

# 14.02 - Principles of Macroeconomics

## Problem Set 1

Spring 2023

### Question 1: Economic Data [35 Points]

This question will ask you to get familiar with economic data, plotting it, and drawing conclusions. Please use the Federal Reserve Economic Data (FRED) database, maintained by the Federal Reserve Bank of St. Louis ([link here](#)). For your reference, note that the National Bureau of Economic Research (NBER) is the entity that dates the business cycles in the US ([link here](#)). Please be precise about what units you are using and don't forget to include a title and axis labels in all charts, you can use any software you'd like, e.g. Excel is fine.

1. [10 Points] Download and plot the series of US Real Gross Domestic Product (code GDPC1, billions of chained 2012 dollars annual rate) at a quarterly frequency, from the earliest available date to the last available date. What is the fourth quarter of 2021 real GDP? At a quarterly frequency, how much did real GDP fall "from peak to trough" during the COVID-19 recession? (i.e.: from the maximum RGDP before the recession, to the lowest point during the recession.) How much did real GDP fall from peak to trough during the Great Recession (2007-2009)?
2. [5 Points] Download and plot the series for quarterly unemployment (UNRATE), from the earliest available date to the latest. How does the unemployment rate in Q4 2019 compare to Q2 2020? How do the changes in unemployment rate now compare to the period between Q2 2008 and Q2 2009?
3. [10 Points] Using the real GDP series you downloaded in (1), compute the quarterly output growth rate as  $g_t = \frac{GDP_t - GDP_{t-1}}{GDP_{t-1}} \times 100$ . Next, using the unemployment rate series you downloaded in (2), compute the quarterly change in the unemployment rate as  $\Delta u_t = u_t - u_{t-1}$ . Plot  $\Delta u_t$  on the y-axis, and  $g_t$  on the x-axis over the period 1960-2019, and over the period 1960-2022. Describe the pattern you find in words. Are the changes in output and unemployment during the 2008 financial crisis and the COVID-19 recession qualitatively consistent with what we would expect from Okun's law?
4. [5 Points] Download the quarterly Employment to Population Ratio for 25-54 year olds (LNS12300060), from the earliest available date to the latest. Plot the non-employment to population ratio, calculated as 100% - employment to population ratio. How does the non-employment to population

ratio in Q4 2019 compare to Q2 2020? How do the changes in the non-employment to population ratio compare to the period between Q2 2008 and Q2 2009?

- [5 Points] Compare the relationship between the evolution of the Unemployment Rate and the evolution of the Non-Employment to Population Ratio from peak to trough of the COVID-19 recession and the 2008 financial crisis. Why is there not a 1-1 relationship between the two variables (write down the formulas for each one)? What can you conclude about labor force participation during the COVID-19 recession (feel free to use FRED to answer this question if helpful)?

## Question 2: Measuring nominal and real GDP [30 Points]

Consider the following closed-economy in which there are only three goods: masks, movies, and air travel. The following table gives the prices and quantities consumed of the three goods for 2019 and 2020, and 2021:

	2019		2020		2021	
	Price	Quantity	Price	Quantity	Price	Quantity
Masks	0.1	60	2	400	0.5	350
Movies	5	90	5	10	5	60
Air Travel	100	15	40	10	75	20

- [5 Points] Compute the Nominal GDP (NGDP) of each year, show your work.
- [5 Points] Compute the real GDP (RGDP) for each year using 2019 as the base year. Then compute annual RGDP growth for each year and express it as a percentage.
- [10 Points] Compute the real GDP (RGDP) for each year using 2020 as the base year. Then compute RGDP growth and express it as a percentage. Explain why it is different from the real GDP growth computed using 2019 as the base year. Do the same using 2021 as the base year.
- [10 Points] The BEA has adopted a different method to compute growth rates (it is explained in full in the appendix of Chapter 2). The formula is given by:

$$g_{T-t,T}^{BEA} = \frac{g_{T-t,T}(T-t) + g_{T-t,T}(T)}{2}$$

Where  $g_{T-t,T}^{BEA}$  is the growth rate calculated by the BEA between years  $T$  and  $T-t$ . And  $g_{T-t,T}(b)$  is the growth rate between year  $T$  and  $T-t$  using  $b \in \{T, T-t\}$  as the base year. Use this method to calculate the growth rate between 2021 and 2020, and between 2020 and 2019. Is this a better method? Explain.

### Question 3: The Goods Market [35 Points]

Consider the following economy. The demand for goods,  $Z$ , is given by

$$Z \equiv C + I + G \quad (1)$$

where  $C$  is consumption,  $I$  is investment, and  $G$  is government spending. The consumption function is given by

$$C = c_0 + c_1 Y_D \quad (2)$$

where  $c_0 \geq 0$ ,  $0 < c_1 < 1$ ,  $Y_D \equiv Y - T$  is disposable income, and  $T$  is taxes.

When we say “exogenous variables”, this refers to variables determined outside of the model such as, for example  $c_0, c_1$ . In contrast,  $C, Y$  are endogenous variables. Hereafter, we assume  $T$  is either exogenous, or endogenous as specified below, while  $G$  and  $I$  will always be treated as exogenous.

1. [5 Points] Describe in words what  $c_0$  and  $c_1$  represent.
2. [5 Points] What equilibrium condition can you use to solve for equilibrium output? Explain it.
3. [5 Points] Draw a graph representing equilibrium in the goods market, appropriately label all axes.
4. [5 Points] Solve for equilibrium output  $Y$  assuming that  $G, T$  and  $I$  are exogenous.
5. [5 Points] What is the autonomous spending ( $c_0$ ) multiplier in this case? That is, how much does equilibrium output change in response to an increase in  $c_0$ ?
6. [5 Points] Let  $S \equiv Y - T - C$  denote the private saving. Express  $S$  in terms of  $I, T$ , and  $G$ .
7. [5 Points] How much does private saving  $S$  increase in response to an increase in  $G$ ? (Use your answer to part 3)

MIT OpenCourseWare  
<https://ocw.mit.edu/>

14.02 Principles of Macroeconomics  
Spring 2023

For information about citing these materials or our Terms of Use, visit: <https://ocw.mit.edu/terms>.