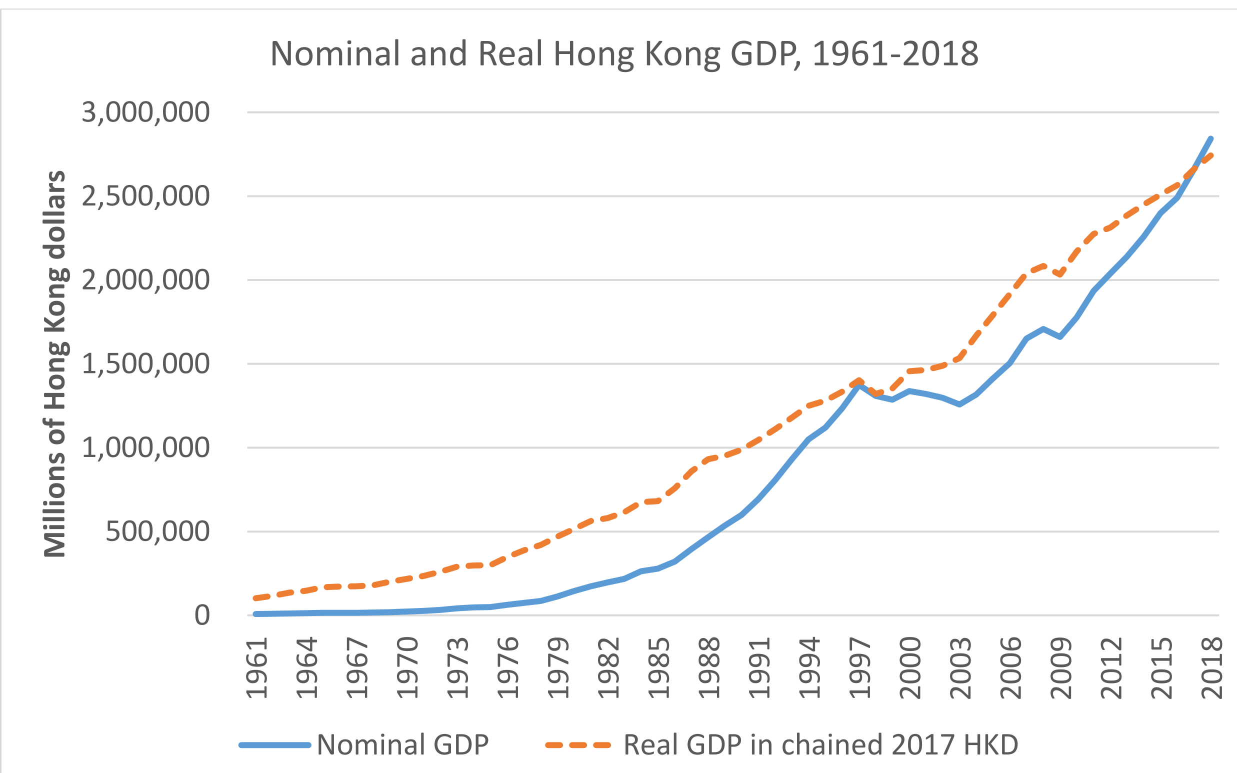
ECON 3123: Macroeconomic Theory 1
Problem Set #1
Due Date: March 10, 2020

1. **Real GDP and the GDP deflator:**

In this exercise, you will generate a graph of nominal and real GDP in Hong Kong, calculate the growth rate of real GDP, and compute the inflation rate based on the GDP deflator. This exercise is designed to enhance your data-handling skills and to review the relationship between major macroeconomic variables.

(a) Download data on nominal and real GDP in Hong Kong from the following page (https://www.censtatd.gov.hk/hkstat/sub/sp250.jsp?tableID=030&ID=0&productType=8). You can click "Customize Statistical Table," select "GDP-At current market prices in HK$ million," "GDP-Chained (2017) dollars in HK$ million," and "All Years," press "Submit," and use "Export Excel" menu. Create a chart similar to Figure 2-1 in our textbook using the downloaded data for Hong Kong.



(b) Compute the growth rate of real GDP from 1962 to 2018. Express them in percent by multiplying 100. What is the growth rate of real GDP in Hong Kong, on average, during the period? (HINT: Use ‘average’ function in Excel.)

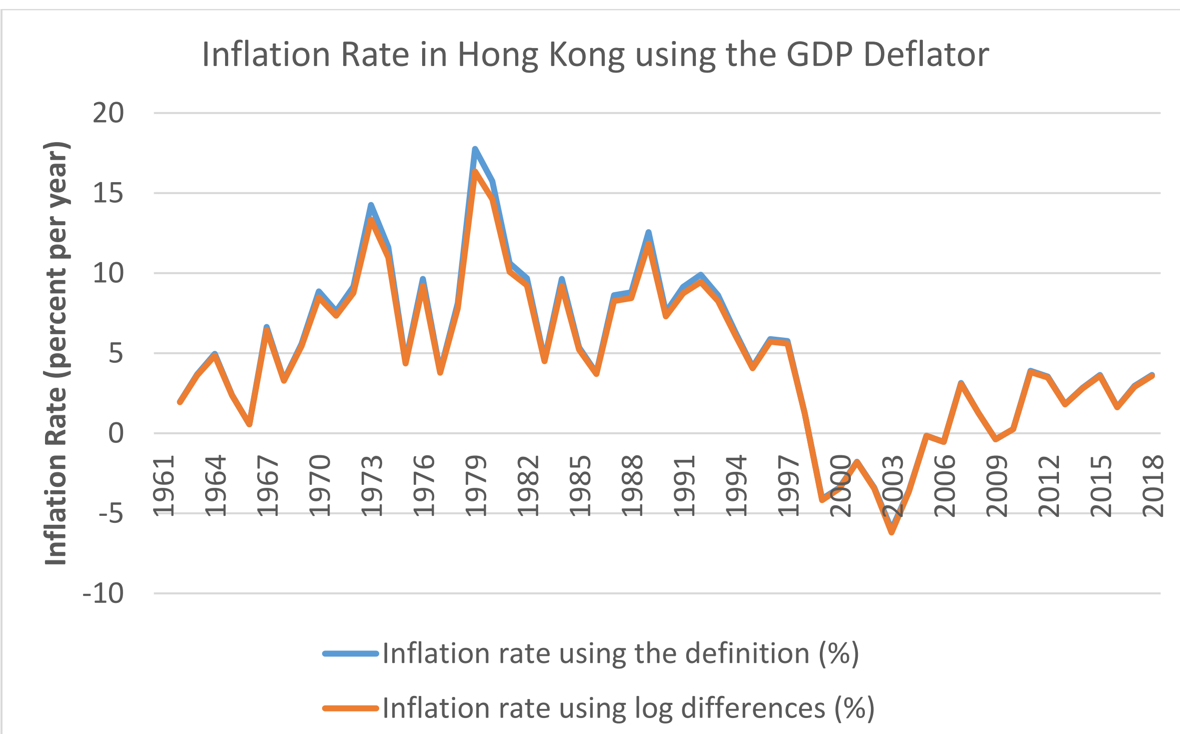
6.05%

(c) Calculate the GDP deflator, P_t, and the inflation rate, π_t, which is defined as $\frac{P_t - P_{t-1}}{P_{t-1}}$. Sometimes, economists use $\Delta \ln(P_t) = \ln(P_t) - \ln(P_{t-1})$ to compute the inflation rate, where $\ln(\cdot)$ is a natural logarithm. Derive the inflation rate using both methods and compare the results. Do you find that they are similar?

As illustrated in the figure below, both methods yield similar inflation rates. It is known that $\ln(1 + x)$ is close to x when x is around 0. Note that

$$\ln(P_t) - \ln(P_{t-1}) = \ln\left(\frac{P_t}{P_{t-1}}\right) = \ln\left(1 + \frac{P_t - P_{t-1}}{P_{t-1}}\right) = \ln(1 + \pi_t) \approx \pi_t$$

for small π_t’s.



2. The composition of HK GDP, 2016:

(a) Using data provided by Census and Statistics Department, the Government of the Hong Kong Special Administrative Region, fill in the following table. Specifically, you may want to look at "Table 031: GDP and its main expenditure components at current market prices." (https://www.censtatd.gov.hk/hkstat/sub/sp250.jsp?tableID=031&ID=0&productType=8)

	Millions of HKD, 2016	Percent of GDP
GDP (Y)	2,490,617	100.0
Consumption (C)	1,649,941	66.2
Investment (I)	535,216	21.5
Government spending (G)	247,973	10.0
Net Exports (NX)	57,040	2.3
Exports (X)	4,657,725	187.0
Imports (IM)	4,600,685	184.7
Inventory investment	447	0.0

(b) Among C, I, G, and NX, what is the largest component of GDP in Hong Kong?

Consumption (C).

(c) A widely used measure of trade openness is the openness index, which is given by $\frac{X+IM}{Y}$. Calculate the index of the Hong Kong economy in 2016. Compare your answer with that of the US economy in 2016, 26.5%.

$\frac{X+IM}{Y} = 371.73\% > 26.5\%.$

The Hong Kong economy is more "open" than the US economy.

(d) (Industry-wise decomposition) Check out "Table 036 : Gross Domestic Product (GDP) by major economic activity - percentage contribution to GDP at basic prices." (https://www.censtatd.gov.hk/hkstat/sub/sp250.jsp?tableID=036&ID=0&productType=8)

What is the most important industry in Hong Kong among the five sectors listed in the table?

Services. The contribution of service sector to the GDP is about 93%!

3. The employment rate:

First, see the following definition of the employment rate from the OECD. (https://data.oecd.org/emp/employment-rate.htm)

Employment rates are defined as a measure of the extent to which available labour resources (people available to work) are being used. They are calculated as the ratio of the employed to the working age population.

Suppose that the participation and unemployment rates are 60% and 5% in an economy, respectively. What is the employment rate in this economy?

Note that

$$Employment\ rate = \frac{E}{Working\ age\ population} = \frac{L}{Working\ age\ population} \times \frac{E}{L}$$

$$= Participation\ rate \times \left(1 - \frac{U}{L}\right) = Participation\ rate \times (1 - u)$$

Therefore, the employment rate is $60\% \times (1 - 5\%) = 0.6 \times 0.95 = 0.57 = 57\%$.

4. (Blanchard (2017), #2-5 on p.85)

The following equations refer to the goods market of an economy in billions of euros:

$$C = 480 + 0.5Y_D$$

$$I = 110$$

$$T = 70$$

$$G = 250$$

(a) Solve for the goods market equilibrium.

From $Y = C + I + G$, we have

$$Y = 480 + 0.5(Y - 70) + 110 + 250 \quad \Rightarrow \quad Y = \frac{1}{1 - 0.5}(480 - 35 + 110 + 250) = 1610.$$

(b) Find equilibrium disposable income (Y_D).

$$Y_D = Y - T = 1610 - 70 = 1540.$$

(c) Find equilibrium consumption (C).

$$C = 480 + 0.5Y_D = 480 + 0.5 \times 1540 = 1250.$$

(d) Calculate the private savings, public savings, and investment spending.

$$Private\ savings: \ S = Y_D - C = 1540 - 1250 = 290.$$

$$Public\ savings: \ T - G = 70 - 250 = -180.$$

Note that $I = 110 = 290 - 180 = Private\ savings + Public\ savings$.

(e) Calculate the multipliers in the following cases.

(i) The government increases G by one unit, while T does not change $\left(\frac{\Delta Y}{\Delta G}\right)$.

Spending multiplier: $\frac{1}{1-c_1} = \frac{1}{1-0.5} = 2$.

(ii) The government increases T by one unit, while G does not change $\left(\frac{\Delta Y}{\Delta T}\right)$.

Tax multiplier: $-\frac{c_1}{1-c_1} = -\frac{0.5}{1-0.5} = -1$.

(iii) The government increases G and T by one unit $\left(\frac{\Delta Y}{\Delta G}|_{\Delta G=\Delta T}\right)$.

Balanced budget multiplier: 1.

You can derive these multipliers from the following expression for the equilibrium output

$$Y = \frac{1}{1 - c_1}(c_0 + \bar{I} + G - c_1 T).$$

Also, you can obtain the same result by carefully investigating how such multiplier effects occur. Because we discussed the government spending multiplier in lecture, here, I will focus on the two other multipliers.

(ii) Tax multiplier

$$\begin{aligned} T: 1 \uparrow \quad \rightarrow \quad Y_D = Y - T : 1 \downarrow \quad &\rightarrow \quad C: c_1 \downarrow \quad \rightarrow \quad Z: c_1 \downarrow \quad \rightarrow \quad Y: c_1 \downarrow \\ &\rightarrow \quad C: c_1^2 \downarrow \quad \rightarrow \quad Z: c_1^2 \downarrow \quad \rightarrow \quad Y: c_1^2 \downarrow \\ &\rightarrow \quad \ldots \end{aligned}$$

Thus, Y decreases by $c_1 + c_1^2 + \cdots = \frac{c_1}{1-c_1}$.

(iii) Balanced budget multiplier

$$\begin{aligned} \begin{matrix} G: 1 \uparrow \\ T: 1 \uparrow \end{matrix} \quad \rightarrow \quad Y_D = Y - T : 1 \downarrow \quad \rightarrow \quad C: c_1 \downarrow \quad &\rightarrow \quad Z: 1 - c_1 \uparrow \quad \rightarrow \quad Y: 1 - c_1 \uparrow \\ \rightarrow \quad C: c_1(1 - c_1) \uparrow \quad &\rightarrow \quad Z: c_1(1 - c_1) \uparrow \quad \rightarrow \quad Y: c_1(1 - c_1) \uparrow \\ \rightarrow \quad \ldots \end{aligned}$$

Thus, Y increases by $(1 - c_1) + c_1(1 - c_1) + c_1^2(1 - c_1) + \cdots = \frac{1-c_1}{1-c_1} = 1$. Or, you can simply consider this as the government spending multiplier minus the tax multiplier, $\frac{1}{1-c_1} - \frac{c_1}{1-c_1} = 1$.

(f) Now, suppose that taxes depend on the level of income. Specifically, consider the following equation for taxes:

$$T = -252 + 0.2Y.$$

Recalculate the government spending multiplier and the tax multiplier.

Note that $C = 480 + 0.5Y_D = 480 + 0.5(Y - T) = 480 + 0.5(Y + 252 - 0.2Y) = 606 + 0.4Y$. Therefore,

$$Y = C + I + G = 606 + 0.4Y + \bar{I} + G$$

$$\Rightarrow \quad (1 - 0.4)Y = (606 + \bar{I} + G)$$

$$\Rightarrow \quad Y = \frac{1}{1 - 0.4}(606 + \bar{I} + G).$$

The government spending multiplier is $\frac{1}{1-0.4} = \frac{5}{3}$.

(g) Why is fiscal policy in this case called an automatic stabilizer?

Note that the new government spending multiplier, $\frac{5}{3}$, is less than the previous one, 2. This is because as Y increases, T also increases. As a result, an increase in Y_D is dampened, which translates into a smaller increase in C, Z, and finally, Y. In this sense, this tax schedule *automatically* stabilizes fluctuations due to G.