Macroeconomics

Week 2

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Introduction to Macroeconomics

Macroeconomic Models

Models? Yes we do!

- **Mathematical models** are essential to Economics

  - Simplification of reality, sometimes gross

  - But all knowledge is abstraction

  - And all abstraction is simplification

- Economics is not the only realm where we *exchange detail for insight*

Like a map

Like a map

Elements of a mathematical model
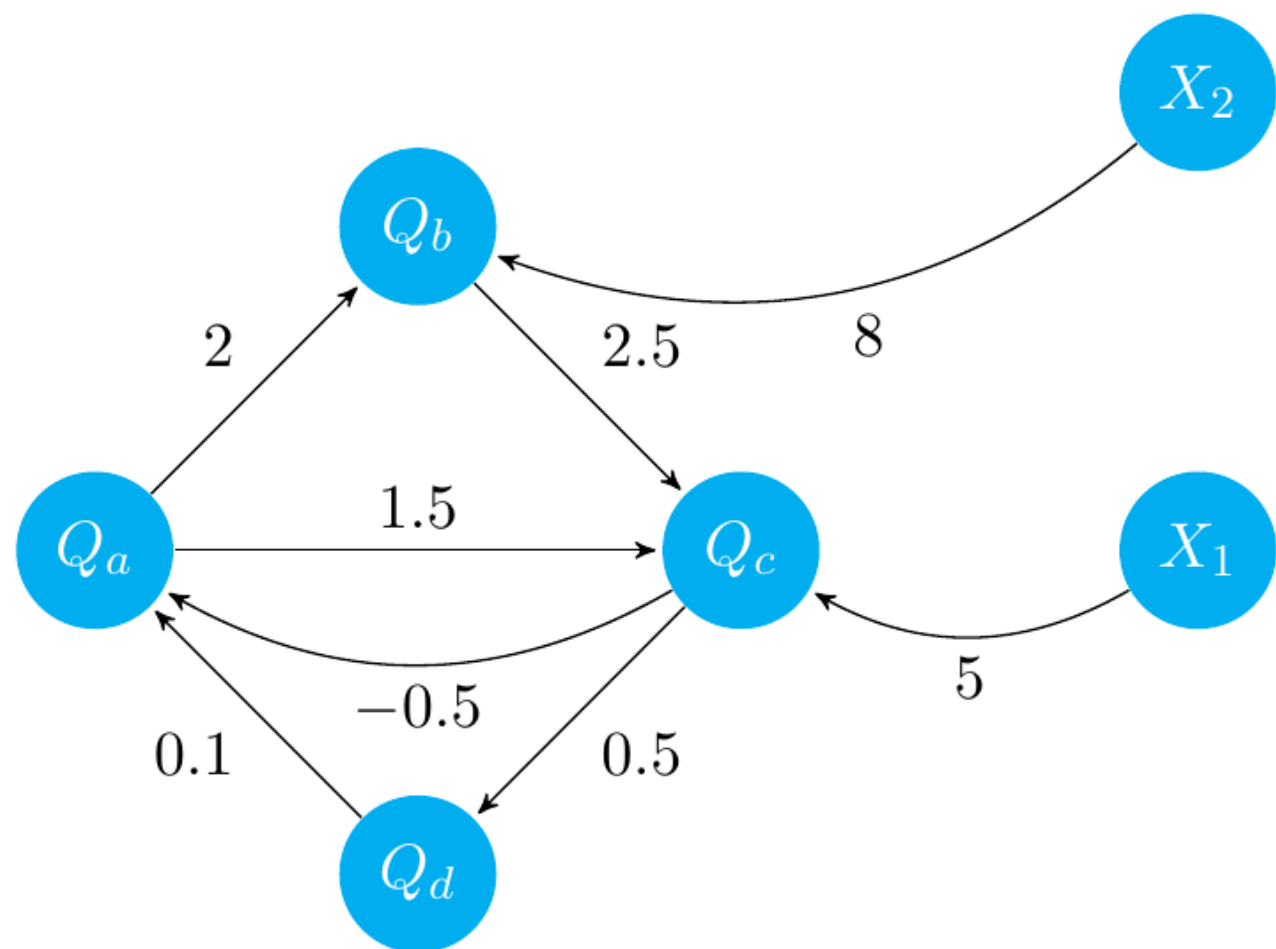
Another representation:

$$Q_a = -0.5Q_c + 0.1Q_d$$
$$Q_b = 2Q_a + 8X_2$$
$$Q_c = 1.5Q_a + 2.5Q_b + 5X_1$$
$$Q_d = 0.5Q_c$$

Q_i **endogenous variables**
X_j **exogenous variables**

The numbers are **parameters** or the **structure** of the model

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Exercises about Macroeconomic Models Notebook 2

Exercise 1. Endogenous vs. exogenous variables

From the textbook

Sciences other than economics also use models to explain the behavior of endogenous variables based on assumptions about the environment and changes in exogenous variables. Suppose you have to design a model that *links childhood obesity and diabetes*.

a. Which one would be the exogenous variable? Which one would be the endogenous variable?

b. Can you think of other exogenous variables?

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Exercise 1. Endogenous vs. exogenous variables

Solution for part a.

- Do all obese children are diabetic?

- Do all diabetic children are obese?

- So child obesity might not be the exogenous variable **causing** child diabetes, though there might exist a **strong correlation**

- It can be because both are the result of something else

Exercise 1. Endogenous vs. exogenous variables

Solution for part b.

Some common roots of child obesity and child diabetes:

- Food/cultural habits

- Education

- Level of income

- Genetic condition

Business Cycle Analysis

GDP: the Economists *mantra*

- Measure of the **value** generated in some territory

- Proxy for **welfare**

- The same story everywhere: a **hockey stick** with **fluctuations**

GDP per capita (current US$)

Data from World Bank

GDP: some issues and questions

- Absolute value or *per capita*?

- Nominal or real?

- Actual or potential?

- What is the relationship with other variables? Unemployment? Interest rates (FED/ECB)? The Monetary Base? Taxation? Public Debt?

- Does it respond to policy (fiscal or monetary)? Can we do anything to stabilize it?

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The Business Cycle

- Any graphical inspection of a GDP series will produce the same two impressions:

  - a **trend** determined by *statistical methods* that points to how we expect the variable to evolve in a big time span

  - **short-run deviations** around the trend resulting from economic activity
    - Positive deviations are called *Expansions or Booms*
    - Negative deviations are called *Recessions*

- We call **business cycle** to a joint pair of expansion and recession

Exercises about Macroeconomic variables Notebook 2

Exercise 3. Plotting Real GDP

Using data from the CONFERENCE BOARD, "The Total Economy Database", we plot the levels of Real GDP for Portugal and France.
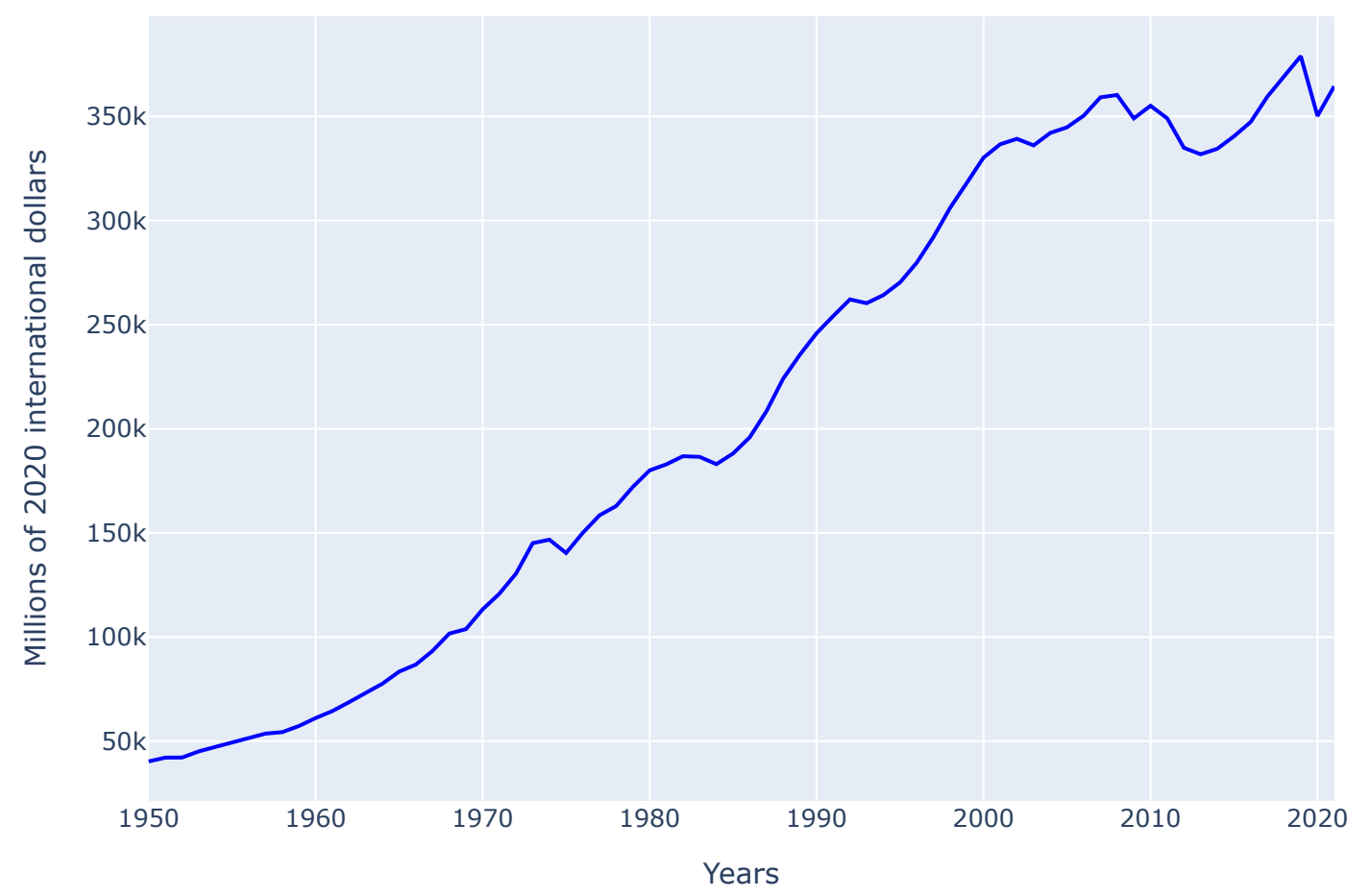
Can we get much information about these plots, as far as the performance of the two economies are concerned?
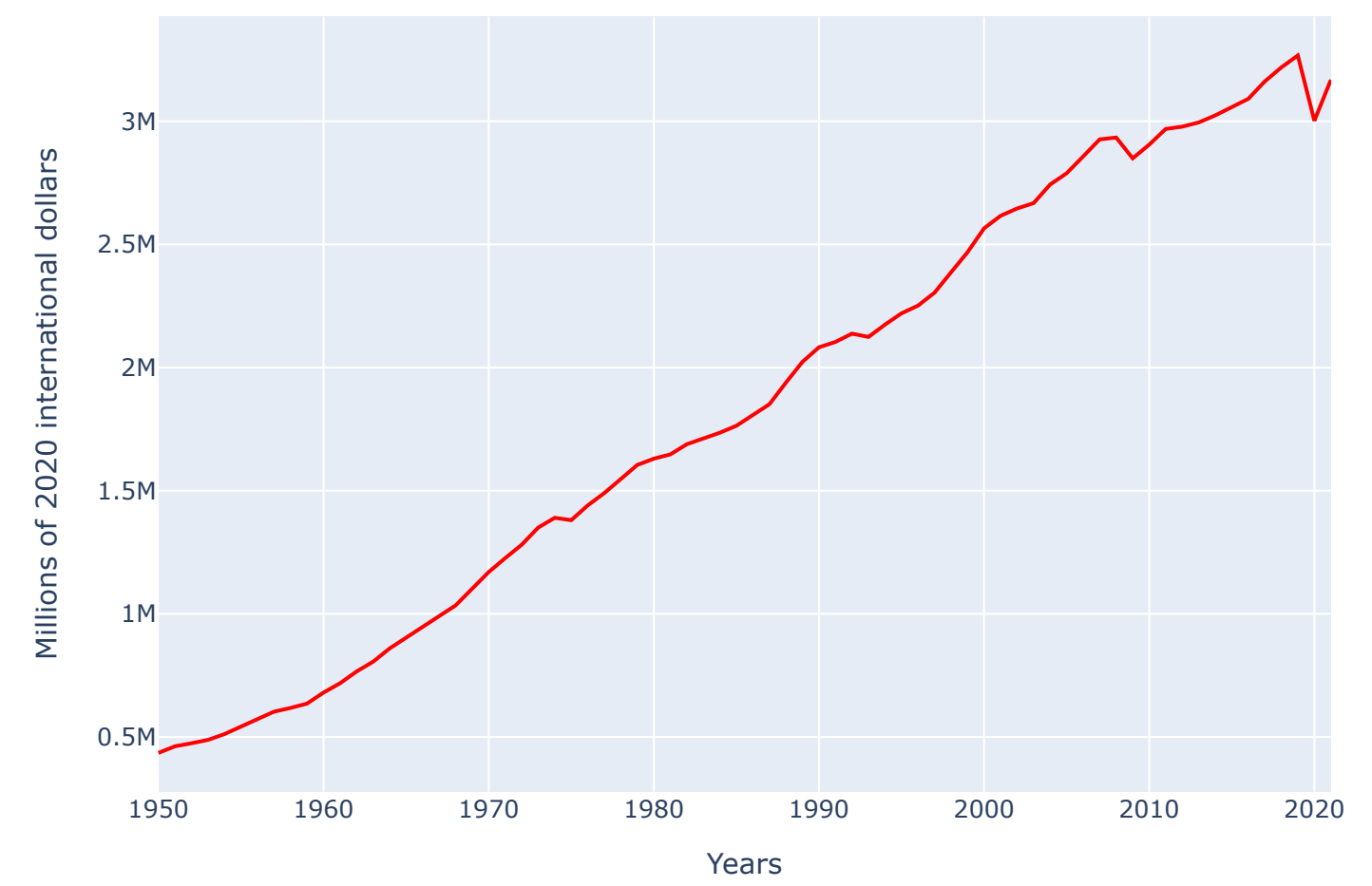
Which country performed better?

Which one showed more volatility in GDP?

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Exercise 3. Plotting Real GDP

Real GDP: Portugal (1950-2021)

Real GDP: France (1950-2021)

Exercise 3. Plotting Real GDP

- Plots with the real series of macroeconomic variable are barely useful

- They certainly do not allow to answer the specific questions

- We lack of information about volatility

- Only we can say is that Real GDP in both countries exhibit an upward trend

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Exercise 4. Business cycles

In the various plots below, we present the following:

1. The evolution of Real GDP and Potential (Real) GDP for Portugal and France;

2. The business cycles as the percentage deviation of Real GDP from Potential GDP for Portugal, France, and the UK.

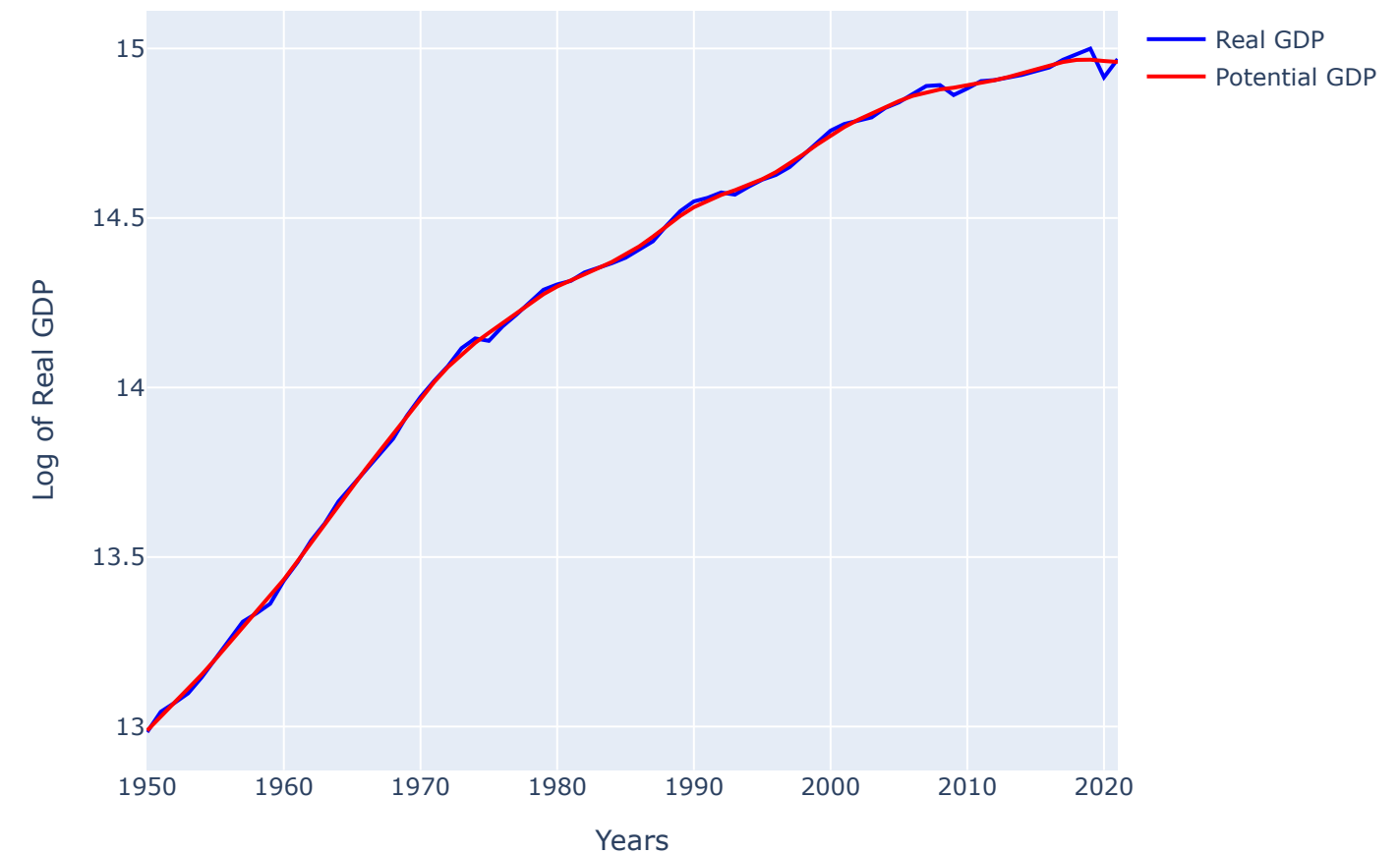**3.** The coss-correlation of business cycles in the Euro Area.

Based on the information provided by these plots, answer the following questions.

Exercise 4. Business cycles

Real vs Potential Real GDP: Portugal (1950-2021)
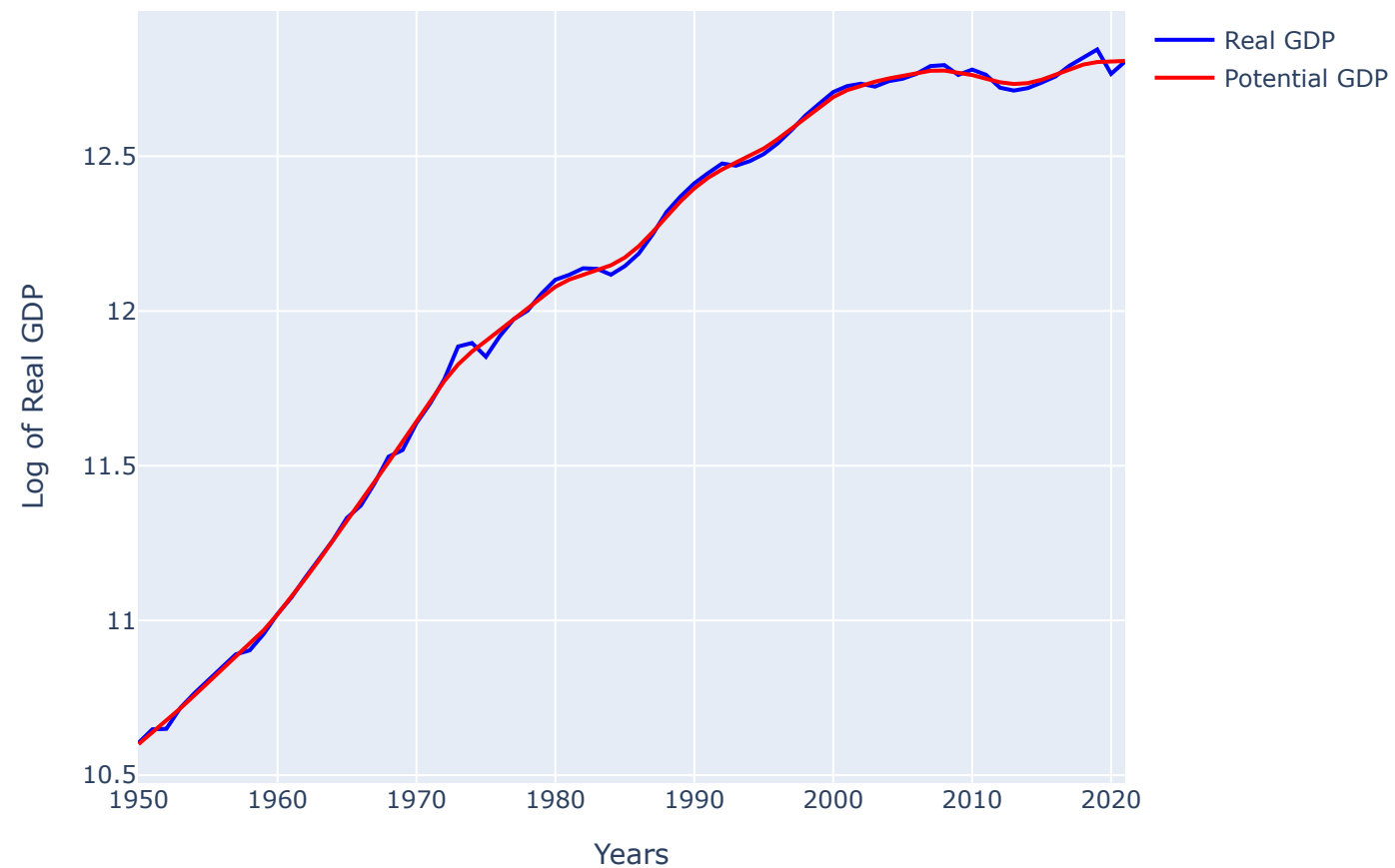
Real vs Potential Real GDP: France (1950-2021)

a. By looking at the evolution of Real GDP and Potential GDP, can you spot one period where each economy was in a recession? And in an economic boom?
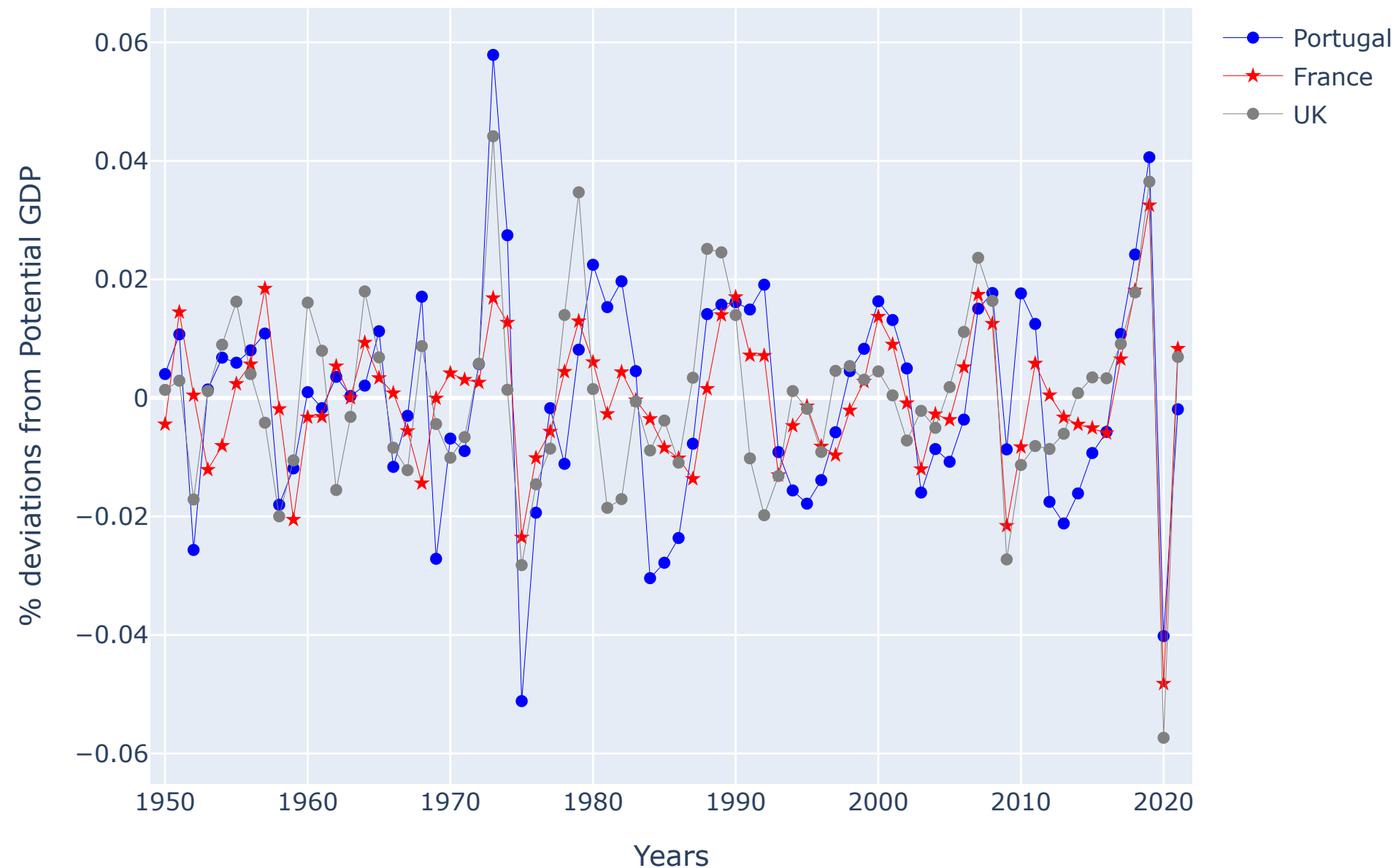
Exercise 4. Business cycles

Solution of part a.

- Remember that a recession implies $Y < Y^P$ (even if $g_Y > 0$)

- And a boom implies $Y > Y^P$ (even if $g_Y < 0$)

- By zooming in on the plot the Portuguese economy was in a boom in 1973 while it was under a recession in 1975

- The same happened in France in the same period

Exercise 4. Business cycles

Business cycles: Portugal, France and UK (1950-2021)

b. The plot in the left displays the business cycles in Portugal, France, and the UK. What are the main points we can observe by inspecting this figure?

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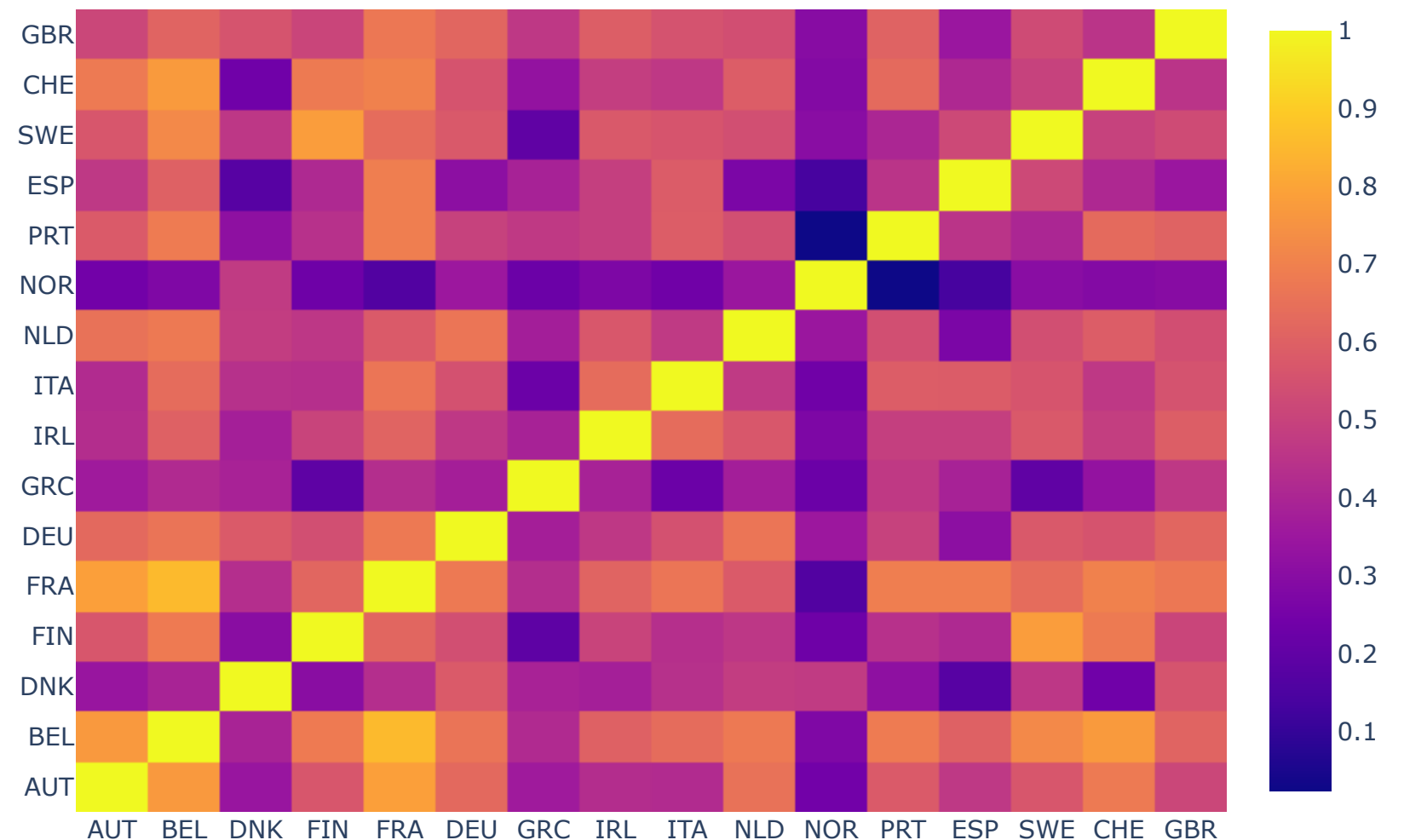
Exercise 4. Business cycles

Solution of part b.

1. The cycles of those three economies *tend to move together* over time
2. The *amplitude or volatility* of the cycles seems to be relatively similar over time
3. The *persistence* of the cycles seems similar across these economies
4. *Cycles are recurrent* — shocks seem to regularly hit economies

Exercise 4. Business cycles

c. By looking at the correlation matrix of the business cycles in the Euro Area, which is presented below, mention three highly positively correlated countries and three with cycles that display low or no correlation at all.

Correlation matrix of the business cycles in the Euro Area: 1950-2021

Exercise 4. Business cycles

- This matrix allows us to graphically see the **cross correlation** of the cycle across countries

- The **Pearson cross correlation coefficient** is the most widely used measure of cross correlation

$$\rho_{X,Y} = \frac{\text{cov}(X,Y)}{\sigma_X \sigma_Y}, \quad -1 \leq \rho_{X,Y} \leq 1$$

- You may use `crosscor(x, y, [lags]; demean=true)` by `StatsBase.jl` in Julia

Exercise 4. Business cycles

Solution of part c.

- *Norway, Greece, and Denmark* display **low cross-correlation** of their cycles with the rest of this group

- *Belgium, France, and the UK* display **high cross-correlation** with the rest of this group

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Exercise 5: The impact of business cycles

In 2007, the world economy was stroke by a financial crisis of enormous proportions. This crisis affected some countries more than others in the European Union and affected more some zones of the world economy than others. Let us see what happens for 23 economies since 2007. For that purpose, we should normalize Real GDP levels for all the 23 economies: Real GDP is set to 100 in 2007.

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Exercise 5: The impact of business cycles

We apply such procedure to three groups of countries:

- The EuroZone periphery countries

- The EuroZone core countries + US, Canada, Switzerland and Japan

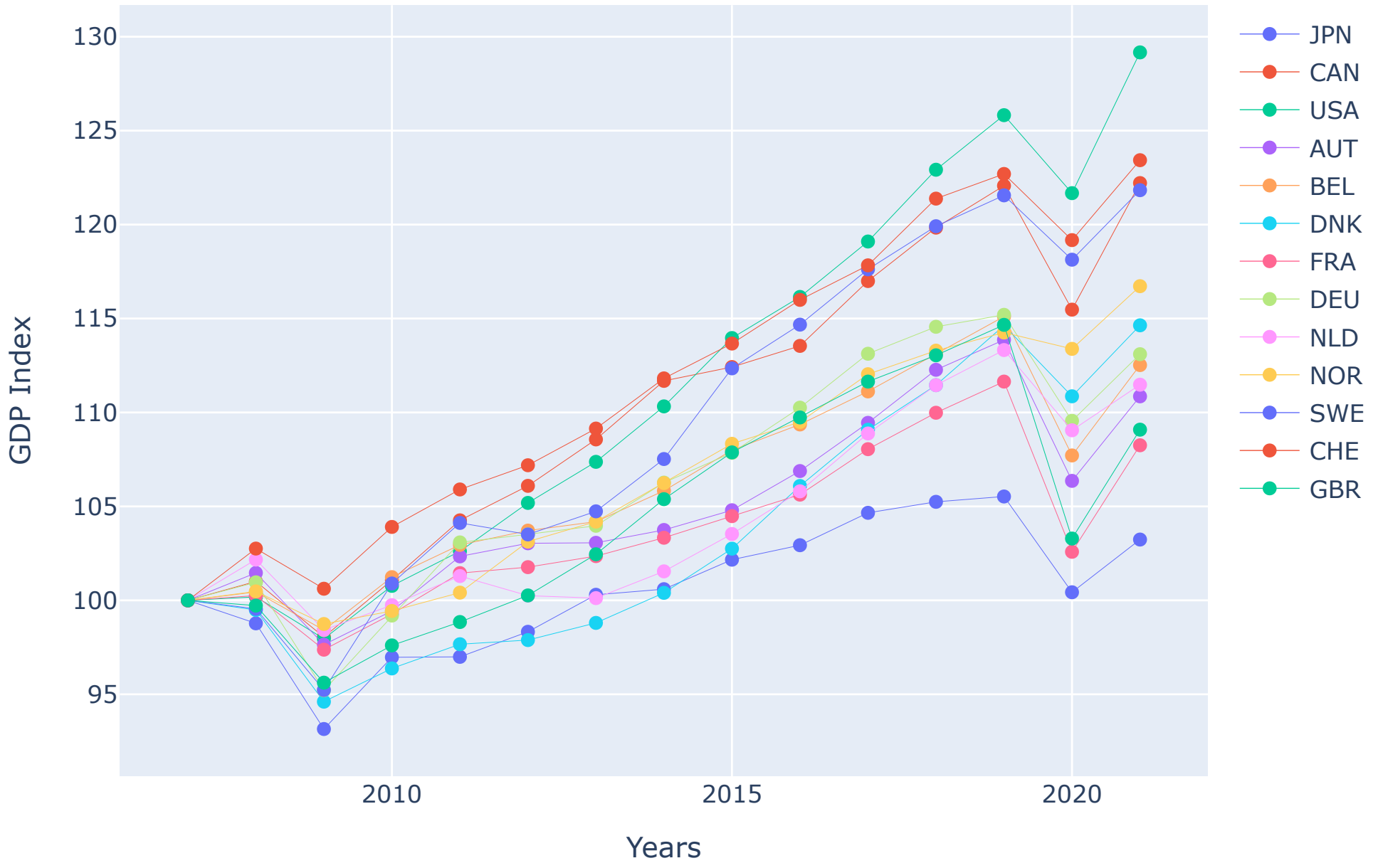- South Eastern Asian countries + Australia and New Zealand

Exercise 5: The impact of business cycles

The impact of the financial crisis in the EZ Periphery (Real GDP)
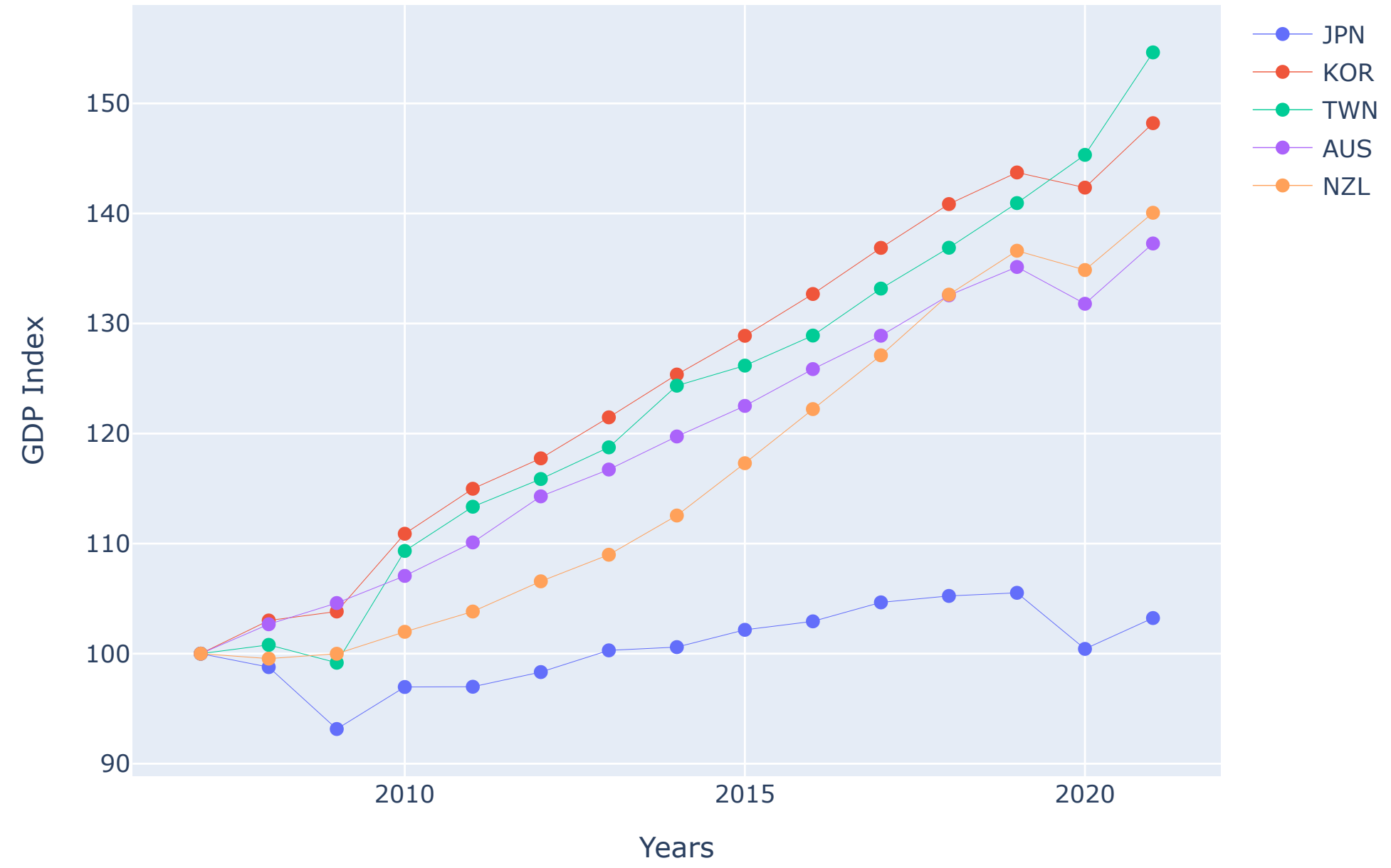
Exercise 5: The impact of business cycles

The impact of the financial crisis in the EZ-Core+ (Real GDP)

Exercise 5: The impact of business cycles

The impact of the financial crisis in Asia + Australia (Real GDP)

Exercise 5: The impact of business cycles

After looking at the three plots, rank the three groups of countries according to their macroeconomic performance after the impact of the financial crisis. What is your opinion about what is happening with Greece?

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Exercise 5: The impact of business cycles

1. The **EuroZone periphery** suffered the most from the financial crisis of 2007 (after 15 years, there are countries with GDP levels still below 2007)
2. **Most western countries** (apart from the previous) recovered GDP levels of 2007 in 7 years
3. The **South East Asian countries, Australia and New Zealand** (apart from Japan) were unaffected by this financial crisis
4. **Greece** has lost 25% of its 2007 GDP and did not recover after 15 years

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Exercise 6. Important macroeconomic variables

In macroeconomics, one of the most important data types is quarterly data. It presents the data relevant to analyzing short-term variations in economic activity. We use the file "Data_US.csv", which comprises quarterly observations for five macroeconomic variables for the USA economy, to plot the behavior of some variables.

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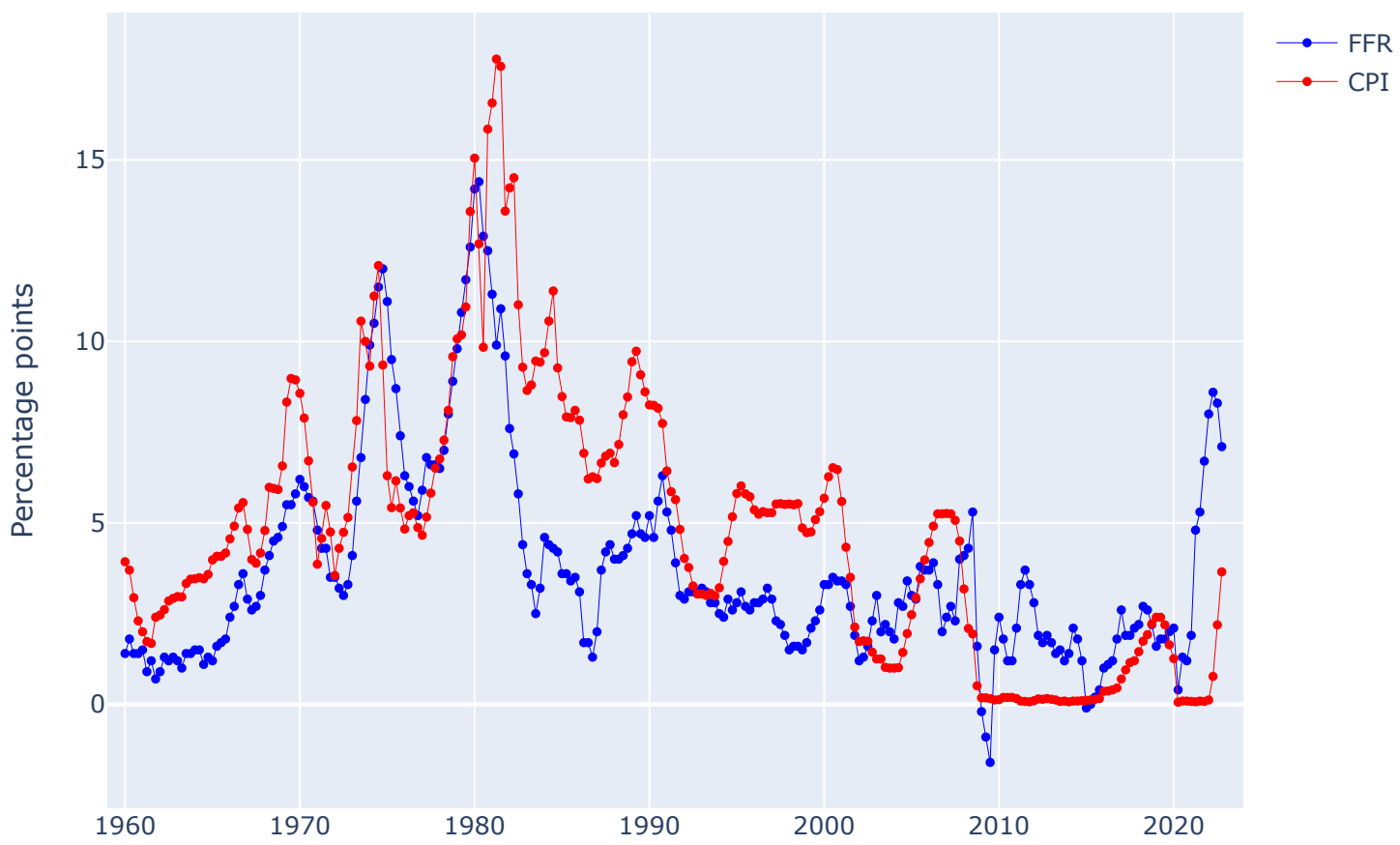# Exercise 6. Important macroeconomic variables

The plotted variables are the following:

1. The unemployment rate
2. The inflation rate
3. The Fed Funds Rate (the interest rate set by the central bank of the USA, called the Federal Reserve Board or simply: *Fed*)
4. The Monetary Base (the quantity of money created by the Fed)
5. The M2 (the total amount of money supplied to the US economy).

Exercise 6. Important macroeconomic variables

a. The following two figures plot the evolution of the rate of inflation (CPI) and the Federal Funds Rate (FFR). What important information about the relationship between these two macroeconomic variables can we get by inspecting these plots?

Exercise 6. Important macroeconomic variables

Inflation (CPI) versus Fed Funds Rate (FFR): USA (1960.Q1--2022.Q4)

Inflation (CPI) versus Fed Funds Rate (FFR): USA (1960.Q1--2022.Q4)

Exercise 6. Important macroeconomic variables

1. When the **rate of inflation** *increases*, **short term interest rate** increases *(highly positive cross correlation coefficient)*
2. There are **loops** in the response of the Fed to changes in inflation (Fed also considers other variables?)
3. There are some periods where the rate of inflation seems to be higher than the Fed Funds Rate, which suggests that the **real interest rate** is *negative* in these periods
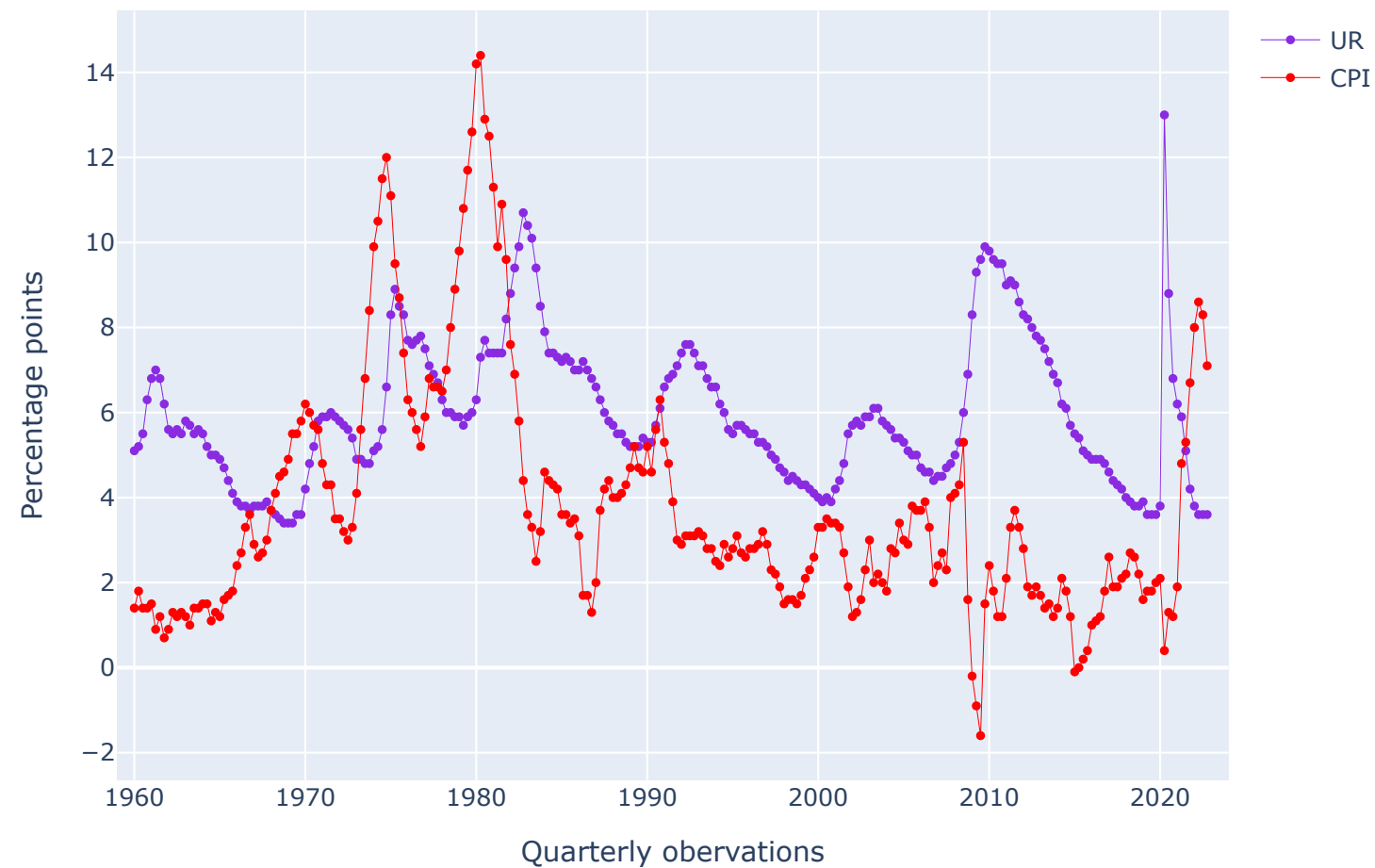
Exercise 6. Important macroeconomic variables

b. The following two figures plot the evolution of the rate of inflation (CPI) and the unemployment rate (UR). What kind of information about the relationship between these two macroeconomic variables can we get by inspecting these plots?
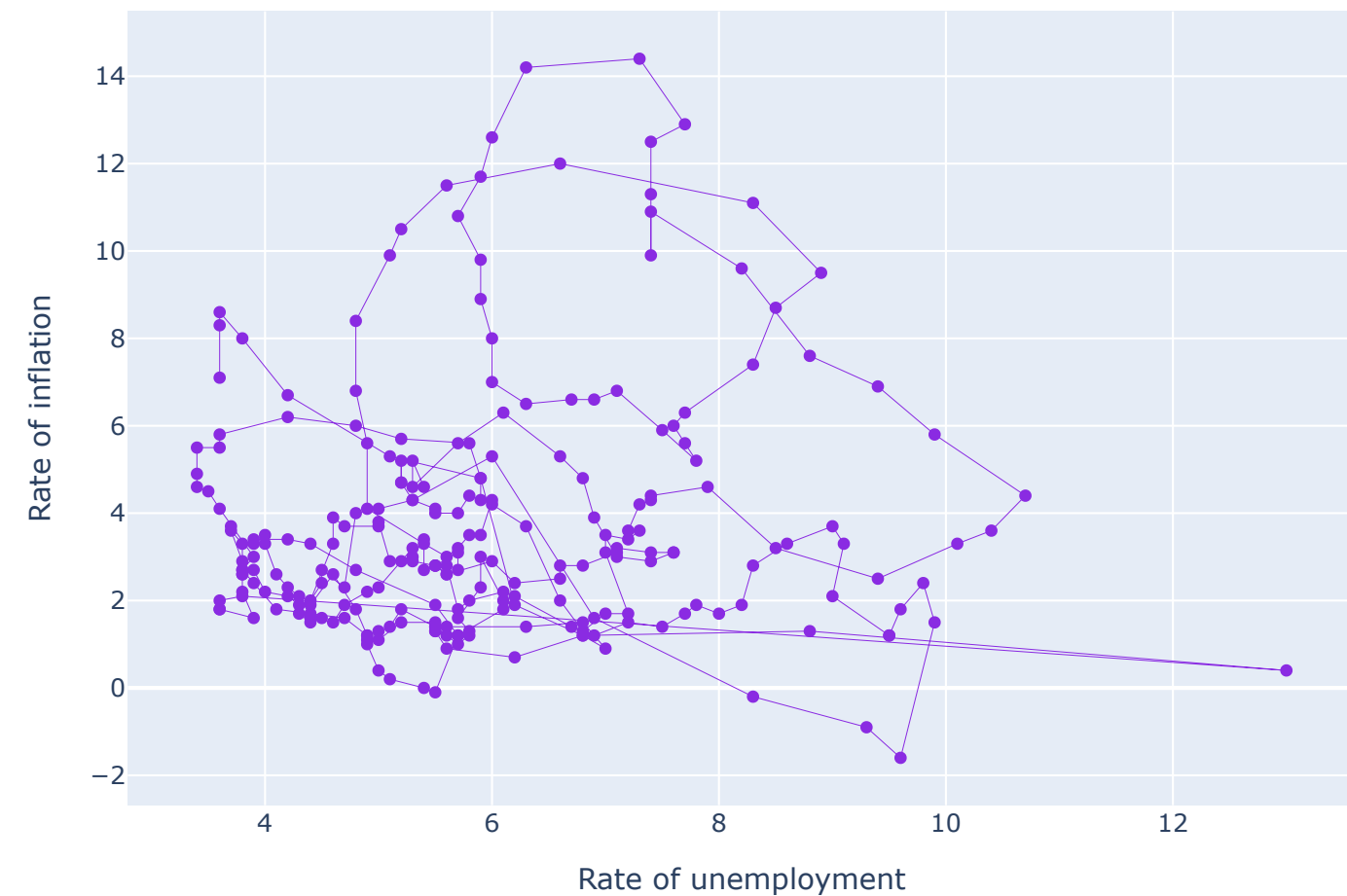
Exercise 6. Important macroeconomic variables

Inflation (CPI) versus Unemployment Rate (UR): USA (1960.Q1--2022.Q4)

Inflation (CPI) versus Unemployment Rate (UR): USA (1960.Q1--2022.Q4)
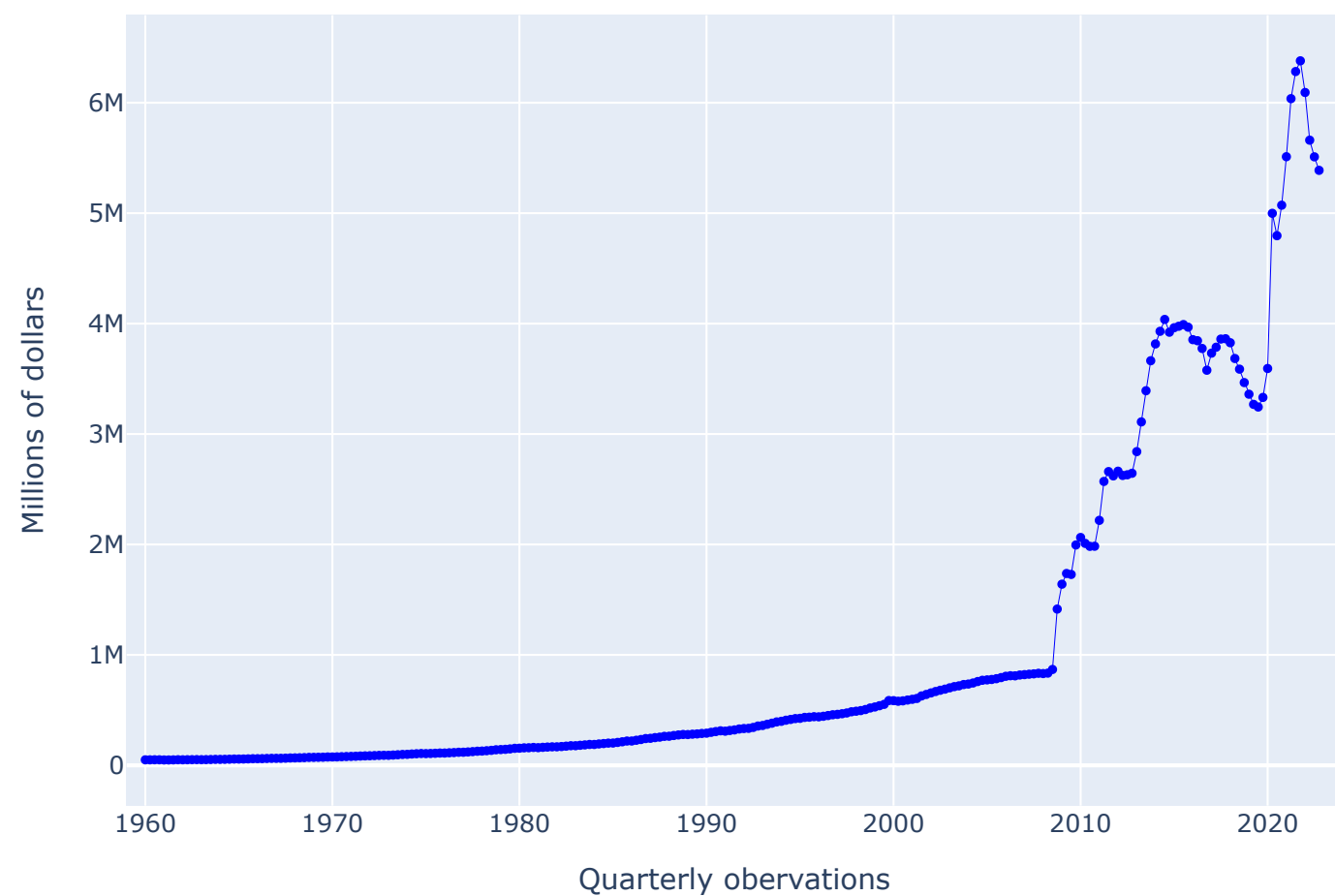
Exercise 6. Important macroeconomic variables

1. Apparently little correlation between the **rate of inflation** and the **rate of unemployment** *(correlation coefficient is close to zero)*

2. For **low levels of inflation** (<4%), *negative relationship*

3. Large loops between these variables: some other variables influence these two variables asymmetrically

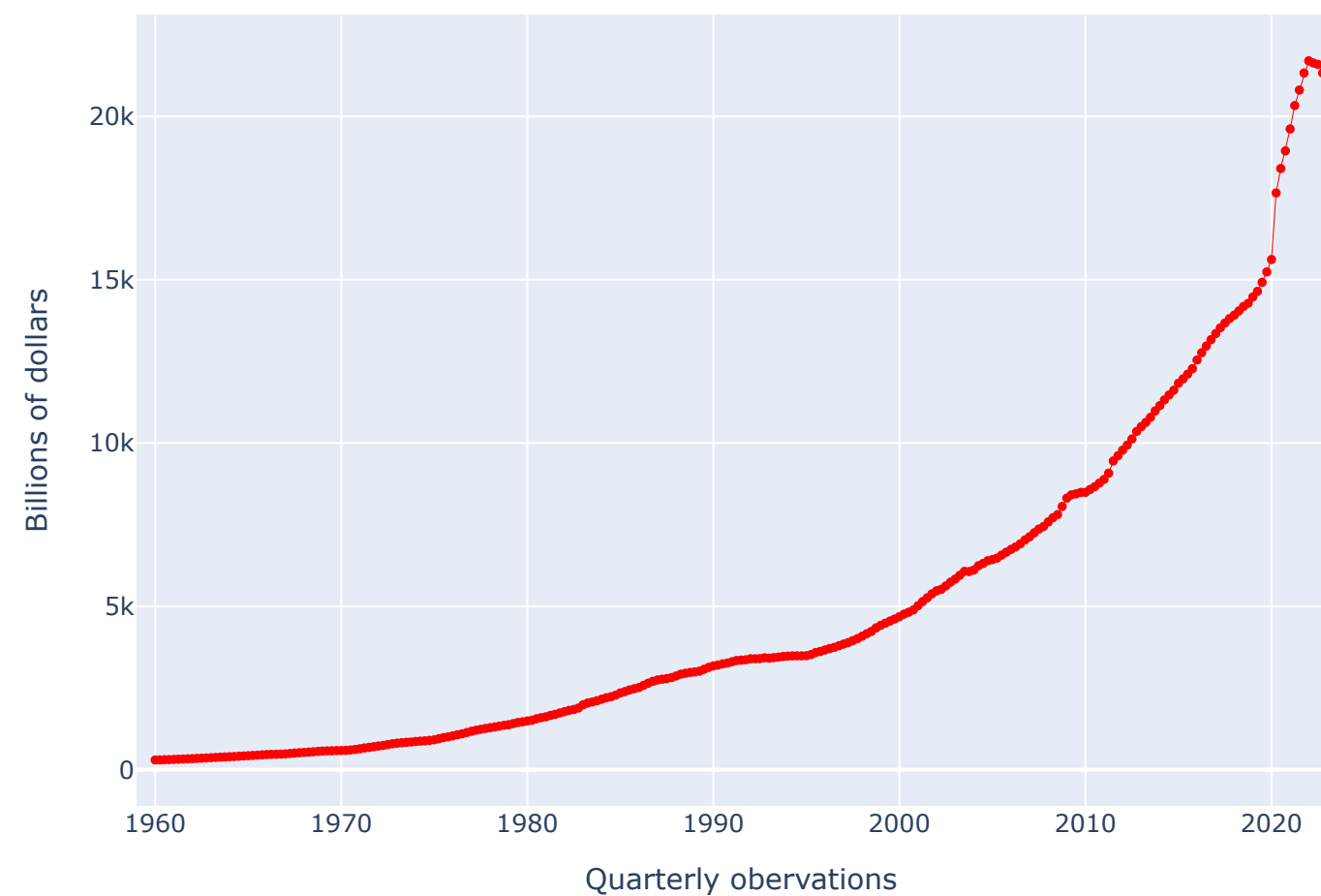# Exercise 6. Important macroeconomic variables

c. The following two figures plot the evolution of the Monetary Base (MB) and the Money Supply (M2) in the US economy. What is striking about these plots?

Exercise 6. Important macroeconomic variables

Monetary Base (MB): USA (1960.Q1--2022.Q4)

Money supply (M2): USA (1960.Q1--2022.Q4)

Exercise 6. Important macroeconomic variables

1. **The MB** *increased dramatically* after 2008 (less than 1 trillion in 2008 to over 6 trillion in 2022)
2. Although the Fed increased the MB dramatically, **M2** *did not follow*: private agents and banks were highly cautious in borrowing and lending

Exercise 7. The sustainability of public debt

We will deal with the sustainability of public debt in great detail in Week 11. Until then, we will only briefly introduce the topic during the current week. It is a terribly important topic, and we call upon your basic intuition rather than knowledge. Read the following sentence, which came out in a book with the suggestive title "Sovereign Debt: A Guide for Economists and Practitioners":

Exercise 7. The sustainability of public debt

"Under normal conditions for growth and interest rates, solvency imposes public debt to be at most equal to the present value of all future primary balances. Equivalently, primary deficits must at some point be fully offset by surpluses."

Debrun, Xavier and Ostry, Jonathan D. and Willems, Tim and Wyplosz, Charles (2019), "Public Debt Sustainability", in "Sovereign Debt: A Guide for Economists and Practitioners", Oxford University Press, available here.

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Exercise 7. The sustainability of public debt

a. What do you think is the main point raised by Debrun et al. in the sentence above? Based on your intuition, do you agree with their main point?
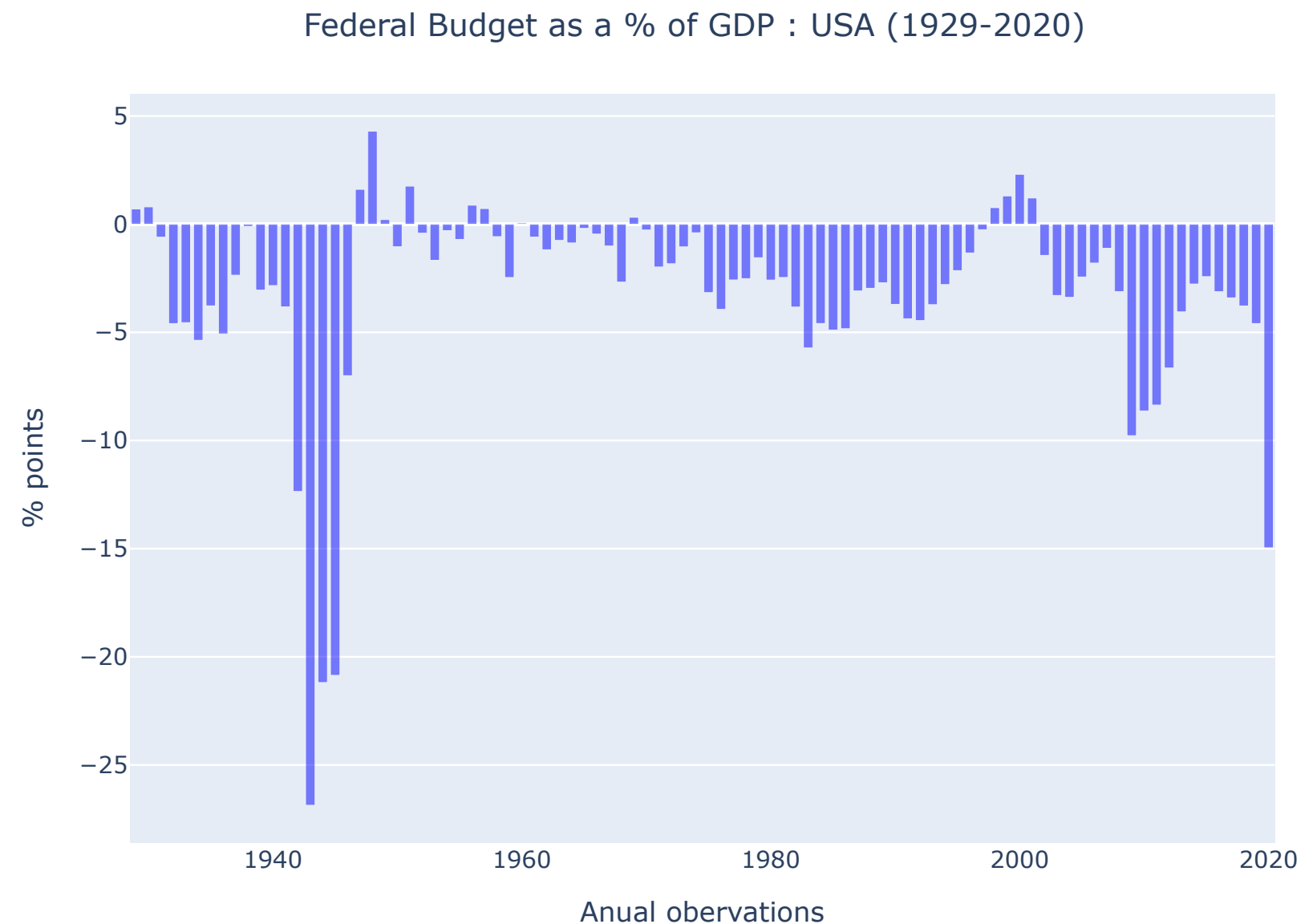
Solution for part a.

Their major point: if a country has debt (i.e., accumulated deficits), government needs to run budget surpluses now or in the future (Ricardian Equivalence)

Exercise 7. The sustainability of public debt

b. In the following figure, we present the evolution of the federal budget of the USA from 1929 and 2020. Based on this single piece of evidence, what do you expect that has happened to this country's public debt?

Federal Budget as a % of GDP : USA (1929-2020)

Exercise 7. The sustainability of public debt

Solution for part b.

- Over *100 years* the US Government has **deficits** systematically (the average of the period is -3.12%)

- There were rarely **tiny surpluses**

- Intuitively (and according to Debrun et al.), this situation would lead to a *permanent growth* in **public debt**

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Exercise 7. The sustainability of public debt

c Assume, for now, that the sustainability of public debt depends on two main macroeconomic variables: the rate of growth of real GDP g and the real interest rate paid on public debt r^d.

A standard result in macroeconomics (that you will learn in a detailed manner in week 11) says that if $g > r^d$, the public debt will tend to decline over time and increase if the opposite occurs.

Exercise 7. The sustainability of public debt

Looking at the following figure, which confronts the federal budget and the public debt, what do you conclude for the period between 1947 and 1974?

Federal Budget and Federal Debt as a % of GDP : USA (1939-2019)
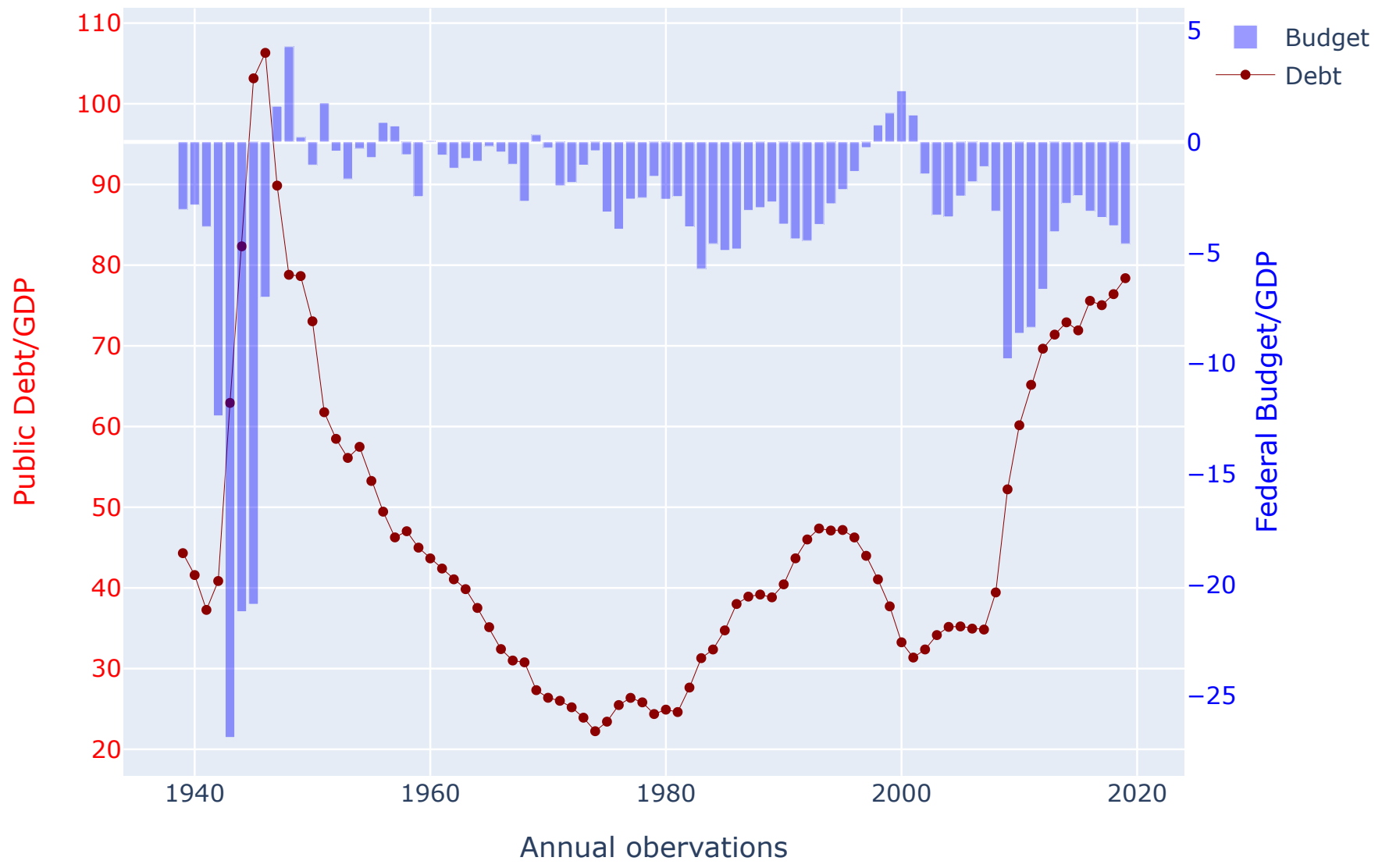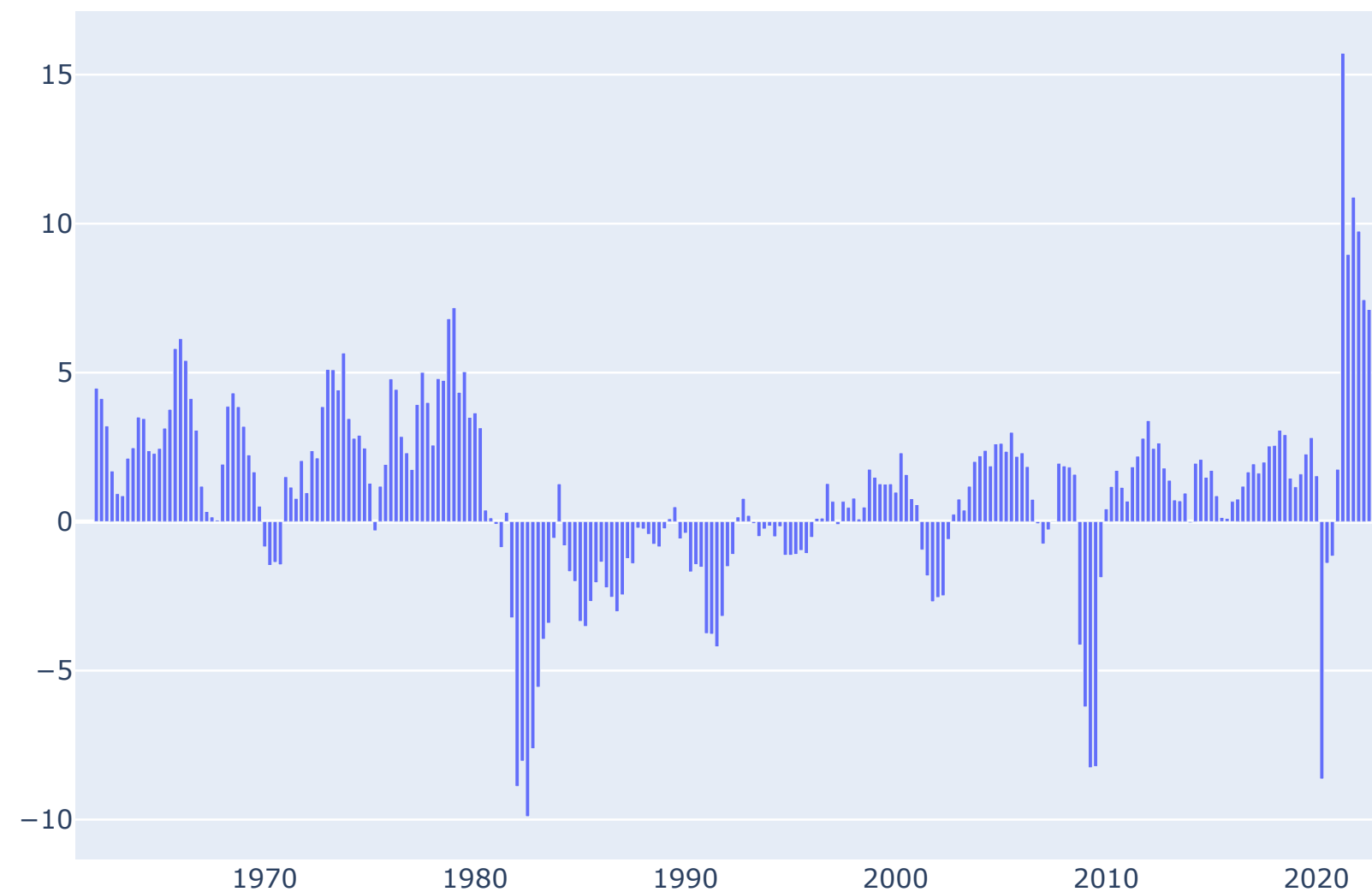
Exercise 7. The sustainability of public debt

Solution for part c.

- US **public debt** *declined* from 1947 (106.31%) to 1974 (22.24%)

- In this period, the US government run **budget deficits**

- This evidence points to the fact that public debt declined because $g > r^d$ as we shall deepen later on

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Exercise 7. The sustainability of public debt

d. In the following figure, we present evidence for the US economy concerning the difference between the real GDP growth rate and the yield of 10-year issued US public debt.

GDP growth rate minus real interest rate on US debt: 1962-Q1--2022-Q4

Exercise 7. The sustainability of public debt

The mean of this difference, for the period considered (1962-2022), is close to +0.948. What does this number tell us about public debt sustainability in the USA?

Solution of part d.

If, on average, $g - r^d = 0.948\%$, unless the US government starts running huge budget deficits, the US public debt (as a percentage of GDP) tends to go down, not up.

Exercise 8. Financial frictions

One of the significant characteristics of a financial crisis is the dramatic increase in the so-called "risk premium". One indicator of such premium predominantly used is the "Moody's Baa Corporate Bond Yield Relative to Yield on 10-Year Treasury Constant Maturity".

The former bond is considered the lowest-ranked safe financial investment, while the latter is the risk-free financial investment instrument. This risk premium, or spread, is also denominated as a "financial friction".

Exercise 8. Financial frictions

Using the file "Moodys_BAA10Y.csv", we plot the evolution of such friction or spread for the USA. Comment upon what happened to this macroeconomic variable in the period between 2007–2010.

oody's Baa Corporate Bond Yield Relative to Yield on 10-Year Treasury Constant Maturit
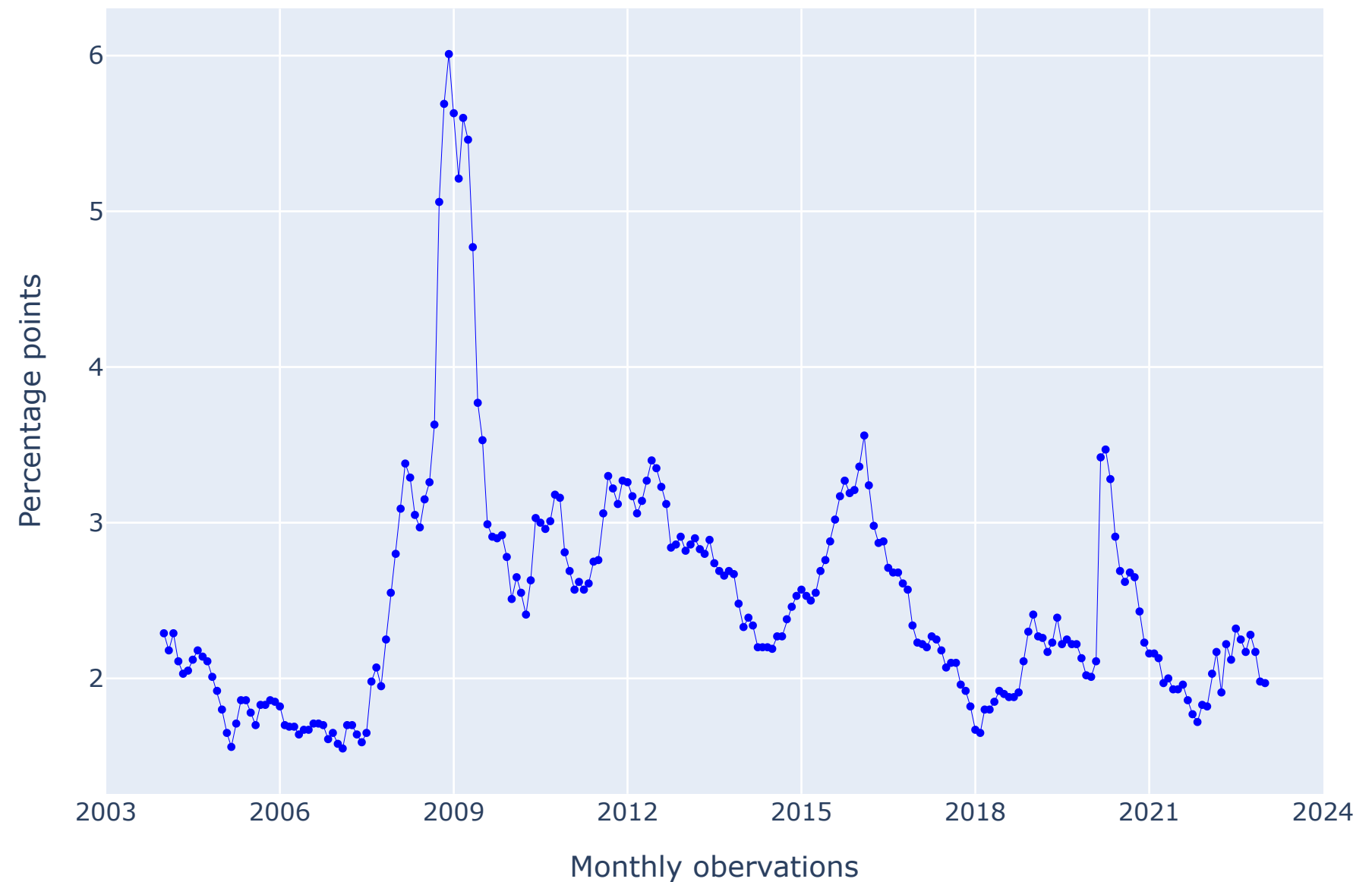
Exercise 8. Financial frictions

Solution

1. The **financial friction** *jumped* from 1.59% in 2007-06 to 6.01% in 2008-12 *(financial crisis)*
2. A spread of this magnitude implies *scarce and expensive credit*, which took until 2010-4 to normalize
3. We can also see *significant instability since then*

Exercise 9. Rules vs discretion

From the textbook

"Consider the difficult task of raising children. One of the most widely recognized challenges of this task is to properly balance rules and ad-hoc decisions. Constantly breaking rules might send the wrong message to a kid, while strictly enforcing rules every time might result in excessive punishments. The debate about the conduct of macroeconomic policy is not significantly different from this example."

a. Comment on the American Recovery and Reinvestment Act of 2009 (ARRA 2009). Can this Act be characterized as discretionary policy?

Exercise 9. Rules vs discretion

Solution of part a.

- The ARRA 2009 is indeed **discretionary policy**

- The Government tried to compensate private expenditure crash boosting public spending

- However, most sectors of society expect the Government to help during a crisis, which turns the program not entirely ad-hoc

- Moreover, the financial volume of the package seems not that relevant

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Exercise 9. Rules vs discretion

b. Is it possible for this set of policies to affect the incentives of financial intermediaries or other major economic agents?

Solution of part b.

- Not really

- The ARRA 2009 did not compromise the sustainability of US public debt.

- Therefore, it had most certainly a positive effect (though certainly not easy to decompose)