Answer for Homework 5: Modern Macroeconomics I*

1. Answer the following question.

   (a) Explain three functions of money.

   Answer Three functions of money are:

   i. A store of value: Money can be used to transfer purchasing power from the present to future.

   ii. A unit of account: Money provides the yardstick with which we measure the value of our transaction.

   iii. A medium of exchange: Money is tool with which we use to buy or sell goods.

   (b) Suppose that currencies are 200 million yen and deposits are 300 million yen and reserves are 100 million yen. Derive a money multiplier in this economy.

   Answer The definition of money multiplier is

$$\text{Money multiplier}=\frac{C/D+1}{C/D+R/D}$$

   where C is currency, D is deposits, and R is reserves. Then, we obtain:

$$\begin{aligned}\text{Money multiplier} &= \frac{C/D+1}{C/D+R/D}\\ &= \frac{\frac{200}{300}+1}{\frac{200}{300}+\frac{100}{300}}\\ &= \frac{5}{3}\end{aligned}$$

   (c) Explain how the Bank of Japan controls money supply.

   Answer There are three instruments:

   i. **Open-Market Operations**: Bank of Japan can sell or buy government bonds. When it buys bonds in the market, it pays yen for the bonds. Therefore, monetary base goes up. On the other hand, when it sells, it receives yen. Hence monetary base goes down.

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ii. **Operations at Exchange Market**: Bank of Japan can sell or buy dollars. When it buy dollars on the market, it pays yen for the dollars. Therefore, monetary base goes up. On the other hand, when it sells, it receives yen. Hence, monetary base goes down.

iii. **Change in the Discount Rate**: When commercial banks find that they do not have enough reserves, they can ask Bank of Japan to discount their bills. When Bank of Japan reduce the discount rate, commercial bank can easily borrow money from Bank of Japan and it increases monetary base.

2. Assume that population and asset is normalized to be 1. Consider the following aggregate supply and aggregate demand model and answer the following questions.

$$\begin{aligned} y &= \phi\left(h_e\left(w\right)\right) \\ w &= \phi'\left(h_e\left(w\right)\right) \\ \rho &= \phi\left(h_e\left(w\right)\right) - wh_e\left(w\right) - \delta \\ y &= c + i + g \\ \frac{m^s}{P} &= k\left(\rho\right) y \end{aligned}$$

Suppose that

$$\begin{aligned} \phi\left(h_e\right) &= \left(h_e\right)^{1-\alpha}, \\ k\left(\rho\right) &= \frac{k}{\rho}, \end{aligned}$$

where y is GDP per capita, w is wage rate, ρ is interest rate, h_e is labor, g is government expenditure, c is consumption, i is investment, m^s is money supply, P is price deflator. We assume that $\alpha = 0.3$ and $k = 0.1$.

(a) Suppose that government increases government expenditure, g, by 200 billion yen. How much does it affect GDP, the interest rate, wage, investment, consumption and aggregate price? Briefly explain your results.

Answer In the long run, y, w, and ρ are determined by supply side. Therefore, an increase in g does not affect y, w, and ρ. However, the increase in g affects consumption c and investment i. Since we know that y is constant in the long run and we have $y = c + i + g$, the increase in g by 200 billion yen decreases $c + i$ by 200 billion yen.

(b) Suppose that Bank of Japan increases money supply, m^s, by 4 %. How much does it affect GDP, the interest rate, the wage, investment, consumption and aggregate price? Briefly explain your results.

Answer In the long run, y, w, and ρ are determined by supply side. Therefore, an increase in m^s does not affect y, w, and ρ. However, the increase in m^s affects aggregate price P. Since we know that $k\left(\rho\right) y$ is constant in the long run and we have $\frac{m^s}{P} = k\left(\rho\right) y$, the increase in m^s by 4% increases P by 4%.

3. Answer the following question.

(a) Suppose that real interest rate is 2 percent. Currently many Japanese believe that inflation rate is 2 percent. How much is the nominal interest rate?

Answer The real interest rate is defined as nominal interest rate minus the expected inflation rate

$$\rho^r = \rho^n - g_P^e$$

where ρ^r is the real interest rate, ρ^n is the nominal interest rate and g_P^e is the expected inflation rate. According to this definition, the nominal interest rate is

$$\begin{aligned} \rho^n &= \rho^r + g_P^e \\ &= 2 + 2 \\ &= 4. \end{aligned}$$

(b) Suppose that Bank of Japan set the growth rate of money supply, M^s, by 2 %. How does it affect GDP, the interest rate, the wage, investment, consumption and aggregate price in the long run? Briefly explain your results.

Answer Let m^s money supply, g government expenditure, y GDP, w wage, ρ interest rate, c consumption, and P price. Given (m^s, g), the long run market equilibrium is summarized by (Y, w, i, C, P), which satisfies

i. Supply side conditions determine (y, w, ρ):

$$\begin{aligned} y &= \phi\left(h_e\left(w\right)\right) \\ w &= \phi'\left(h_e\left(w\right)\right) \\ \rho &= \phi\left(h_e\left(w\right)\right) - wh_e\left(w\right) - \delta \end{aligned}$$

ii. Demand side conditions determine (i, P).

$$\begin{aligned} y &= c + i + g \\ \frac{m^s}{P} &= k\left(\rho\right) y \end{aligned}$$

First, in the long run, GDP, the interest rate, and wage are determined by the supply side. Therefore, they do not change whereas money supply increases. Second, the consumption and the investment are determined by the interest rate, GDP, and government expenditure. Since interest rate is constant, the investment is constant. In addition, since $y = c+i+g$ and we know y, i, and g are constant, c is also constant. Therefore, the investment and the consumption do not change. However, the aggregate

price depends on the money supply: $P = \frac{m^s}{k(\rho)y}$ and

$$\begin{aligned}\frac{P^* - P}{P} &= \frac{\frac{m^{s*}}{k(\rho)y} - \frac{m^s}{k(\rho)y}}{\frac{m^s}{k(\rho)y}} \\ &= \frac{m^{s*} - m^s}{m^s},\end{aligned}$$

where P^* is the aggregate price when m^s increases to m^{s*}. Therefore, an increase in the money supply raise the aggregate price by 2 percent in the long run.