Discussion handout 2 (Semester 1/2017)

Consider a modified version of the IS-LM model where government spending is counter-cyclically tied to the level of GDP (Y).

$C = C_0 + C_1 Y_d - C_2(i - \pi), \qquad 0 < C_1 < 1$

$I = I_0 + I_1 Y - I_2(i - \pi), \qquad 0 < I_1 < 1$

$G = G_0 - G_1 Y, \qquad 0 < G_1 < 1$

$T = T_0$

$M^s = M_0$

$M^d = L_1 Y - L_2 i$

where C is the private consumption, I is the private investment, G is the government spending, T is tax, M^s is the level of money supply, M^d is the level of money demand, i is the level of nominal interest rate, and π is the level of inflation. Other than those explicitly stated, all the remaining coefficients are ***non-negative***, and that $C_1 + I_1 > G_1$. (All the variables are measured in the units of million dollars.)

For the sake of simplicity, let's assume in the meantime that π is an *exogenous variable*. (*Advanced student should also look into the next part when the model is modified to take into account more realistic features.*)

a) Derive the IS and LM equations.

b) Write the IS-LM equation in terms of the matrix representation, *and* state the condition that warrants the *uniqueness* of the solution.

c) Solve for the equilibrium GDP and interest rate (Y^*, i^*) using the **Cramer's rule**

d) Calculate the multiplier of G_0 and M_0 *on* $\boldsymbol{Y^*}$ **and** $\boldsymbol{i^*}$**.** Briefly interpret the meaning, and discuss whether the multiplier is bigger or smaller than the case that government spending is strictly exogenous.

Storyline: *"The government is seeking for some advices on fiscal and monetary policy implementation. The goal of the government is to (i) increase the real GDP by \$100 million ($\Delta y = 1$), while (ii) keeping the current level of nominal interest rate fixed. (That is, the government was thinking that the country is running into an unemployment situation, but the level of interest rate is now optimal.)"*

Following the storyline given above and all your work that you have done before, answer the next two questions.

e) Can the government successfully achieve both goals by simply relying on *a single type of policy implemented*? That is, would it work to either change the *government expenditure* or *money supply*, but not both at the same time, to achieve the two goals? If yes, *under which conditions*? Provide some intuitions.

f) If the condition that you assumed in (e) does not hold, what would you recommend to the government so that both goals can be simultaneously achieved? (Hint: *Think about an appropriate mixture of the two policies. Graphing might help, but it must be roughly related to your numerical result*.)

Question 2 (Romer 2003: The Keynesian economics with LM curve: *A heuristic framework of modern monetary policy model*)

While the IS-LM model, as outlined in question 1, is commonly used as the workhorse for macroeconomics teaching, the framework itself contains two important limitations which make the implications obtained from the model less insightful. *First*, inflation is assumed to be given. This assumption is not true. In the data, we normally see that inflation typically commoves with output in a positive direction. *Second*, the model assumes that central bank controls the level of money, and hence treating the level of money supply as an exogenous variable. This assumption is at odds with the conventional practice adopted by monetary policymakers all around the globe. Most central banks have nowadays chosen to adjust the level of nominal interest rate, rather than controlling the level of money supply. (Of course, this practice is also adopted by the Bank of Thailand).

The purpose of this question/example is to modify to the above IS-LM model, and bring in a new simplified model that is getting more closely resemble to the structure of monetary policy model commonly used by most of the central banks. The presentation follows and simplifies the analysis made in Romer (2003). In his work, the modifications applied to the original model are made to the following two points. *First*, we assume that the inflation is no longer treated as given, but instead can be explained by the following equation;

$$\pi = \pi_0 + \kappa(Y - Y^N) + s$$

where π_0 and Y^N are long-term inflation rate and the natural rate of output. s represents the supply-side effect; an increase in "s" implies an increase in inflation. (The three are exogenous variables.) The above equation is a variant static version of

the so called Phillips relationship. In words, the relationship suggests that inflation would rise above its long-term level if actual GDP (Y) is higher than its natural rate level (Y^N). Empirically, the value of the coefficient κ is greater than zero.

Second, let's instead assume that central bank controls the level of money supply, and hence adjusting the level of money to hit the target of nominal interest rate. Conventional framework commonly used to understand the behavior of central bank for the adjustment of the interest rate is usually borrowed from the idea of John Taylor (1993). In his work, he argues that central bank adjusts the level of nominal interest rate using a policy rule given by,

$$i = r^* + \alpha(\pi - \pi_0) + \beta(Y - Y^N)$$

where r^* is the exogenously-determined natural level of interest rate. α and β are two coefficients with positive value.

a) State all the endogenous variables.
b) Under the given policy rule, can we now treat money supply as an exogenous variable as before? If not, derive the endogenously-determined level of money supply.
c) Use the Cramer's rule and solve for the equilibrium solution of output (Y), inflation (π) and nominal interest rate (i)
d) What happens to the equilibrium output and inflation if "s" increases. That is, what would happen if the economy is subjected to a negative supply-sided effect (shock).
e) How does the level of long-term inflation rate, natural rate of output and natural rate of interest affect the equilibrium