Problem set 4

Importance of Micro Foundations

1. (25 points). Read the Wikipedia article on Lucas critique, and answer the following questions.
   a. According to Robert Lucas, is policy advice based on “large-scale macroeconometric models” (developed from the Keynesian model discussed in class) valid?

   No.

   b. Why, or why not?

   Key parameters of the Keynesian model can change due to changes in physical or monetary policy.

   c. Give an example of a parameter in the Keynesian model, which is not policy-invariant.

   MPC - marginal propensity to consume. For example, following a current tax reduction, consumers might anticipate a future tax hikes, and therefore save more now (i.e. \( MPC \downarrow \)).

   d. Give an example of a parameter in the classical model, which is policy invariant.

   Preference parameter \( \alpha \) is policy invariant. It represents the weight on consumption in the utility function, and should not be affected by government policies. Another example is the capital share \( \theta \) in the production function.

   e. According to Robert Lucas, if we want to predict the effect of a policy experiment, what kind of models should we use? In particular, address the importance of Micro Foundations in these models.

   Lucas advocates the use of micro-foundations macro models for policy analysis, because the parameters of these models are policy invariant.
2. (25 points). Consider the Keynesian model discussed in class. Suppose that the economy is characterized by the following behavioral functions:

Consumption: \( C = 75 + 0.75(Y - T) \)
Investment: \( I = 100 \)
Government spending: \( G = 300 \)
Taxes: \( T = 100 + 0.2Y \)
Full employment output: \( Y_f = 1200 \)

a. Solve for the Keynesian equilibrium in the goods market.
We always prefer to solve analytically, and plug numbers in the very last step.

\[
Y = E \\
Y = C_0 + MPC(Y - T_0 - tY) + I_0 + G_0 \\
Y - MPC(1-t)Y = C_0 - MPC \cdot T_0 + I_0 + G_0 \\
Y^* = \frac{C_0 - MPC \cdot T_0 + I_0 + G_0}{1 - MPC(1-t)}
\]

Plugging the numbers:

\[
Y^* = \frac{75 - 0.75 \cdot 100 + 100 + 300}{1 - 0.75(1-0.2)} = \frac{400}{0.4} = 1000
\]

b. Suppose that investment falls by $10. Show how the government can restore the previous equilibrium output using its spending.

\[
Y^* = \frac{75 + 0.75(Y - 100 - 0.2Y) + 100 - 10 + 300 + \Delta G_0}{1 - 0.75 \cdot 0.8}
\]

We can see that in order to keep equilibrium output unchanged, the government needs to increase its spending by 10, i.e. \( \Delta G_0 = 10 \).

Another way of solving the problem is using the Keynesian multiplier.

\[
m_k = \frac{1}{1 - MPC(1-t)} = \frac{1}{0.4} = 2.5
\]

Thus, a change in investment will change the equilibrium output as follows:

\[
\Delta Y^* = m_k \Delta I_0 = 2.5 \cdot (-10) = -25
\]

In order to restore the original equilibrium output, the required change in government spending is found as follows:

\[
\Delta Y^* = m_k \Delta G_0 \\
25 = 2.5 \cdot \Delta G_0 \\
\Rightarrow \Delta G_0 = \frac{25}{2.5} = 10
\]
c. Suppose instead that the investment falls by $10, but the government wants to restore the previous equilibrium using taxes. Find the required change in the autonomous tax that would restore the equilibrium output to its initial level.

The general solution is

\[ Y^* = \frac{C_0 - MPC \cdot T_0 + I_0 + G_0}{1 - MPC(1-t)} \]

Thus, if we want to keep \( Y^* \) at its original level, we must change the autonomous tax \( T_0 \) such that

\[-MPC \cdot \Delta T_0 + \Delta I_0 = 0\]

\[ \Rightarrow \Delta T_0 = \frac{\Delta I_0}{MPC} = \frac{-10}{0.75} = -13\frac{1}{3} \]

In other words, the autonomous tax needs to decline by \( 13\frac{1}{3} \).

Another way of solving the problem is using the Keynesian tax multiplier.

\[ m_k(T) = \frac{-MPC}{1 - MPC(1-t)} = \frac{-0.75}{1 - 0.75(1-0.2)} = -1.875 \]

Thus, the required change in autonomous tax is found from:

\[ \Delta Y^* = m_k(T) \cdot \Delta T_0 \]
\[ 25 = -1.875 \cdot \Delta T_0 \]

\[ \Rightarrow \Delta T_0 = \frac{25}{-1.875} = -13\frac{1}{3} \]


d. Suppose instead that the investment falls by $10, but the government wants to restore the previous equilibrium using taxes. Find the required change in the proportional tax rate that would restore the equilibrium output to its initial level.

Now the only unknown is \( t \), the proportional tax rate.

\[ Y^* = \frac{C_0 - MPC \cdot T_0 + I_0 + G_0}{1 - MPC(1-t)} \]

\[ 1000 = \frac{100 - 0.75 \cdot 100 + 100 - 10 + 300}{1 - 0.75(1-t)} \]

\[ 1000 = \frac{390}{1 - 0.75 + 0.75t} \]

\[ 0.25 + 0.75t = \frac{390}{1000} \]

\[ t = \frac{\left( \frac{390}{1000} - 0.25 \right)}{0.75} = 0.18666... \]

Thus, the change in \( t \) is \( \Delta t = 0.18666... - 0.2 = -0.01333... \)
e. Based on the Keynesian model, answer the following questions:

(1). What causes business cycles?

Shocks to investment (animal spirit of investors).

(2). Can the government smooth out business cycles by stimulating the economy in times of recessions?

Yes, if $Y^* < Y_f$ (equilibrium output falls below full employment output level).
Search Model of Unemployment

3. (10 points). Consider the search model of unemployment studies in class. Illustrate with 3 fully labeled graphs the impact of an increase in unemployment insurance benefits \((b \uparrow)\) on: (1) reservation wage \(w^*\), (2) probability of acceptance of job offers \(H(w^*)\), and (3) steady-state unemployment rate \(U^*\).
4. (10 points). Consider the search model of unemployment studies in class. Illustrate with 3 fully labeled graph the impact of an increase in probability of getting a job offer \( (p \uparrow) \) on: (1) reservation wage \( w^* \), (2) probability of acceptance of job offers \( H(w^*) \), and (3) steady-state unemployment rate \( U^* \).
(10 points). Consider the search model of unemployment studies in class. Illustrate with 3 fully labeled graphs the impact of an increase labor income tax ($t_w \uparrow$) on: (1) reservation wage $w^*$, (2) probability of acceptance of job offers $H(w^*)$, and (3) steady-state unemployment rate $U^*$.
6. (10 points). Consider the search model of unemployment studies in class. Illustrate with 3 fully labeled graph the impact of an increase in separation rate \( s \uparrow \) on: (1) reservation wage \( w^* \), (2) probability of acceptance of job offers \( H(w^*) \), and (3) steady-state unemployment rate \( U^* \).
7. (20 points). **Bonus question.** Using the mortgage calculator from the following page [http://online.sfsu.edu/mbar/useful.htm](http://online.sfsu.edu/mbar/useful.htm), answer the following questions.
   a. Suppose you take a mortgage of $700,000 for 30 years (360 monthly payments) at 5% annual interest rate. What is the sum of all the interest payments on this mortgage?

   $652,790.49

   b. Suppose that the above interest payments are tax deductible, and you are in the 35% income tax bracket. What is the total amount of tax deductions that you get as a subsidy of your mortgage?

   \[
   Sub = 35\% \cdot 652,790.49 = $228,476.67
   \]

   c. Suppose that you took the same mortgage, but your income tax bracket is only 25%. What is the total tax subsidy you get on the mortgage?

   \[
   Sub = 25\% \cdot 652,790.49 = $163,197.62
   \]

   d. Suppose that the above mortgage has adjustable rate, so that for the first two years the interest rate is only 1%, and it jumps to 8% after that. Calculate the monthly payment during the first two years and the monthly payment after that.

   First two years: **$2,251.48**

   After the first two years: **$4,925.46**