ECON 2102 **Fall 2013**
Professor F. Demers

ANSWERS TO ASSIGNMENT 2

This assignment has 3 pages. There are 3 questions with parts. Question 1 is worth 40 points. Question 2 is worth 25points and question 3 is worth 35 points. The weight of each part is indicated in the margin. Please answer the questions **carefully**. **Explanations are important.** When asked to draw a graph, **make sure you label all the curves and the axes.** Sloppy work will not be graded or will lose points.

(40) 1. Consider the following model of a closed economy in the short run:

$C = 360 + 0.8\,(Y - T)$
$I = 550 - 40\,r$
$\bar{G} = 500$
$T = 100 + 0.25\,Y$
$PE = C + I + G$
$Y = PE$ $(Equilibrium\ condition\ for\ the\ goods\ market)$.
$M^d / \bar{P} = 0.5\,Y - 50\,r$

Suppose that the central bank sets the nominal money supply $M^s = 1500$.
Goods market equilibrium is obtained when $Y = C + I + G$, while money market equilibrium is obtained when $M^s / \bar{P} = M^d / \bar{P}$

NOTE: In this problem taxes have two components: a lump-sum component and a component that depends on income Y. You must take this into account when deriving the IS equation.

(25) a)

(4)(i) What is the "tax multiplier" for this economy? Find its algebraic expression and then find its numerical value.

(4) (ii) Find the IS equation and the LM equation (as a function of *P*) for this economy.

(6) (iii) Using the expressions you found in question **1(a)(ii)** find the **aggregate demand equation (**which is a function of *P)*. Draw a graph to illustrate the ***AD*** equation.

(10) (iv) Now assume that ***P* = *2***. Using the numerical *IS* and *LM* equations for the economy solve for the equilibrium values of *Y* and *r*. What would be these equilibrium values if we had ***P* =*3*** instead? Find the new equilibrium values of *r* and *Y*, and **draw a graph (in *Y*- *r* space)** to explain the impact of the increase in the price on output and the interest rate.

(7) b) Assuming again that ***P* = *2*,** consider an improvement in consumer confidence, such that autonomous consumption expenditures increase from 360 to 460 units. (That is, $\Delta\ \bar{C} = 100$). What is the impact of this change on the equilibrium output, on the equilibrium interest rate **and on consumption**? Calculate. **Explain your result. Draw a graph to illustrate.**

(8) c) If the central bank wanted to maintain the interest rate constant after the change in $\bar{C}$, by how much would it have to change the money supply? (Assume again that ***P*=*2*.**) Calculate. **Explain your result. Draw a graph to illustrate.**

ANSWER:

a) (i) The tax multiplier is given by $\left[\frac{-c}{1-c(1-t)}\right]$

(ii) For goods market equilibrium, we must have Y = E

$$Y = C + I + G$$

$$Y = \left[\frac{1}{1-c(1-t)}\right]\{[\bar{C} + \bar{I} + \bar{G} - c\bar{T}] - br\}$$

Numerical IS equation: $Y = 2.5\,[1330 - 40r]$
or, $Y = 3325 - 100r$

(Note that the government multiplier is now given by

$$\frac{1}{1-c(1-t)}$$

For money market equilibrium, we must have

$$M^s / \bar{P} = M^d / \bar{P}$$

$$1500/ \bar{P} = 0.5Y - 50r$$

which yields

$$Y = \frac{3000}{\bar{P}} + 100r$$

or, soling for *r*

$$r = 0.01Y - \frac{30}{\bar{P}}$$

Note that we are writing the LM equation as a function of *P*.

(iii) Now substitute for *r* from the LM into the IS equation:

$$Y = 3325 - 100\,\{\,0.01Y - \frac{30}{\bar{P}}\,\}$$

Solving for Y, we obtain the **Aggregate Demand equation** which relates the amount of output demanded Y to the price level P**:**

AD equation: $Y = 1662.5 + \frac{1500}{P}$

(iv) Now, assume that $\bar{P} = 2$. The LM equation becomes:

Numerical LM equation: $Y = 1500 + 100r$

To find equilibrium r,

$$3325 - 100r = 1500 + 100r$$

Solve for *r*

$$r* = 9.125$$

Substitute into either IS or LM equation to find equilibrium output as:

$$Y* = 2412.5$$

Alternatively, substituting for $\bar{P} = 2$ into the ***AD*** equation will also yield $Y* = 2412.5$.

If $\bar{P} = 3$ instead, then the **LM equation** becomes: $Y = 1000 + 100r$

To find equilibrium r,

$$3325 - 100r = 1000 + 100r$$

Solve for *r*

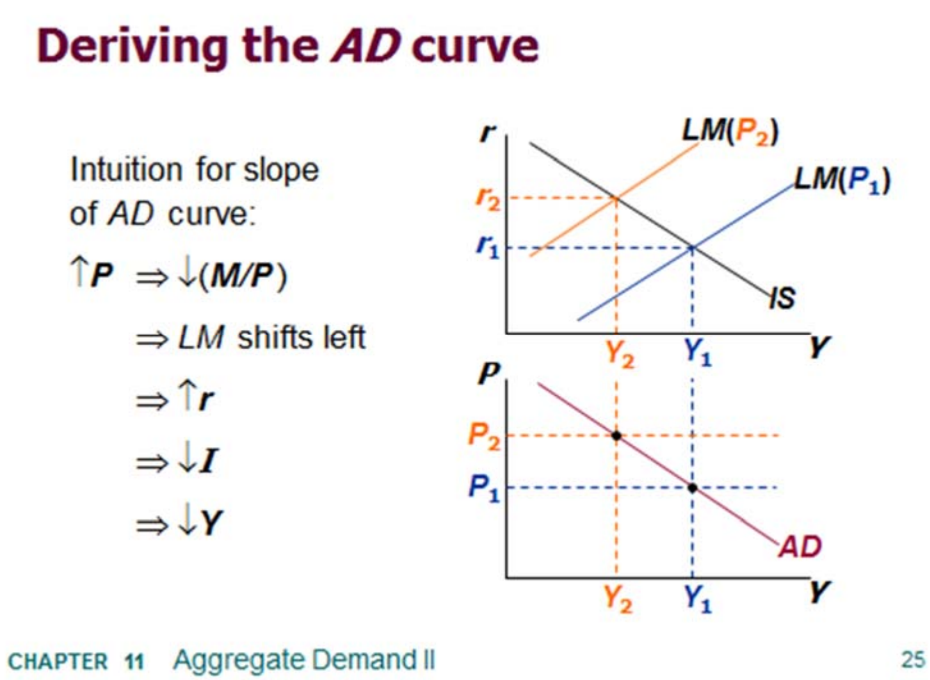
$$r* = 11.625$$

Substitute into either IS or LM equation to find equilibrium output as: (after rounding off)

$$Y* = 2162.5$$

Alternatively, substituting for $\bar{P} = 3$ into the ***AD*** equation will also yield $Y* = 2162.5$. Hence, we can see that output falls as the price level increases.

4 points for graph. See below:



b) 3points for graph and brief explanation, 2pts each for Δr* and for Δ*C*

If $\bar{C}$ increases by 100 units, then you can either repeat the steps in part (a) but assuming now that $\bar{C} = 460$

or do the following:

From IS eq. $\Delta Y = 2.5\Delta \bar{C} - 100\,\Delta r$
From LM eq $\Delta Y = 100\,\Delta r$
Hence, $100\,\Delta r = 2.5\,\Delta\bar{C} - 100\,\Delta r$
Solving for Δr $yields$ $\Delta r = 1.25$

$$Hence\ now\ r = 10.375$$

Also, from the LM eq. $\Delta Y = 100 \times \Delta r = 125.$

$$Hence, now, Y = 2537.5$$

Y has increased by 125 units.

What happens to total consumption?

First, **before the change in $\bar{C}$**

$$C = 360 + 0.8\,(Y - T)$$

and

$$T = 100 + 0.25\,Y$$

so that

$$C = 360 + 0.8(2412.5 - 100 - 0.25[2412.5])$$
$$C = 1727.5$$

After the change in $\bar{C}$

$$C = 460 + 0.8(2537.5 - 100 - 0.25[2537.5])$$
$$C = 1902.5$$

Hence, consumption has increased by 175 units, which is *more* than the change in $\bar{C}$. This is due to the increase in *Y*.

GRAPH: see p.345, Fig. 11.1 in the textbook. The impact is the same. However in our problem it is $\bar{C}$ that is changing, and NOT Gov. expenditures.

c) 4pts for calculating the change in the money supply, 4pts for the graph and a very brief explanation.

First find by how much Y increases if *r* stays at 9.125 %.

From IS eq.

$$\Delta Y = 2.5\Delta\ \bar{C} = 250.$$

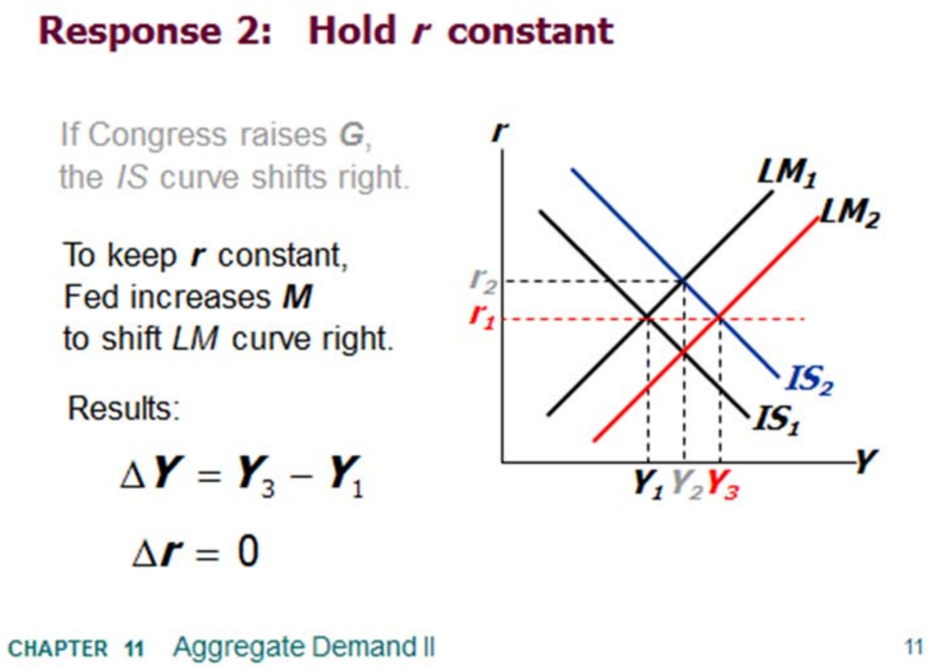
We see that output increases by more when the interest rate stays constant.

Hence, with $P = 2$, from LM eq. we obtain

$$\Delta\ \bar{M} = 250$$

The CB must increase the money supply by 250 units to maintain the interest rate constant.

GRAPH: see next page The impact is the same. However in our problem it is $\bar{C}$ that is changing, and NOT Gov. expenditures.



(SEE ALSO Chap. 11, p.348, fig. 11-4 (b) except that in our problem both the IS and the LM curves shift to the *right* instead of to the left.)

(25) 2. Consider the following model of a closed economy in the short run:

$C = 250 + 0.75\,(Y - T)$
$I = 600 - 50\,r$
$\bar{G} = 325$
$\bar{T} = 100$
$PE = C + I + G$
$Y = PE$ $(Equilibrium\ condition\ for\ the\ goods\ market)$.
$M^d / \bar{P} = 1.5\,Y - 60\,r$

Suppose that the central bank sets the nominal money supply at $M^s = 3000$ and that $\bar{P} = 1$.
Goods market equilibrium is obtained when Y = C + I + G, while money market equilibrium is obtained when $M^s / \bar{P} = M^d / \bar{P}$.

(8) a) Write the numerical *IS* and *LM* equations for the economy and solve for the equilibrium values of *Y* and *r*.

(8) b) Suppose that the government uses **contractionary** fiscal policy in order to reduce the budget deficit, and increases taxes so that now $\bar{T} = 250$. (That is, $\Delta\bar{T} = 150$). What is the impact of this change on the equilibrium output level and on the equilibrium interest rate? Calculate. **Explain your result. Draw a graph to illustrate.**

(9) c) Suppose that the Central Bank sets the money supply in such a way as to keep output constant at the initial level you found in part (a).

(5) (i) Under this condition, what is the impact of the contractionary fiscal policy action ($\Delta\ \overline{T} = 150$) described in part (b) on the interest rate? Calculate**.** Compare this value of *r* to the value you found for *r* in part 2(b). **Explain your result. Draw a graph to illustrate.**

(4) (ii) By how much must the Central Bank change the money supply in order to maintain output constant after the contractionary policy action? Calculate.

ANSWER:

a) The numerical IS equation is given by:

$$Y = \frac{1}{(1-0.75)}\{[250+600+325-75]-50r\}$$

or,

$$Y = 4[1100-50r]$$

and finally

$$Y = 4400-200r$$

The numerical LM equation is given by:

$$Y = 2000+40r$$

We can solve these two equations simultaneously to solve for Y and r. Therefore,

$$2000+40r = 4400-200r$$

Solving for r yields the equilibrium interest rate:

$$r *= 10$$

Now, using either the IS or the LM equation, we can obtain the value of Y*. Let us use the IS eq. to get:

$$Y = 4400-200(10)$$

$$Y^* = 2400$$

b) Let $\Delta\overline{T} = 175$

You may redo the operations above with the new value of $\overline{T} = 250$ and find the new r* and Y*. Then you can calculate the *difference* in Y and r brought about by the fiscal policy measure by subtracting the values you obtained in part (a) from the ones you obtain in part (b).

Alternatively, it is quicker to proceed directly as follows.

From the IS eq. we know that

$$\Delta Y = \frac{1}{(1-c)}\{-c\Delta\overline{T}-70\Delta \mathrm{r}\}$$

or

$$\Delta \mathrm{Y} = 4(-0.75)(150)-4(50)\Delta \mathrm{r}$$

or

$$\Delta Y = -450 - 200\Delta r$$

From the LM equation we know that:

$$\Delta Y = 40\Delta r$$

Now we may use this expression to find Δr

$$40\Delta r = -450 - 200\Delta r$$

$$\Delta r \cong -1.875$$

Hence the interest rate **falls** by 1.8 %. The new $r \cong 8.125$.

To find the change in output, we may use the LM eq. that says

$$\Delta Y = 40\Delta r$$

Therefore

$$\Delta Y = 40(-1.875)$$

so that

$$\Delta Y = -75$$

The new $Y* = 2325$ Therefore, as expected, contractionary fiscal policy has reduced output and reduced the interest rate.

(**For a graph see the impact of fiscal policy in the IS-LM model in Chapter 11, p.345, fig.11-1, except that here with *contractionary fiscal policy* the IS curve shifts to the *left* instead of shifting to the right**. See also figure below for a tax ***cut***. In this question we have a tax ***increase.***)

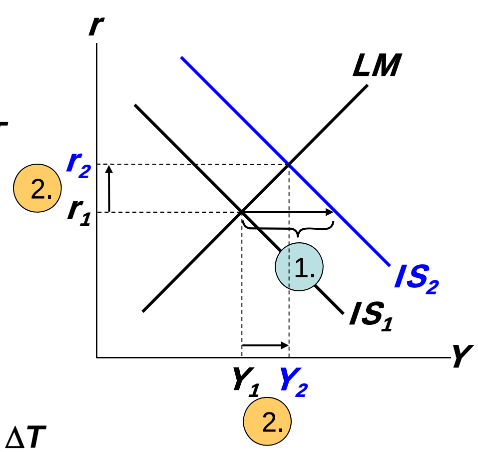
A tax cut

Consumers save (1–*MPC*) of the tax cut, so the initial boost in spending is smaller for Δ***T*** than for an equal Δ***G***…

and the *IS* curve shifts by

1. $\dfrac{-MPC}{1-MPC}\Delta T$

2. …so the effects on ***r*** and ***Y*** are smaller for Δ***T*** than for an equal Δ***G***.



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c) (i) Now suppose the Central Bank uses monetary policy to maintain the output fixed. What is the impact on the interest rate?

First, since we know that Y has not changed, we know that $\Delta Y = 0, or\ Y^* = 2400$. Hence, there will not be a fall in output after the fiscal contraction.

Therefore, from the IS equation, we have:

$$\Delta Y = -450 - 200\Delta r$$

$$0 = -450 - 200\Delta r$$
$$450 = -200\ \Delta r$$

or,

$$\Delta r = -2.25$$

Hence, the interest rate would fall by 2.25% relative to its initial value if the Central Bank uses expansionary monetary policy to keep output constant.
We can therefore say that the interest rate falls by *more* than in part (b) due to the Central Bank's action.

(ii) From the LM equation we have

$$\frac{\Delta\bar{M}}{\bar{P}} = -60\Delta r$$

Since $\bar{P} = 1$, and $\Delta r = -2.25$, $\Delta\bar{M} = 135$. Hence, the money supply must increase by 135 units to keep output constant.

For a graph, see Chap. 11, p.348, fig. 11-4 (c)

(35) 3. Consider the following short-run model of an open economy where there is perfect capital mobility so that the domestic interest rate equals the world interest rate, i.e., the *"interest rate parity"* condition holds and r = r*. Assume also that there is a flexible (or "floating") exchange rate regime, where the nominal exchange rate is denoted by ***e***

$C = 120 + 0.8\,(Y - \bar{T})$
$\bar{I} = 200 - 30\,r$
$\bar{G} = 264$
$\bar{T} = 100$
$NX = 200 - 50\,(\bar{P} / P^*)\,\boldsymbol{e}$
$PE = C + I + G + NX$
$Y = PE$ (equilibrium condition for the goods market).

$M^d / \bar{P} = 2\,Y - 40\,r$

$r = r^*$ (the interest rate parity condition)

Suppose that the central bank sets the nominal money supply $M^s = 2000$ and that $\bar{P} = 2$. Also suppose that the foreign price $P^* = 1$ while the world interest rate $r^* = 6$.

Goods market equilibrium is obtained when Y = C + I + G+ NX, while money market equilibrium is obtained when $M^s/\bar{P} = M^d/\bar{P}$.

(15) a) Write the numerical *IS** and *LM** curves for the economy and solve for the equilibrium values of *Y*, ***e*** and *NX*. **Draw a graph (or graphs) to illustrate the equilibrium.**

(10) b) Suppose that the central bank doubles the ***nominal*** money supply to stimulate the economy, so that $M^s = 4000$, (or alternatively, the change in the nominal money supply is $\Delta M^s = 2000$). What is the impact of this expansionary monetary policy move on the equilibrium output level *Y*, the equilibrium nominal exchange rate ***e*** and on equilibrium net exports *NX*? Is monetary policy effective? **Explain and draw a graph to illustrate the impact of the policy change.**

(10) c) Now, suppose that fiscal policy is used to stimulate the economy ***instead*** of monetary policy, and that government expenditures increase by 100 units (i.e., $\Delta\bar{G} = 100$). What is the impact of this expansionary fiscal policy move on the equilibrium output level *Y*, the equilibrium nominal exchange rate ***e*** and on equilibrium net exports *NX*? Is fiscal policy effective? **Explain and draw a graph to illustrate the impact of the policy change.**

ANSWER:

(a) The IS* equation is given by:

$$Y = \frac{1}{1-c}\{\,[\bar{C} + \bar{I} + \bar{G} - c\bar{T} + \overline{NX}] - br^* - q\left(\frac{\bar{P}}{P^*}\right)e\,\}$$

Numerically:

$$Y = 5\{704 - 30(r*) - 100e\}$$

or, since $r^* = 6$

$$Y = 2620 - 500e$$

and LM*:

$$\frac{\bar{M}}{\bar{P}} = kY - hr^*$$

and numerically:

$$\frac{2000}{2} = 2Y - 40(6)$$

so that

$$Y^* = 620$$

Then we can find from the IS eq.

$$\boldsymbol{e}^* = 4$$

NX can be also found as

$$NX = 200 - 50\,(\bar{P}/P*)\,\boldsymbol{e}$$

$$= 200 - 100(4)$$

Therefore, $NX *= -200$. Hence we have a trade deficit.

(b) From the LM* equation:

$$\Delta \frac{\overline{M}}{\overline{P}} = k\Delta Y$$

or

$$\Delta Y^* = \frac{2000}{4} = 500$$

Hence, *Y* increases by 500 units so that now $Y *= 1120$.

Then from the IS eq.

$$\Delta Y = -500\Delta e$$
$$500 = -500e$$

so that

$$\Delta e = -1$$

We observe a **depreciation** of ***e***.

We now have

$$\boldsymbol{e}^* = 3$$

while net exports are given by

$$NX = 200 - 50\,(\bar{P}\,/\,P*)\,\boldsymbol{e}$$
$$= 200 - 100(3)$$
$$NX = -100$$

So that *NX* have increased. Equivalently, we could calculate

$$\Delta NX = -100(-1) = 100$$

That is, *NX* have increased by 100 units.
Thus, the depreciation in the exchange rate has brought about an improvement in net exports.

Yes, monetary policy is effective: output has increased due to the increase in net exports resulting from the depreciation of the domestic currency.

Graph: See Figure 12-7 on p. 387 (or see below)

Monetary policy under floating exchange rates

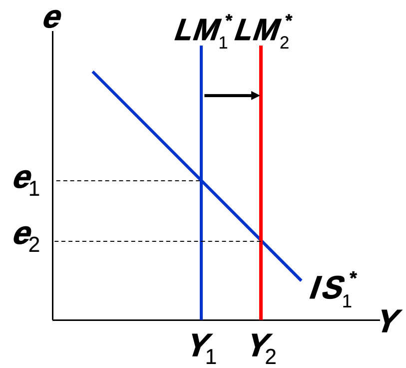
$$Y = C(Y - T) + I(r^*) + G + NX(e)$$

$$M/P = L(r^*, Y)$$

An increase in M shifts LM^* right because Y must rise to restore eq'm in the money market.

Results:

$\Delta e < 0, \ \Delta Y > 0$



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c) Now, here note that $\Delta Y = 0$ (as we observe from the LM* eq.)
From the IS* eq,

$$0 = 5\,\Delta\bar{G} - 500\Delta \boldsymbol{e}$$

where $\Delta\bar{G} = 100$. Solving for $\Delta \boldsymbol{e}$ we obtain $\Delta e = 1$. The domestic currency **appreciates,** and now $e = 5$.

From the NX equation we also get $\Delta NX = -100(1) = -100$. That is, as the currency appreciates, net exports fall and the trade deficit worsens. We see that there is no change in output, but *NX* fall. This shows that fiscal policy is not effective under floating exchange rates.
Net exports are fully "crowded out" by the expansionary fiscal policy measure.

Graph: See Figure 12-6 on p. 386 (or see below).

Fiscal policy under floating exchange rates

$$Y = C(Y - T) + I(r^*) + G + NX(e)$$

$$M/P = L(r^*, Y)$$

At any given value of **e**, a fiscal expansion increases ***Y***, shifting *IS** to the right.

Results:

$\Delta e > 0$, $\Delta Y = 0$