Econ 362, Macroeconomic Theory
Aggregate demand problem set

In the following two problems, you will figure out what happens to the AD curve - shift out (up), shift back (down), or nothing - in an economy where the central bank fixes the money supply. To figure out how the AD curve shifts, you will figure out what would happen to *Y if* the price level remained fixed. Of course, the price level *won't* remain fixed, except perhaps in the very short run. But to figure out how the AD curve shifts, you imagine the hypothetical of a fixed price level and see what would happen to *Y*. In both problems, always assume that expected inflation π^e remains fixed.

1) Suppose output is initially equal to potential output $\bar{Y}$, which means the real interest rate is equal to the initial natural rate of interest denoted $\bar{r}_0$. Then there is an increase in the exogenous level of government spending on goods and services $\bar{G}$ from a "before" level $\bar{G}_0$ to an "after" level $\bar{G}_1$. The increase in $\bar{G}$, denoted $\Delta\bar{G}$, is equal to $(\bar{G}_1 - \bar{G}_0)$. There is no change in any other exogenous variable, and the increase in government spending does not affect $\bar{Y}$.

a) Write down the big equation that gives *Y* in terms of *r*. Using the equation, figure out how the change in $\bar{G}$, that is $\Delta\bar{G} = (\bar{G}_1 - \bar{G}_0)$, would affect *Y* if the real interest rate remained equal to $\bar{r}_0$. This change in output, denoted ΔY, is equal to something times $(\bar{G}_1 - \bar{G}_0)$. What is "something"?

b) Using a graph that has the real interest rate on the vertical axis and output Y on the horizontal axis, draw what happens to the IS curve and the natural rate of interest as a result of the increase in $\bar{G}$. Denote the new natural rate of interest by $\bar{r}_1$

c) Draw what would happen in the IS/LM graph assuming P remains fixed. Denote the "before" values of r and Y by $\bar{r}_0$ and $\bar{Y}$. Denote the "after" values by r_1 and Y_1.
Hint: r_1 is *not* equal to $\bar{r}_1$.

d) Is $(Y_1 - \bar{Y})$ bigger than, smaller than, or the same as ΔY from part a)? Explain how you know.

e) Draw what happens in the "money market" graph that has the real interest rate on the vertical axis and real balances M/P on the horizontal axis (again assuming P remains fixed). Denote the "before" values of r by $\bar{r}_0$. Denote the "after" value by r_1. Hint: think about how the money-demand curve shifts if Y changes as you found in in c).

f) Now draw what happens to the AD curve.
Hint: your answer to a) tells you the change in output that would occur *if* the price level remained fixed.

g) Using the shift in the AD curve you drew in f), show what must happen to the price level in response to the increase in G assuming that the price level is perfectly flexible and always instantaneously adjusts to keep $Y = \bar{Y}$. (Mankiw calls this "the long run.") Use P_0 to denote the "before" price level that makes $Y = \bar{Y}$. Use P_1 to denote the "after" price level that keeps $Y = \bar{Y}$ after the increase in G.

h) Now draw what happens to the IS/LM graph given the increase in *G and* the change in the price level from d). Hints: consider how the change in the price level affects the LM curve; remember that output remains equal to $\bar{Y}$; remember that the change in G affects the natural rate of interest $\bar{r}$.

i) Now draw what happens to the money market graph given the increase in *G and* the change in the price level from d). Hint: consider how the change in the price level affects the supply of real money balances *M/P*.

2) Suppose output is initially equal to potential output $\bar{Y}$. Then there is an increase in the fixed money supply from a value M_0 to a larger value M_1. The increase in *M* is equal to $(M_1 - M_0)$. Holding the price level fixed, the corresponding change in real money balances, denoted $\Delta(M/P)$, is $(M_1 - M_0)/P$ There is no change in any other exogenous variable, and the increase in government spending does not affect $\bar{Y}$.

a) Does the change in *M* affect the natural rate of interest $\bar{r}$? Explain how you know.

b) Using the equation that gives demand for real money balances, figure out what would happen to *r if* output remained fixed and the price level remained fixed, too. This change in *r*, denoted Δr, is equal to something times the change in real balance $\Delta(M/P)$. What is "something"?

c) Using the "money market" graph that has the real interest rate on the vertical axis and real balances *M/P* on the horizontal axis, draw what would happen to the real interest rate *r* if there were *no* change in output *Y* (and assuming *P* remains fixed). Denote the "before" value of *r* by $\bar{r}$. Denote the "after" value by $\hat{r}_1$.

d) Your answers to b) and c) tell you how the change in the money supply affects the LM curve. Using the IS/LM graph, draw what would happen to r and Y as a result of the increase in M assuming P remains fixed. Denote the "before" values of r and Y by $\bar{r}$ and $\bar{Y}$. Denote the "after" values by r_1 and Y_1. Draw $\hat{r}_1$ on the graph, too.

e) Now draw another money market graph. On this graph, draw what actually happens to the real interest rate r given the change in output you found in b). On the graph, mark r_0, $\hat{r}_1$ and r_1 (same r_1 as in d). Hint: the change in Y from d) means that the *demand* for real money balances shifts.

f) Now draw what happens to the AD curve. Hint: your answer to d) tells you the change in output that would occur *if* the price level remained fixed.

g) Given the shift in the AD curve you figured out in f), draw what happens to the price level in response to the increase in M assuming that the price level is perfectly flexible; it always instantaneously adjusts to keep $Y = \bar{Y}$. Use P_0 to denote the "before" price level that keeps $Y = \bar{Y}$. Use P_1 to denote the "after" price level that keeps $Y = \bar{Y}$ after the increase in M.

h) Now draw what happens to the IS/LM graph given the increase in *M and* the change in the price level from d). Let LM_0 denote the LM curve before the increase in *M*, LM_1 denote the LM curve from d), and $\bar{LM}$ denote the LM curve given the increase in *M and* the change in the price level. Hint: consider how the change in the price level affects the LM curve. Also, remember that *Y* must end up equal to $\bar{Y}$.

i) Now draw what happens to the money market graph given the increase in *M and* the change in the price level from d). Hint: consider how the change in the price level affects the supply of real money balances *M/P*. Also, remember that *Y* remains equal to $\bar{Y}$.

j) What is the relation between the change in the money supply and the change in the price level P that keeps output equal to the natural rate of output? That is, if the money supply increases by 10 percent, what is the percent increase in P ?