

# Macroeconomics

## Week 11: Fiscal Policy & the Government Budget

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# Theoretical Review

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# The Government Budget Constraint

Public Debt is the result of:

$$D_t = (G_t - T_t) + (1 + r)D_{t-1} \quad (1)$$

After a few transformations:

$$\frac{D_t}{Y_t} = \frac{G_t - T_t}{Y_t} + (1 + r) \frac{D_{t-1}}{Y_t} \Leftrightarrow d_t = p_t + (1 + r) \frac{D_{t-1}}{Y_{t-1}} \frac{Y_{t-1}}{Y_t} \Leftrightarrow$$
$$\boxed{d_t = p_t + \frac{1+r}{1+g} d_{t-1}}, \quad \frac{Y_t}{Y_{t-1}} \equiv 1 + g \quad (2)$$

# What is sustainable Public Debt?

$$d_t = p_t + \frac{1+r}{1+g} d_{t-1}$$

- This budget constraint gives us an **arithmetic criterion**
  - if  $g > r$ ,  $d_t$  is **sustainable**
  - if  $g < r$ ,  $d_t$  is **explosive**
- But is it all that we have to say?

# Is Public Debt a burden?

- **No** because of **positive externalities** associated to Physical and Human public capital
- **Yes** because of inefficiency, perverse redistribution effects, negative incentives

# What kind of expenses should the State have?

- Most of them are **mandatory**
  - **classical functions** of the State (defense, justice, etc.)
  - **social functions** fo modern States (healthcare, social security, etc.)
- Other are **discretionary**
  - avoidable with **small social cost**
  - used to **react to shocks**

# Why react to the business cycle?

- Political reasons
- **Economical reason: cœteris paribus**  $\Delta G > 0 \Rightarrow \Delta Y = m^g \Delta G$ ,  
with  $m^g > 0$  or even  $m^g > 1$

## Proof.

$$\begin{cases} Y = m\bar{A} - m\phi(\bar{r} + \lambda\pi) \\ \pi = \pi^e + \gamma(Y - Y^P) + \rho \end{cases} \Rightarrow$$
$$Y = m\bar{A} - m\phi(\bar{r} + \lambda[\pi^e + \gamma(Y - Y^P) + \rho])$$

# The magic of Fiscal Multiplier

**Proof.**

$$Y = \frac{m}{1 + m\phi\lambda\gamma} \bar{A} - \frac{m\phi}{1 + m\phi\lambda\gamma} \dots \Rightarrow m^g \equiv \frac{\partial Y}{\partial \bar{G}} = \frac{m}{1 + m\phi\lambda\gamma}$$

- In general, the **steeper** the AS, the lower the fiscal multiplier  $m^g$
- Always **positive** (and very high in the ZLB)



# Is it real?

- Some authors believe there is a **counter-factual**: evidence on growth under spending's cuts (**expansionary austerity**)
- Some others argue that **unfavorable results** are the common outcome for **most of the time**
- Recent evidence on **the Great Recession of 2008–2012 seems not in support of expansionary austerity**

## And what if both perspectives are wrong?

- They both are wrong, **if fiscal policy is simply irrelevant**
- Barro (1974): it is, **under certain conditions**
  - Agents anticipate that lower taxes today imply higher taxes in the future — **Ricardian Equivalence**
  - No changes in aggregate demand or aggregate savings
- But...

# Against the Ricardian Equivalence...

- Households heterogeneity
- Distortionary taxes affect incentives in several markets
- Generations mismatch
- Credit markets are not perfect
- Rational expectations might not hold

# Exercises

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# Exercise 1. Primary deficit

*From the textbook.*

*Suppose government purchases of Goods & Services amount to \$2.5 trillion, transfer payments to households amount to \$1 trillion, net interest payments are \$0.5 trillion, and tax revenue is valued at \$3 trillion.*

**b)** *Calculate the government budget balance.*

$$\begin{aligned}\text{Budget} &= T - (G + TR + \text{Interest}) \\ &= 3 - (2.5 + 1 + 0.5) \\ &= -1 \text{ \$trillions}\end{aligned}$$

# Exercise 1. Primary deficit

*From the textbook.*

*Suppose government purchases of Goods & Services amount to \$2.5 trillion, transfer payments to households amount to \$1 trillion, net interest payments are \$0.5 trillion, and tax revenue is valued at \$3 trillion.*

**b)** *Calculate the government's primary budget balance.*

$$\begin{aligned} \text{PB} &= T - (G + TR) \\ &= \text{Budget} + \text{Interest} \\ &= -1 + 0.5 \\ &= -0.5 \text{ \$trillions} \end{aligned}$$

## Exercise 2. Population aging and the government deficit

*From the textbook.*

*Assume that Social Security tax rates remain constant, but the number of employed people in the United States declines over time. Assume also that the proportion of old population increases, as well as their life expectancy.*

**a)** *Explain the effect of such a scenario on the size of the contributions for social insurance and the government deficit in the United States.*

- *Cœteris paribus:* revenues ↓ and outlays ↑
- Federal Budget deficit ↑

## Exercise 2. Population aging and the government deficit

*From the textbook.*

*Assume that Social Security tax rates remain constant, but the number of employed people in the United States declines over time. Assume also that the proportion of old population increases, as well as their life expectancy.*

**b)** *Assume now that employment remains constant but there is an increase in unemployment insurance benefits. How would your answer to part a) change?*

- *Cœteris paribus:* revenues = and outlays  $\uparrow$
- Federal Budget deficit  $\uparrow$
- The situation will get worse



## Exercise 2. Population aging and the government deficit

*From the textbook.*

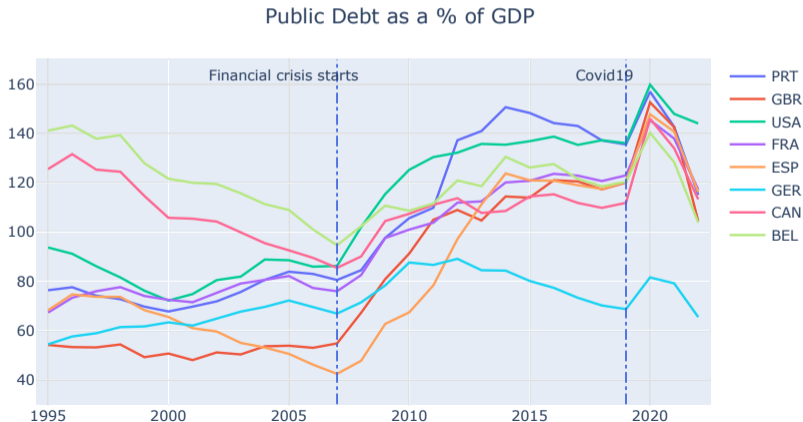
*Assume that Social Security tax rates remain constant, but the number of employed people in the United States declines over time. Assume also that the proportion of old population increases, as well as their life expectancy.*

**c)** *What forces have been driving the evolution of total public spending in the US economy since the 1960s?*

Mainly demographics:  
population aging

## Exercise 3. The Size of public debt

The evolution of public debt in five G7 economies (plus Portugal, Spain, and Belgium) is presented in the figure below.



## Exercise 3. The Size of public debt

**a)** *What happened to public debt when the big financial crisis struck in 2007? And when the Covid19 pandemic broke out?*

**b)** *Why did the level of public debt increase so significantly in the face of those two terrible shocks (financial crisis and Covid19)?*

**c)** *Now that the two shocks seem to be overcome, what strikes you in terms of the behavior of public debt in this set of countries?*

**a)** In all countries  
Public Debt  $\uparrow$

**b)** Because  $G \uparrow$  to avoid  
big recessions

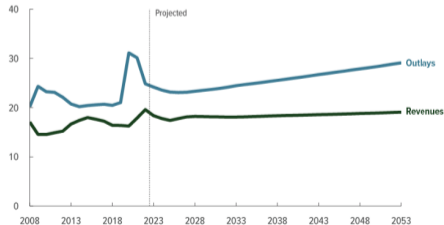
**c)** In all countries  
Public Debt  $\downarrow$ .  
Germany has a very  
low level of Public Debt

# Exercise 4. Mandatory vs discretionary spending

The US Congressional Budget Office (CBO) published last June **“The 2023 Long-Term Budget Outlook”**. In this document, the CBO portrays a dark future for the sustainability of the US budget, with ever-larger budget deficits resulting from Medicare and Social Security spending, as shown in the figure below. To understand this problem correctly, the distinction between mandatory and discretionary spending is crucial.

**Total Outlays and Revenues**

Percentage of GDP



Outlays increase faster than revenues—mainly because of rising interest costs and growth in spending on the major health care programs and Social Security. The result is ever-larger budget deficits over the long term.

## Exercise 4. Mandatory vs discretionary spending

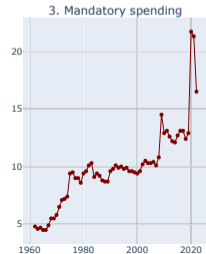
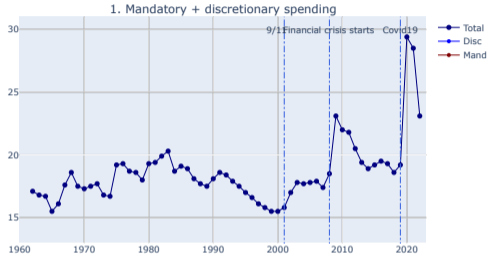
*a) What is the difference between mandatory and discretionary public spending?*

- **Mandatory** — big social impact
  - Spending on the **classical functions** of the State (justice, defense)
  - Spending on **basic social insurance functions** (health care, unemployment and retirement benefits)
- **Discretionary** — low social impact

# Exercise 4. Mandatory vs discretionary spending

**b)** In the following figure, we plot the evolution of mandatory, discretionary, and the sum of the two as a percentage of GDP. Do you agree with the dim view of the CBO? Specifically, look at what happened between 1975 and 2007.

Mandatory and Discretionary Spending as a % of GDP in the US (1962-2022)



## Exercise 4. Mandatory vs discretionary spending

- Share of **older population is increasing**
- Population is **living longer**
- Higher cost with **social security** and medical care
- **Mandatory public spending** remained **stable**
- **Discretionary spending reduced** a lot since 1968
- **Total public spending remained constant** from 1968 to 2007

## Exercise 5. Projections...What to make with them?

*In 2011, President Barack Obama said: "If you look at the numbers, then Medicare, in particular, will run out of money, and we will not be able to sustain that program no matter how much taxes go up (...) We have an obligation to make sure that we make those changes that are required to make it sustainable over the long term."*

*A recent set of studies in the US has unveiled a remarkable novelty: the projections made in the late 2000s about Medicare in the US proved dramatically wrong. See an exposition here, from where we borrow the image below. In 2010, the CBO projected that Medicare spending per beneficiary would be \$22 006 in 2023, but instead, it is only \$12 459.*

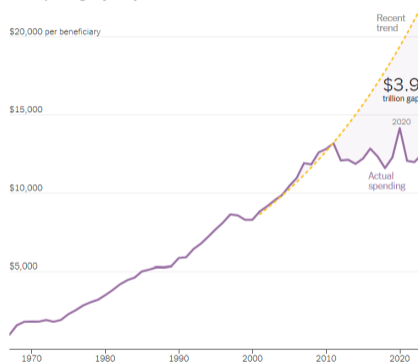


# Exercise 5. Projections... What to make with them?

The figure below shows the gap, representing an error corresponding to \$3.9 trillion (around 14.1% of GDP in 2023).

Given this evidence, what do you make of the CBO projections (for 30 years) presented in Exercise 4?

If the spending trajectory had continued



Sources: New York Times analysis of data from the Congressional Budget Office, the White House Office of Management and Budget, and the Medicare board of trustees. - Note: Mandatory Medicare outlays adjusted for inflation using the G.D.P. price index.

## Exercise 5. Projections... What to make with them?

- Projections are made out of **available data** — uncertainty
- Maybe they also **overlooked** relevant available information
- **Be cautious** when crediting projections

## Exercise 6. The data vs the popular view

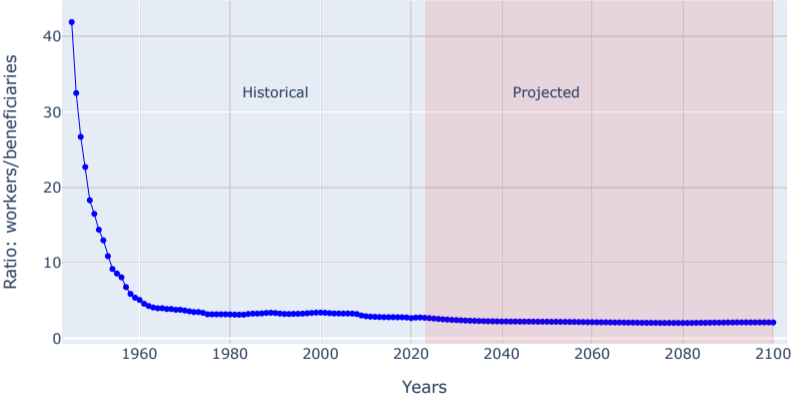
*The popular view on the population aging problem and the sustainability of the social security system (and public debt, for the matter) seems to be something like this:*

*«The US social security system will blow up because the evidence has shown that, as time goes on, the number of contributors gets smaller and smaller, while the number of receivers gets bigger and bigger.»*

*In the figure below, we present evidence for the US economy (the data can be found [here](#)), regarding the ratio of the number of contributors (workers) per beneficiary of the social security system. What is your opinion about the sustainability of the US social security system, **as far as this ratio is concerned?***

# Exercise 6. The data vs the popular view

Number of workers per beneficiary of the US social security system

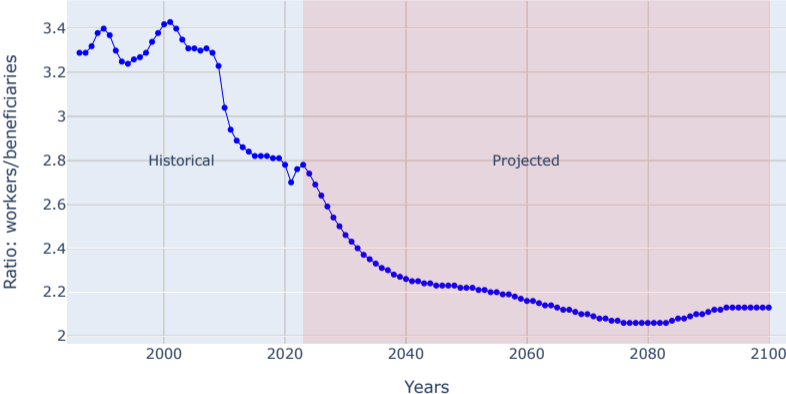


## Exercise 6. The data vs the popular view

- Since the **1980s**, the ratio of **contributors to beneficiaries** seems **stabilized**
- A **linear extrapolation from the 50's** seems to convey a **wrong** message

# Exercise 6. The data vs the popular view

Number of workers per beneficiary of the US social security system



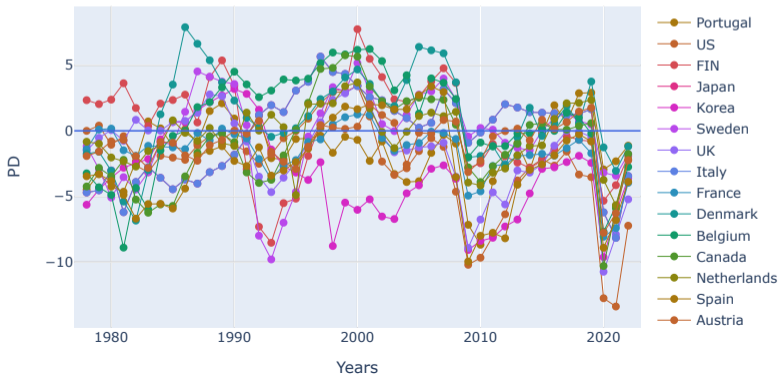
## Exercise 6. The data vs the popular view

- **The story changes** dramatically when you look into details:  
**-17% since the late 80's**, about -50% from the 60's
- Indeed the 50's blur the insight because **social values changed** sharply during the **60's**
- Why start at **1986**? The generation born in **1968 reaches adulthood**
- **1968**: sexual revolution/contraception (namely, the **contraceptive pill**)

# Exercise 7. Business cycles and primary balances

a) By inspecting Figure 4 below, what can one conclude about the primary balances of these sixteen countries of the OECD? **Hint: we suggest to zoom in between 2004 and 2022.**

Fig 4. Primary balances in the OECD:1978-2022





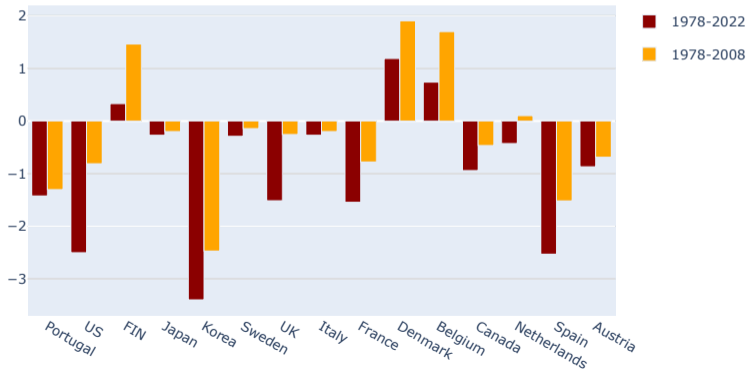
## Exercise 7. Business cycles and primary balances

- **Primary Balances** exhibit the **same evolution**
- In 2008 **PB**↓ to stimulate demand during **the Great Recession**, improving until 2019
- The **Covid-19** pandemic also brought **PB**↓

# Exercise 7. Business cycles and primary balances

**b)** What kind of information can we obtain in Figure 5 below regarding the two periods considered in the plot?

Fig 5. Primary balance: mean between 1978-2022 (Source: OECD)



## Exercise 7. Business cycles and primary balances

- The average **Primary Balance** is **more negative for the entire period** (1978–2022) than the average between 1978–2008
- The **Great Recession** and the **Covid-19** pandemic required **much public spending**
- **Finland, Denmark and Belgium** had average **surpluses** considering both periods, but always better in 1978–2008

## Exercise 7. Business cycles and primary balances

**c)** *South Korea has the highest primary deficit in this sample of countries (an average of of GDP). With such a high primary deficit average, what would we expect to see in terms of this country's total public debt as a percentage of GDP?*

**c)** Intuition: an average primary deficit close to 3.4% of GDP for 45 years leads to high level of public debt

## Exercise 7. Business cycles and primary balances

**d)** *However, when looking at the total public debt of South Korea (59% of GDP in 2020), we find that it is one of the lowest levels in the whole OECD. What factor can explain this apparent contradiction between high primary deficits and low public debt?*

**d)** Apparent contradiction: high negative primary deficit vs one of the lowest levels of Public debt of the entire OECD

## Exercise 8. The sustainability of public debt

*Consider an economy with the following averages for the primary deficit as a percentage of GDP ( $p$ ), the real interest rate on public debt ( $r_p$ ), the rate of growth of real GDP ( $g$ ), and an initial Public Debt to GDP ratio ( $d_1$ ):*

$$p = 2, r_p = 1.2, g = 3, d_1 = 0$$

*These values (all in percentage points) represent a close picture of what happened in the US economy from the 1950s to 2008. We chose these values because they represent a "normal" situation before the tremendous shocks associated with the Great Recession of 2009/2009 and the Covid-19 pandemic hit the US economy.*

## Exercise 8. The sustainability of public debt

- a)** *Simulate the dynamics of Public Debt as a percentage of real GDP ( $d_t$ ) over 500 years.*
- b)** *Using the zoom functionalities of the plot, zoom over 20 years within the region comprehended between the first and the 100th year. What is the natural conclusion if you were confronted only with this slice of the process?*
- c)** *Now, assuming that the current level of  $d$  is 1.25 (data for US economy in 2021-Q2), see what happens if this were the initial state in our exercise.*

## Exercise 9. The US public debt sustainability

*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”:*

*«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](#).*



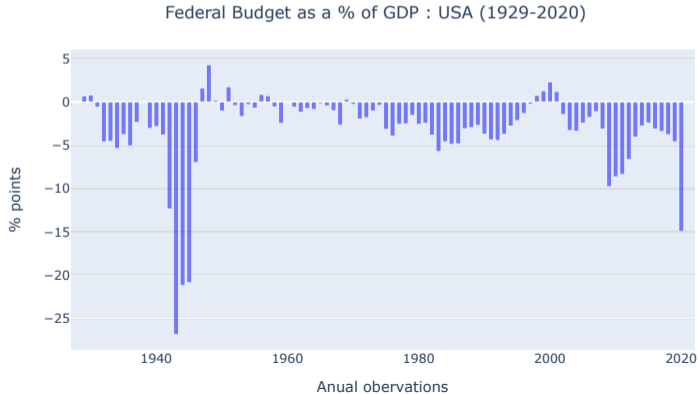
## Exercise 9. The US public debt sustainability

**a)** *What do you think is the main point raised by Debrun et al. in the sentence above?*

Main idea: the level of public debt resulting from accumulated budget deficits, shall be offset by future budget surpluses (*present value approach*)

# Exercise 9. The US public debt sustainability

**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?



## Exercise 9. The US public debt sustainability

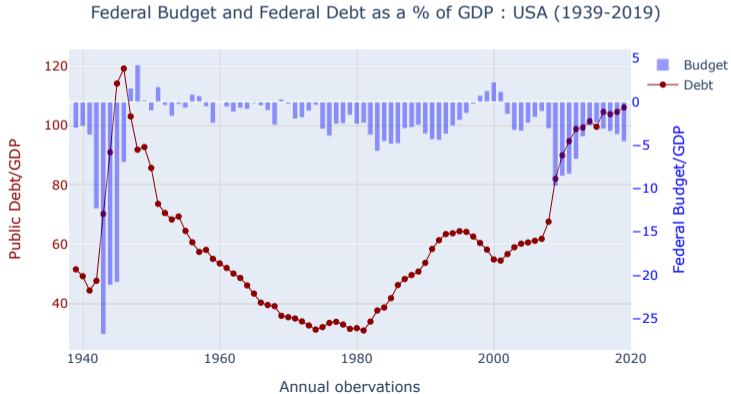
- **Since 1929:** rare or small budget surpluses
- **Persistent budget deficits** would suggest a **high level of Public Debt**

## Exercise 9. The US public debt sustainability

**c)** *As we saw in the previous exercise, 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 ( $r_p$ ). A standard result in macroeconomics says that if  $g > r_p$ , the public debt will tend to decline over time and increase if the opposite occurs.*

# Exercise 9. The US public debt sustainability

Looking at the following figure, which confronts the federal budget balance and the public debt, what do you conclude for the period between 1946 and 1981?

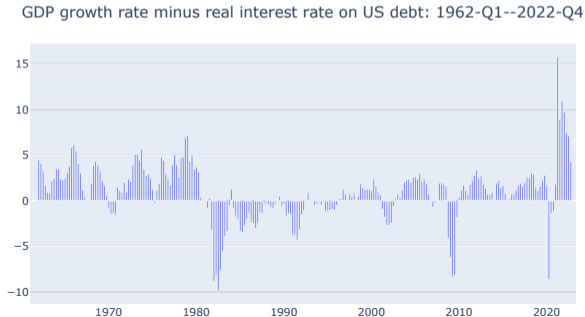


## Exercise 9. The US public debt sustainability

- **1946–1981:** Public Debt decreased from 119.1% to 31% of GDP.
- **Public Debt declined** because  $r_p < g$ .

## Exercise 9. The US public debt sustainability

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



## Exercise 9. The US public debt sustainability

- On average  $g - r^d = 0.948\%$
- The US **public debt tends to decrease**



## Exercise 10. The fiscal multiplier

Consider our standard macroeconomic model that we have developed since week 4:

$$AD: Y = m \cdot \bar{A} - m \cdot \phi \cdot (\bar{r} + \lambda\pi)$$

$$AS: \pi = \pi^e + \gamma(Y - Y^P) + \rho$$

$$MP: r = \bar{r} + \lambda\pi$$

$$\text{Fisher Eq. : } i = r + \pi$$

and the following information concerning exogenous variables and parameters:

$$\begin{aligned} \bar{A} = 7.6, \quad m = 2.0, \quad \phi = 0.2, \quad \bar{r} = 2.0, \\ \lambda = 0.5, \quad \pi^e = 2.0, \quad \gamma = 4.5, \quad Y^P = 14.0, \quad \rho = 0. \end{aligned}$$

## Exercise 10. The fiscal multiplier

Note that  $\{\pi^e, \bar{r}, r, i, \rho\}$  are rates measured in percentage points (e.g., 2.0 means 2.0%), while  $\{Y, Y^P, \bar{A}\}$  are measured in trillion dollars. In the solutions below, to avoid doubt, we put the symbol % only at the final step of the solutions.

**a)** In the previous weeks, we saw that the multiplier of the Autonomous Aggregate demand ( $\bar{A}$ ) — which we named by  $m$  — is equal to  $m = 2$ . This fact tells us how much the Aggregate Demand is multiplied if ( $\bar{A}$ ) changes by 1 unit. It involves only the demand side of the economy. To calculate the **fiscal multiplier**, we must consider both the demand and supply sides.

## Exercise 10. The fiscal multiplier

We can calculate it by imposing the usual condition  $AD=AS$  and solving for  $Y$ .  
Let us do it:

$$Y = \frac{m}{1 + m\phi\lambda\gamma} \bar{A} - \dots \quad \Rightarrow \quad m^g = \frac{\partial Y}{\partial \bar{A}} = \frac{m}{1 + m\phi\lambda\gamma}$$

- a)** Calculate the value of the fiscal multiplier considering the parameter's values above.
- b)** In Exercise 6, Week 9, question a), we saw that an increase in  $\bar{G}$  of \$0.2 trillion would force GDP to increase from \$14 trillion to \$14.21 trillion. What is the value of the fiscal multiplier in that particular exercise?
- c)** Where is the fiscal multiplier higher: in the normal region or the ZLB?