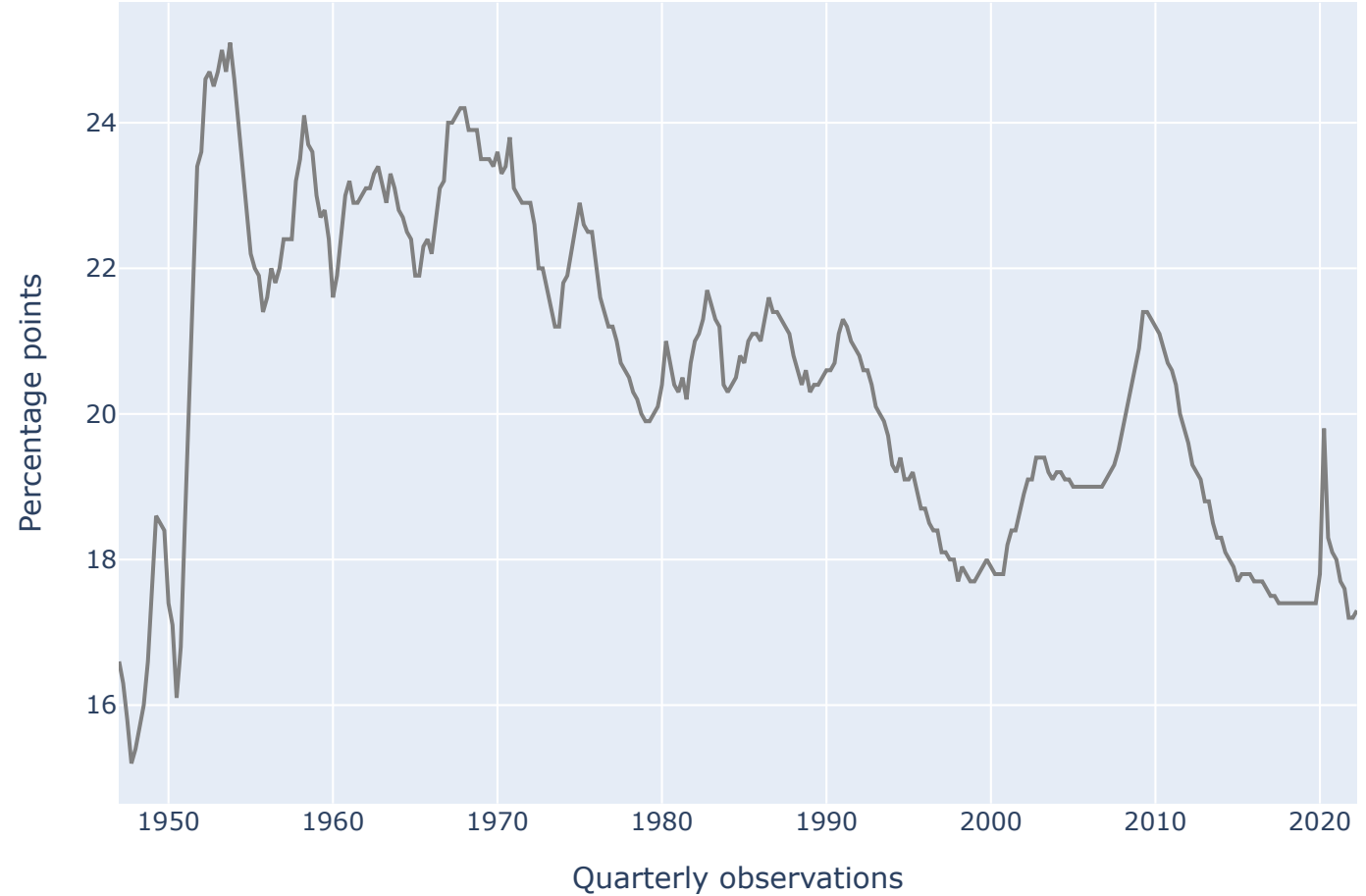
We provide some evidence in the following plots obtained with data from FRED.

# Exercise 5. GDP and its shares

Personal consumption expenditures as a % of GDP (US)



Government consumption expenditures and gross investment as a % of GDP (US)



# Exercise 5. GDP and its shares

- Chris Edwards: **what aggregate**? Assumption: GDP share of government spending on goods & services and gross investment
- The plots above show that Edwards might be **wrong**
  - The **share of public spending** has historically decreased in the US
  - Furthermore, an **increase in private spending** seems to have compensated for the decline in public spending
- Such assertions must rely on **data and facts**

# Exercise 6. Income vs Product

Using the information in Table 6.1, calculate the following macroeconomic aggregates using the income approach. Take into account that the income aggregates in the table below are net of income taxation imposed by the government (that is, their values are after-income taxation)

Table 6.1. Income distribution in Pandora's economy (2020)

	<b>Code</b>	<b>Item</b>	<b>Billions of dollars</b>
1	ce	Compensation of employees	6.637
2	git	Government income transfers to households	800
3	ri	Rents and interest	2.500
4	rcp	Retained corporate profits	1.500
5	div	Dividends	450



# Exercise 6. Income vs Product

Table 6.1. Income distribution in Pandora's economy (2020)

	<b>Code</b>	<b>Item</b>	<b>Billions of dollars</b>
6	<i>nfi</i>	Net factor income with the world	300
7	<i>pit</i>	Personal income taxes	2.100
8	<i>cit</i>	Corporate income taxes	700
9	<i>vat</i>	VAT taxes	2.900
10	<i>dep</i>	Depreciation	2.500

# Exercise 6. Income vs Product

- a.** Total National Income (NI)
- b.** Gross National Product (GNP)
- c.** Gross Domestic Product (GDP)

Solution:

```

1 begin
2     NI = ce + ri + rcp + div + pit + cit
3     GNP = NI + dep
4     GDP = GNP + nfi
5
6     [NI, GNP, GDP]
7 end

```

```

1 begin
2     ce = 6637
3     git = 800
4     ri = 2500
5     rcp = 1500
6     div = 450
7     nfi = 300
8     pit = 2100
9     cit = 700
10    vat = 2900
11    dep = 2500
12 end;

```

# Exercise 7. Price indexes and real GDP

Consider an economy where only the following goods are produced:

<b>Product</b>	<b>2004 Quantities</b>	<b>2004 Prices</b>	<b>2005 Quantities</b>	<b>2005 Prices</b>
Computers	450	6	500	6
Bikes	900	4	800	5

```

1 begin
2   # data for 2004      data for 2005
3   Qc_04 = 450 ;      Qc_05 = 500      # Quantities of Computers
4   Qb_04 = 900 ;      Qb_05 = 800      # Quantities of Bikes
5   Pc_04 = 6 ;        Pc_05 = 6        # Price of Computers
6   Pb_04 = 4 ;        Pb_05 = 5        # Price of Bikes
7 end;
```

# Exercise 7. Price indexes and real GDP

- a. Why have economists developed the concept of a Price Index?

Solution:

- Remember that  $GDP = \sum_i GAV_i = \sum_i p_i \times q_i$
- This means that  $\Delta GDP = \sum_i \Delta p_i \times q_i + \sum_i p_i \times \Delta q_i$
- We want to get rid of inflation on the actual value of GDP

# Exercise 7. Price indexes and real GDP

**b.** Calculate the value of nominal GDP for 2004 and 2005. Between these two years, how much did nominal GDP grow (as a percentage)?

```

1 begin
2     NGDP04 = Qc_04 * Pc_04 + Qb_04 * Pb_04           # Quantities 2004 x prices 2004
3     NGDP05 = Qc_05 * Pc_05 + Qb_05 * Pb_05           # Quantities 2005 x prices 2005
4     Ngr     = round(((NGDP05/NGDP04) - 1)*100,digits=2) # Growth rate of nominal GDP
5 end;
```

**c.** Calculate the value of real GDP using 2004 as the base year. Calculate the growth rate of real GDP between 2004 and 2005.

```

1 begin
2     # 2004 as the base year (prices of 2004)
3     RGDP04_04 = Qc_04 * Pc_04 + Qb_04 * Pb_04           # Quantities 2004 x prices 2004
4     RGDP05_04 = Qc_05 * Pc_04 + Qb_05 * Pb_04           # Quantities 2005 x prices 2004
5     Rgr_04    = round(((RGDP05_04/RGDP04_04) - 1)*100, digits=2) # Growth rate of real GDP
6 end;
```

# Exercise 7. Price indexes and real GDP

**d.** Calculate the value of real GDP using 2005 as the base year. Calculate the growth rate of real GDP between 2004 and 2005.

```

1 begin
2     # 2005 as the base year (prices of 2005)
3     RGDP04_05 = Qc_04 * Pc_05 + Qb_04 * Pb_05
4     RGDP05_05 = Qc_05 * Pc_05 + Qb_05 * Pb_05
5     Rgr_05    = round(((RGDP05_05/RGDP04_05) - 1)*100,digits=2)
6 end;
```

**e.** Using 2004 as the base year, calculate the value of the GDP price index for both years. What was the rate of inflation in this economy between 2004 and 2005?

```

1 begin
2     IP_04 = NGDP04/RGDP04_04
3     IP_05 = round(NGDP05/RGDP05_04, digits = 2)
4     π_04_05 = round(((IP_05-IP_04)/IP_04) * 100, digits = 2)
5 end;
```

# Exercise 7. Price indexes and real GDP

**f.** If we use 2005 as the base year, would we expect to get the same real GDP growth rates and inflation rate as calculated in the case of 2004 as the base year? Why?

- No. A change in the base year will change all the real values of macroeconomic aggregates: **Gerschenkron effect**
- A solution: Chain-Weighted prices indices
- Exercise 12 presents an example.

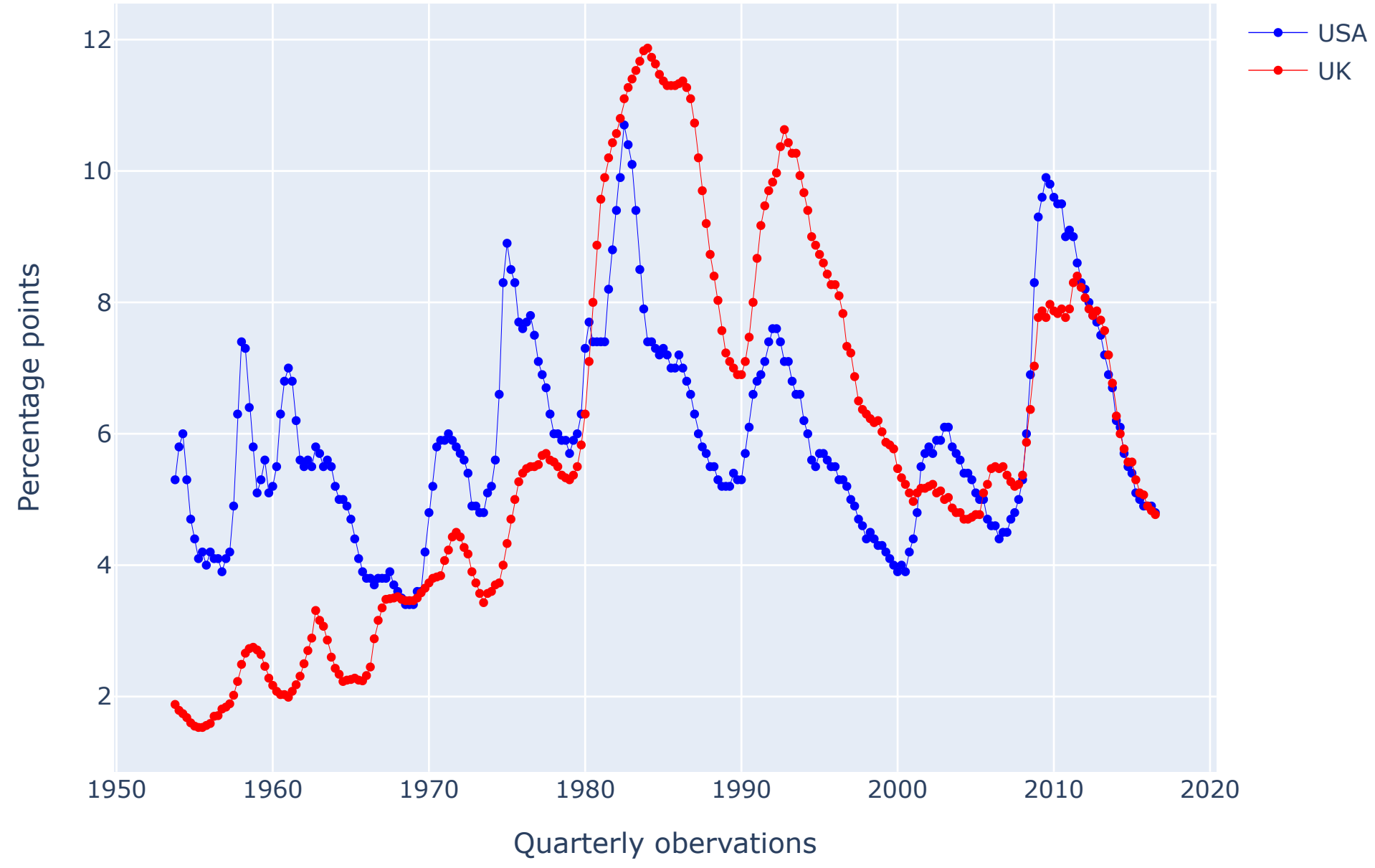
# Exercise 9. The natural unemployment rate

The three figures below present the plots for the US and UK unemployment rates between 1954 and 2016. According to the “Natural Rate of Unemployment” theory, we should expect the actual unemployment rate should always be significantly above zero at any period in time due to frictional unemployment and structural unemployment.



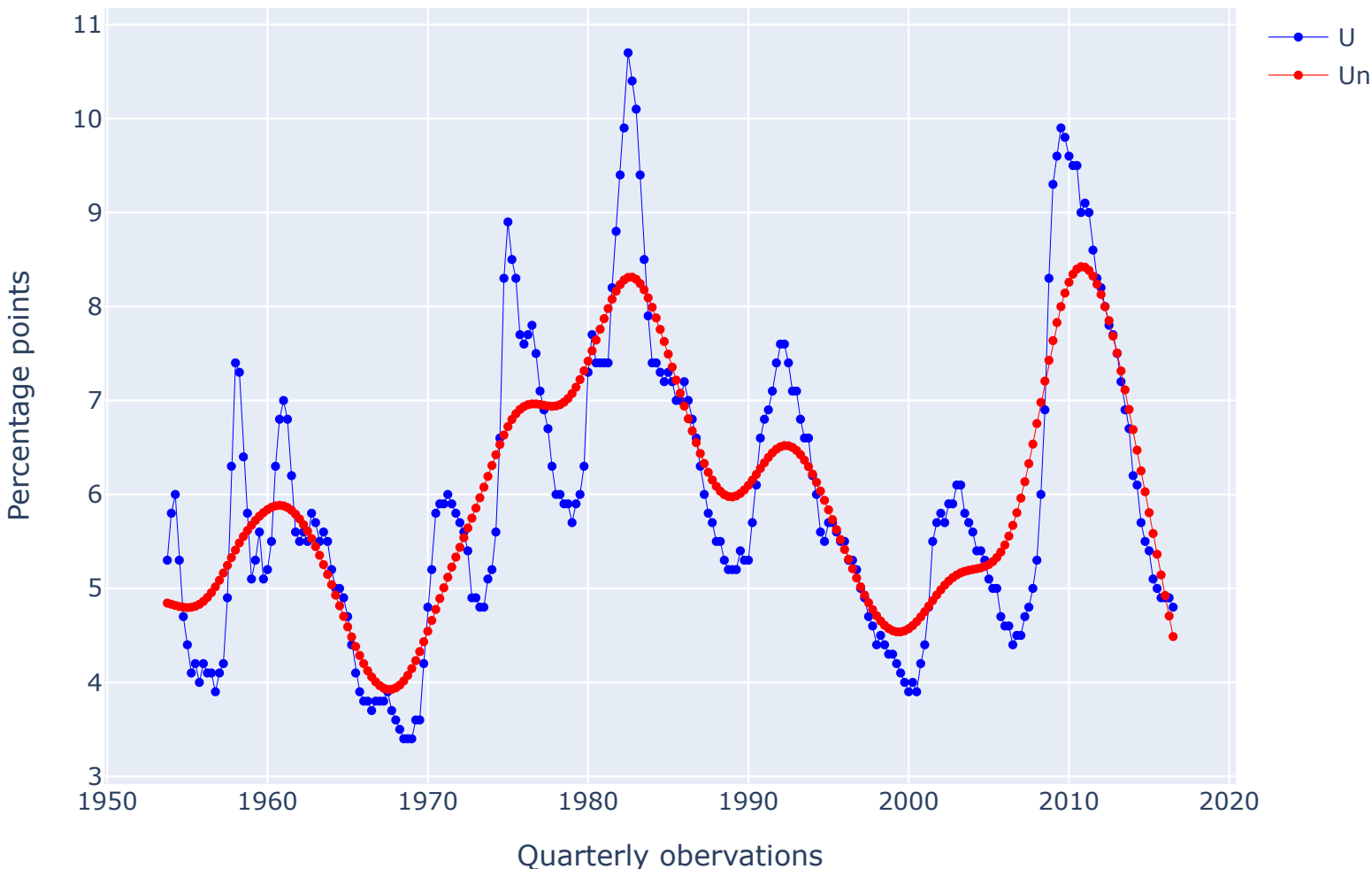
# Exercise 9. The natural unemployment rate

Actual unemployment rate in the USA and UK: (1954.Q4--2016.Q3)

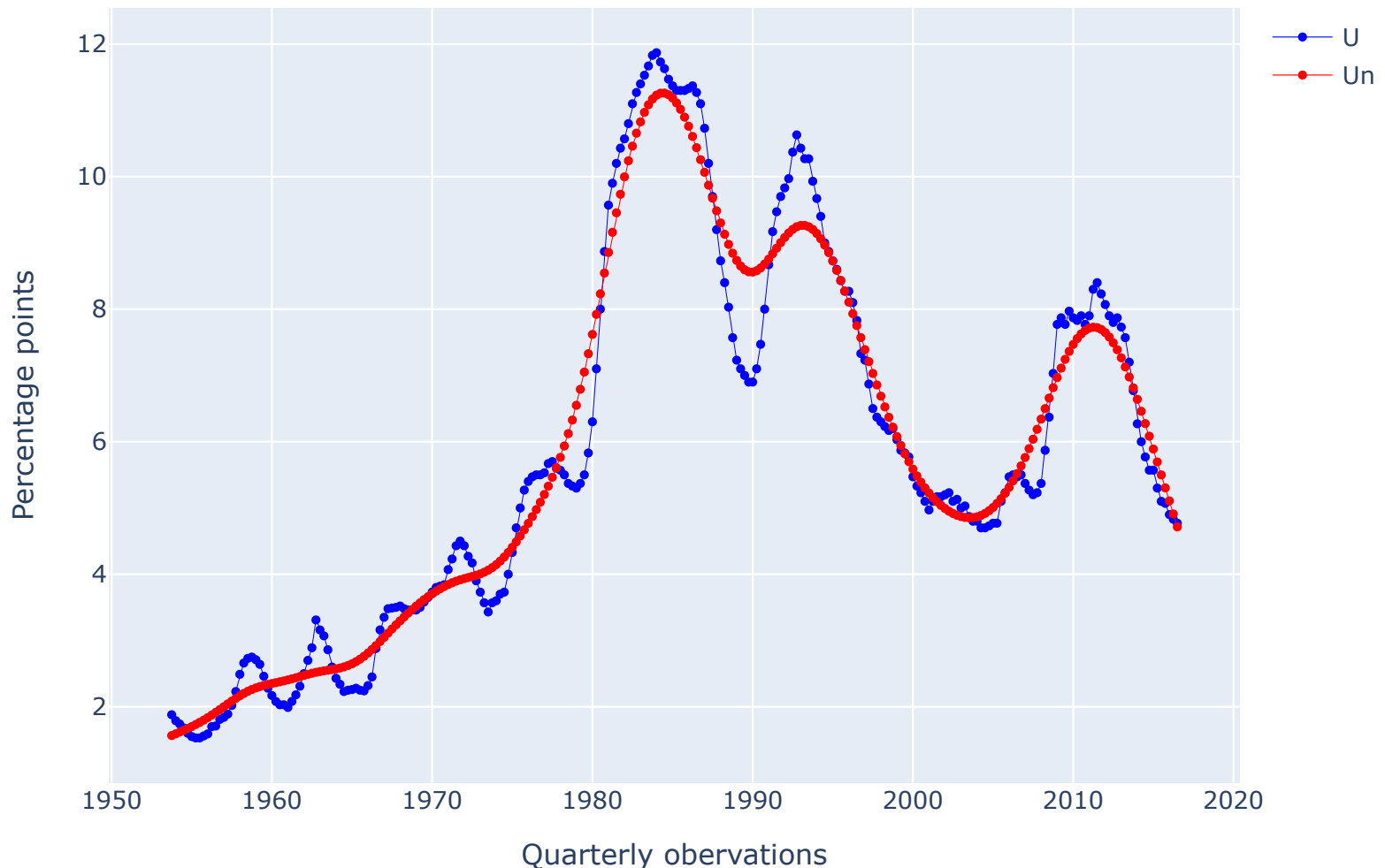


# Exercise 9. The natural unemployment rate

Actual vs Natural Unemployment (US)



Actual vs Natural Unemployment (UK)



# Exercise 9. The natural unemployment rate

Do you consider it acceptable, as a theory, that, e.g., the UK had a natural unemployment rate equal to 11.26% in 1984.Q3?

Does it look so 'natural' to have an unemployment rate higher than 10% of the total labor force?

Comment upon this apparent contradiction.

Suggested answer:

- Potential GDP and so natural unemployment may change in response to **large shocks**
- From mid-1970s to mid-1980s UK did not face any significant shock
- The unemployment level above cannot logically be 'natural'

# Exercise 10. Negative real-interest rates

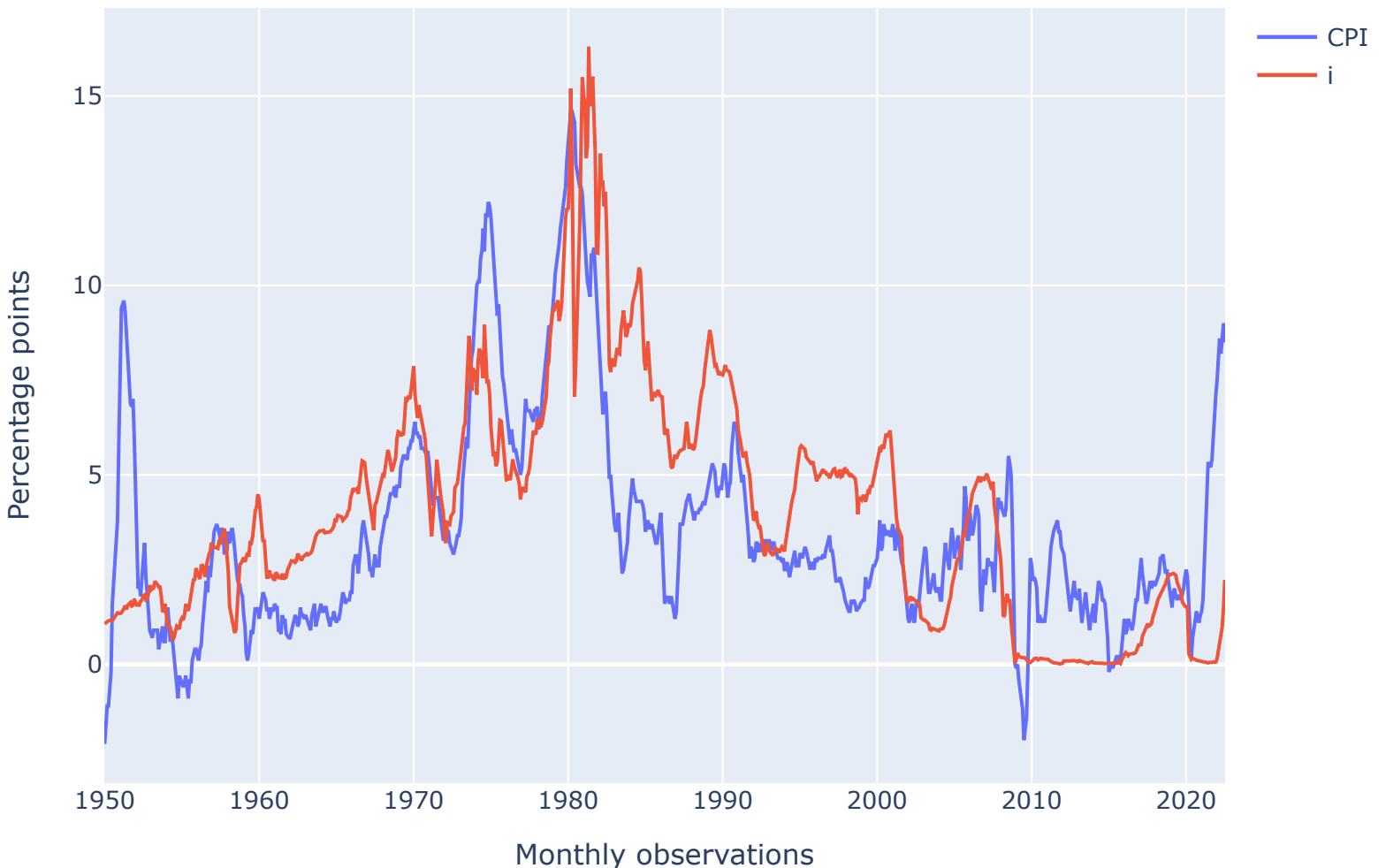
From an economic perspective, it seems highly relevant to see if negative real-interest rates are standard behavior or just sporadic facts. From mere intuition, one would be inclined to conclude that those occurrences should be rare because such rates do not make much economic sense. Let us see what has happened in the case of the US since the early 1950s.

By definition, the real-interest rate is the difference between the nominal interest rate and the rate of inflation. It is familiar to use the Fed Funds Rate as the proxy for the nominal interest rate and compare it with the inflation rate. However, it is better to use the 3-month maturity Treasury Bills rate (3MTB) instead of the Fed Funds rate because the Fed has no control over the yields of 3MTB (they are essentially a market phenomenon).

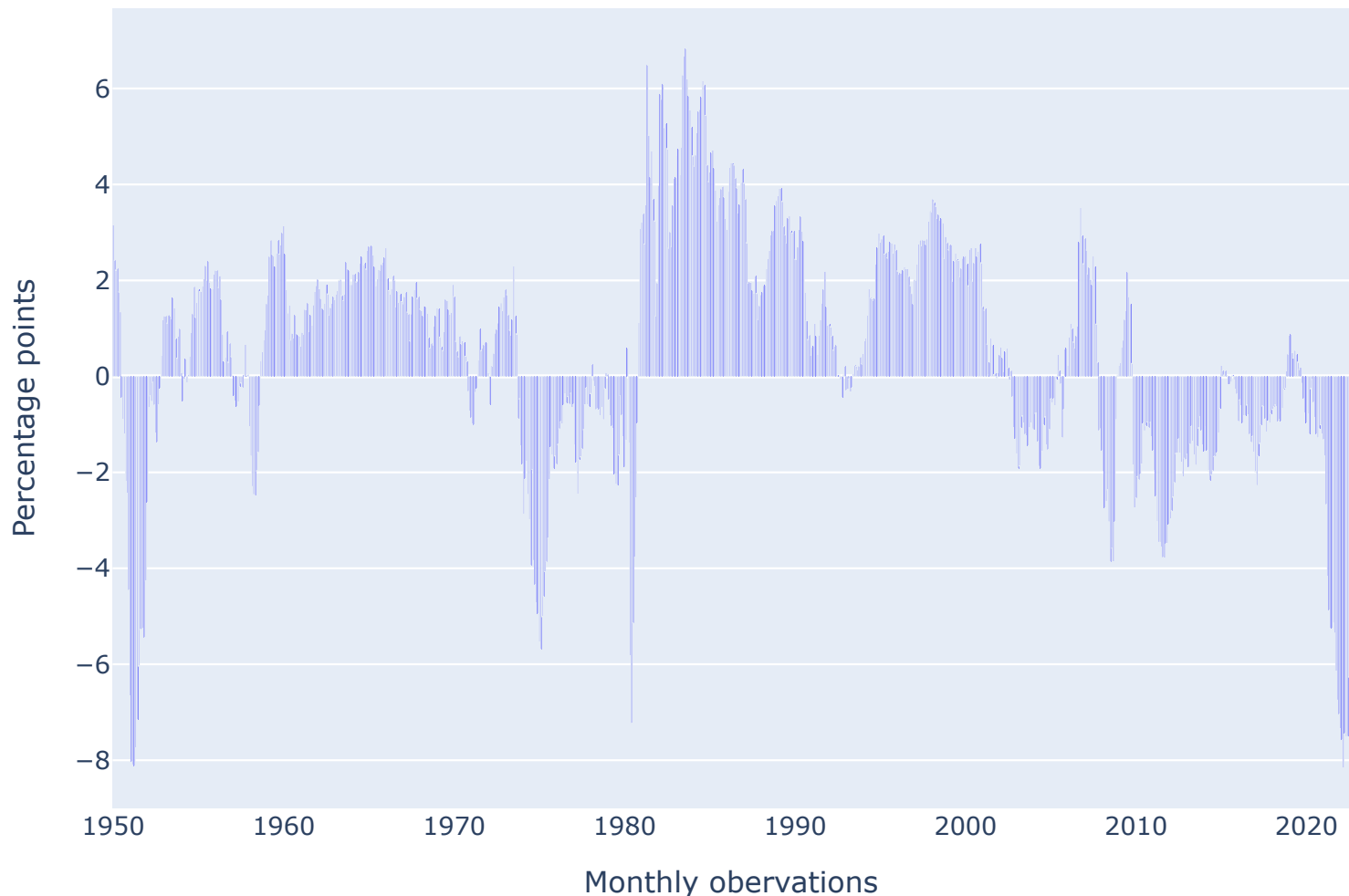
Now, consider the following figures:

# Exercise 10. Negative real-interest rates

3-Month Treasury Bills rate vs CPI rate: US (1950.M1--2022.M4)



Real Interest Rate: US (1950.M1--2022.M4)



# Exercise 10. Negative real-interest rates

**a.** Given the figures above, what would you conclude about the frequency of negative real-interest rates? Do you consider such frequency a good or a bad signal about economic performance?

- **Three periods** when the real interest rate  $r$  was significantly negative: the early 1950s, throughout the 1970s, and from 2002 onwards
- Negative interest rates are a frequent event, though they are an **economic contradiction** (we expect a value around 1-3%)

# Exercise 10. Negative real-interest rates

- However, if either *inflation is out of control* or if private agents have *pessimistic expectations* about the future very low or even negative real interest rates will emerge

# Exercise 10. Negative real-interest rates

**b.** With western economies currently displaying a poor performance in economic growth and with such negative real-interest rates, do you consider it risky for governments to borrow to finance investment in infrastructure, health, and education?

- We are facing **two devastating shocks**:
  - 1.** a war pushing up energy prices
  - 2.** the end of a pandemic that clashed supply chains
- Instability leads to large and abrupt changes in the yields of financial assets, public bonds included



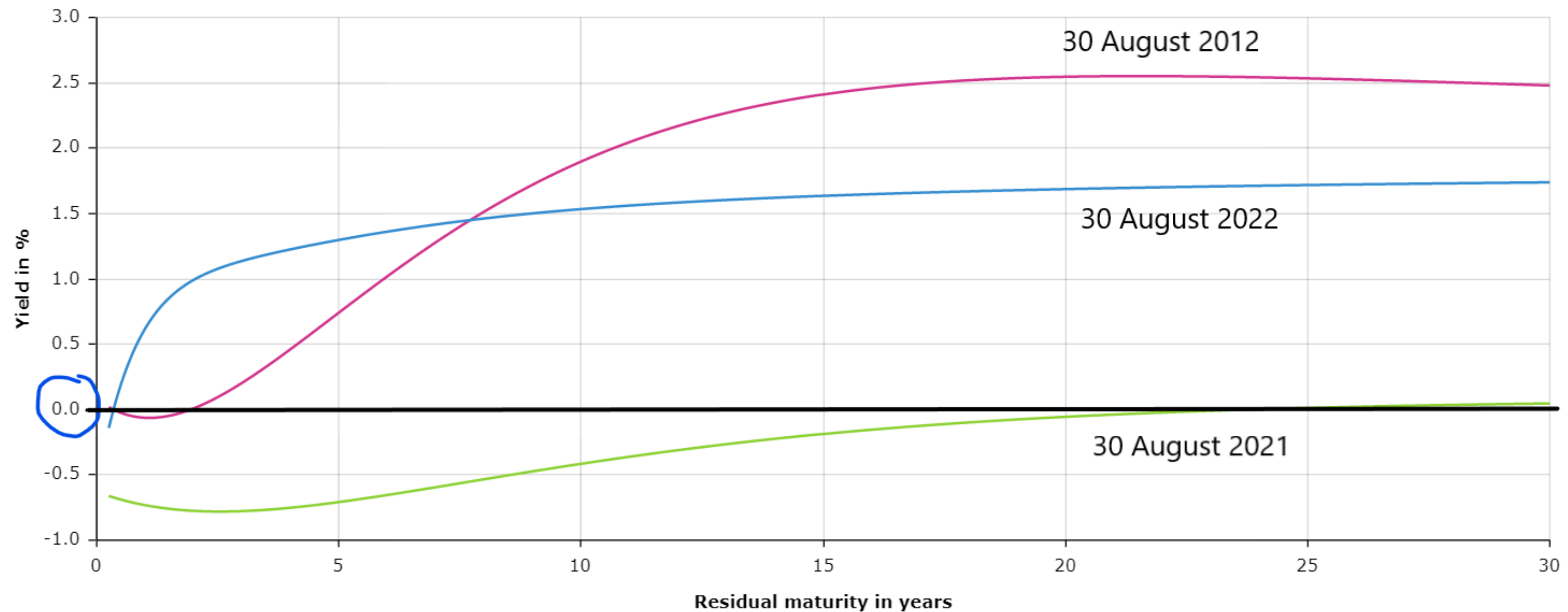
# Exercise 10. Negative real-interest rates

30 August 2012 30 August 2021 30 August 2022

AAA rated bonds  All bonds Select maturity ▾

Spot rate | Instantaneous forward | Par yield

Curve | Yields | Parameters



# Exercise 10. Negative real-interest rates

- A completely different answer from 2021 to today
- In 2021
  - Western economies experienced deflation
  - Inflation expectations were stable and low
  - Long-term interest rates were stable and very low (lower than 1%)
  - Yields of 30-year public bonds were negative in the most developed countries in the world
  - Public borrowing was safe and clean

# Exercise 10. Negative real-interest rates

- Today
  - Inflation spiked to unseen levels over the last forty years
  - Short and long-term interest rates jumped in response
  - Caution is required in long-term public investment decisions (like schools, infrastructure, health, and environmental protection)

