

# Econ 302 Intermediate Macro Handout 6

March 10, 2016

## Chapter 10&11 IS-LM model

### The Keynesian Cross

The Keynesian cross compares what we call planned expenditure and actual expenditure. Mathematically, planned expenditure is represented as follows:

$$PE = C * (Y - \bar{T}) + \bar{I} + \bar{G}$$

where barring indicates that the variable is exogenously given (i.e. is a policy variable, etc). Basically, it's what everyone in the economy expects will be supplied and demanded at a given time. Note that  $C$  and  $Y$  are the only two variables that are not barred. Graphically, this translates to the slope of the  $PE$  curve being the  $MPC$ . (Why? As you move right along the curve,  $PE$  increases by some factor of  $Y$ . As shown in the above equation,  $C$  is the only variable that will change due to  $Y$ . Thus the movement along the  $PE$  curve is exactly the same as the increase in  $C$  due to increases in  $Y$ , or the  $MPC$ . Note that this is talking about a movement ALONG the curve, not a movement OF the curve.)

The economy is considered to be in equilibrium when planned expenditure equals actual expenditure. This means when the  $PE$  curve intersects the 45-degree line from the origin (see Figure 1).

Imagine we were not in equilibrium. If we're above  $Y = PE$ , actual expenditure is higher than planned and firms have excess inventory, causing them to scale back production and fire workers, driving down GDP until we are at equilibrium again. If we are below  $Y = PE$ , firms have a shortage of inventory, hire more workers to pick up the slack, and that drives up GDP until equilibrium is reached again.

Changes in  $I$ ,  $G$ , and  $T$  can cause the  $PE$  curve to shift up and down. The size of the shift and the growth in output do not have a one-to-one relationship due to the multiplier effect. Both  $I$  and  $G$  have similar multipliers.

$$\Delta Y = \frac{1}{1 - MPC} \Delta G, \Delta Y = \frac{1}{1 - MPC} \Delta I$$

The multiplier effect exists because an increase in  $I$  or  $G$  results in an increase in  $Y$ , which in turn increases  $C$  (by a function of the  $MPC$ ), which again

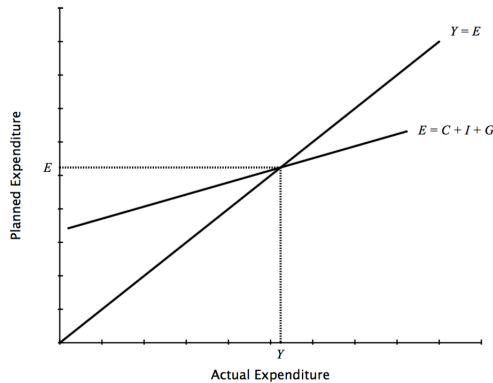


Figure 1:

increases  $Y$ , which again increases  $C$ , and so on until the final effect is given by the above equations.

There is a similar effect for changes in taxes

$$\Delta Y = -\frac{MPC}{1 - MPC} \Delta T$$

where the secondary appearance of the  $MPC$  is because part of any change in taxes will partially affect savings.

To see this graphically, suppose there is an increase in government spending (see Figure 2). The relationship between the upward shift in the  $PE$  curve and the outward movement along the  $Y$  axis will be determined by the size of the multiplier effect. The higher the slope of the  $PE$  curve, the greater the change in  $Y$  for any given increase in  $PE$ . This makes sense, since we just decided that the slope of the  $PE$  curve is the  $MPC$ , and that the higher the  $MPC$ , the higher the effect of an increase in  $PE$ .

## IS curve and LM curve

The Keynesian cross assumes a fixed amount of investment at a given  $Y$ . Is that realistic? Not really. We've talked at length about the fact that as the interest rate changes, the demand for investment changes. We need a way to tie investment back to the interest rate, i.e. to be able to write  $I(r)$  again. That's where the IS curve comes in. The IS curve graphs the relationship between the interest rate and output that is brought about by the interaction between  $I$  and the interest rate.

As is to be expected, there is an inverse relationship between  $r$  and  $Y$ , that is, a decrease in the interest rate means an increase in  $I$ , and thus an increase in  $Y$ . If we were looking at the Keynesian cross, the increase in  $I$  would result

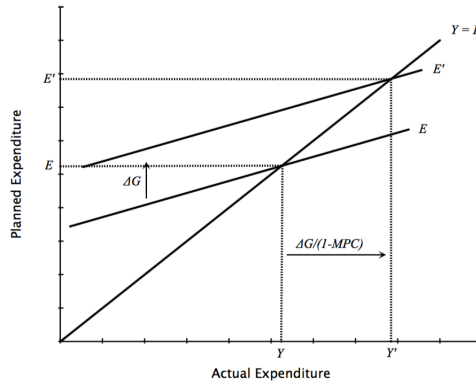


Figure 2:

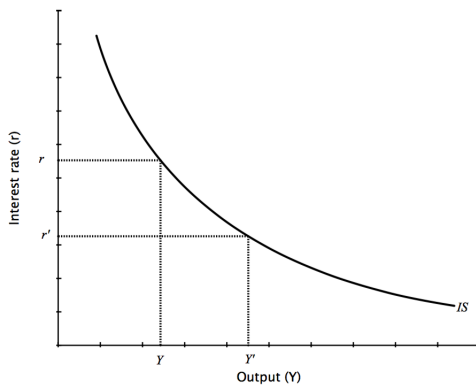


Figure 3:

in an upward shift of the  $PE$  curve, and an increase in  $Y$ , just like we see here (see Figure 3).

So the Keynesian cross and the  $IS$  curve are pretty closely related. Can we assume that things that move the  $PE$  curve move the  $IS$  curve? Yes ...most of the time. If it's a shift in  $PE$  due to a change in the interest rate (and thus a change in  $I$ ), then that is a movement along the  $IS$  curve. However, any other change in  $PE$  is a shift of the  $IS$  curve (e.g. fiscal policy, changes in consumer confidence). So changes in  $G$  and  $T$  will shift the  $IS$  curve inward or outward, just like they shift the Keynesian cross down or up. Changes in the demand for investment at all interest rates will also shift the  $IS$  curve.

The  $LM$  curve is the next piece of this story. It relates the interest rate to the level of income through the level of real money balances in the economy.

Remember the old  $MV = PY$  equation? It's back. The  $LM$  curve is drawn for a given fixed level of real balances ( $\bar{M}/\bar{P}$ ). As output increases, people need

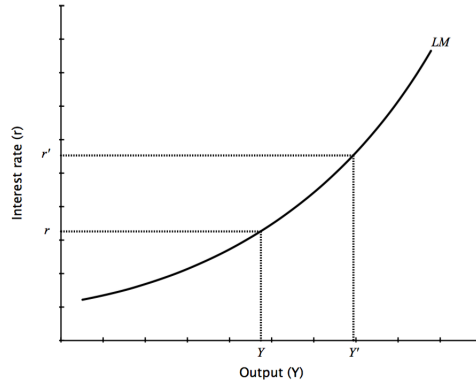


Figure 4:

more money to buy that output, and there is an increase in demand for real money balances. But we just said the level of real money balances was fixed, so an increase in demand with no change in supply must mean the price of real money balances goes up (and the price is  $r$ ). That means an increase in the demand for money will only increase the interest rate ...which is just what the upward sloping LM curve shows (see Figure 4).

What shifts the LM curve? It is drawn for a given level of real money balances, so any change in real money balance will shift the LM curve. What changes real money balances? That would be changes in  $P$  or  $M$ .

## IS-LM model

When the IS-LM curves get together, they tell us the short-run equilibrium level of income and the interest rate for a given level of real money balances and an equilibrium in the goods and services market (see Figure 5). These two curves will ALWAYS be in equilibrium (see Figure 5).

It turns out once these two hang out, our Keynesian cross multiplier stuff gets a little less certain. Before, an increase in  $G$  shifted our IS curve out, resulting in a nice increase  $Y$ , and it still does.

But we now see that if we shift out the IS curve, we also get a new higher interest rate, which lowers  $I$ . So an increase in  $G$  will still bring about an increase in  $Y$ , but it will be partially offset by a decrease in  $I$ . How much of a decrease depends on the slope of the IS curve, i.e. the sensitivity of the investment market to the interest rate. Similar effects will take place with any other variables that shift the IS curve.

Similarly, any shift in the LM curve will result in a change in both the interest rate and income. For example, if the Fed increases the money supply, the LM curve will shift outward, resulting in a higher  $Y$  and a lower  $r$ . Or an increase in prices  $P$  will decrease real money balances, shifting the LM curve

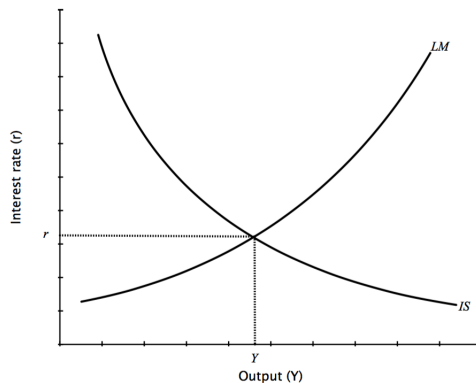


Figure 5:

back, increasing the interest rate and decreasing output (which makes sense ...higher  $r$  means lower  $I$ , which means lower  $Y$ ).

Here's a couple of examples. In the first (Figure 6a), the government decides to buy a whole bunch of new F-14 Tomcats, resulting in a huge increase in  $G$  and an outward shift of the IS curve, which gives us a higher  $Y$  and a higher  $r$ . In the second example (Figure 6b), a negative oil supply shock increases prices in the economy, decreasing real money balances and shifting the LM curve backward, resulting in a lower  $Y$  and a higher  $r$ .

## IS-LM and AD

It turns out these curves have a higher meaning. Every intersection of the IS-LM model tells us a story about the AD curve. Movements in IS-LM due to changes in price are movements along the AD curve. Consider a decrease in prices . . . it means higher real money balances, decreasing the interest rate, which increases  $I$  and thus  $Y$  ...another key as to why the AD curve slopes downward.

A shift in either IS or LM due to anything other than a price change results in a shift in the AD curve. The position of the AD curve is determined by the intersection of the IS-LM curves, and thus is determined by everything that makes up the IS-LM curves . . . government spending, investment, consumption, money supply, you name it. Check out the table below for some examples for what changes in the IS-LM model will do to the AD curve.

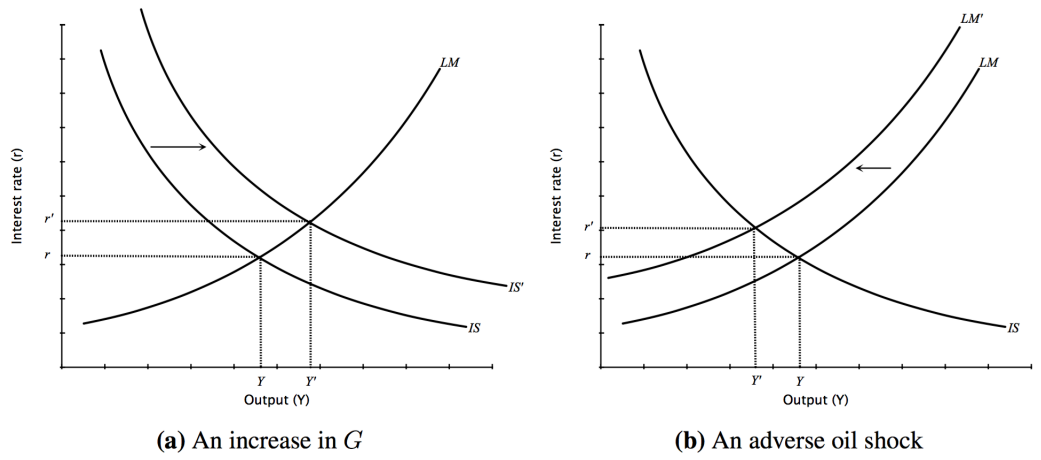


Figure 6:

Policy/Shock	IS Curve	LM Curve	AD Curve
Increase in $M$	Nothing	Shifts outward	Shifts outward
Decrease in $P$	Nothing	Shifts outward	Movement right ALONG the curve
Decrease in $G$	Shifts inward	Nothing	Shifts inward
Increase in $MPC$	Shifts outward	Nothing	Shifts outward
After eliminating all competitors and dominating the economy, Wal-Mart lets loose a mighty roar and crushes society below its all-powerful monopolistic feet by increasing all prices to levels unseen since before the days of K-Mart blue light specials	Nothing	Shifts inward	Movement left ALONG the curve

Figure 7:

## Exercises

1. Use the IS-LM model to predict the short-run effects of each of the following shocks on income. In each case, explain what the Fed should do to keep income at its initial level.
  - (a) After the the invention of a new high speed computer chip, may firms decide to upgrade their computer systems.
  - (b) A wave of credit card fraud increases the frequency by which people make transactions in cash.
  - (c) A best-seller titled Retire Rich convinces the public to increase the percentage of their income devoted to savings.
  - (d) The appointment of a new “dovish” Federal Reserve chairman increases expected inflation.
  
2. Consider an economy
  - (a) The consumption function is given by  $C = 200 + .75(Y - T)$ . The investment function is  $I = 200 - 25r$ . Government purchases and taxes are both 100. For this economy, graph the IS curve.
  - (b) The money demand function is  $Md = Y - 100r$ . The money supply  $M$  is 1,000 and  $P$  the price level is 2. For this economy, graph the LM curve.
  - (c) Find the equilibrium interest rate  $r$  and the equilibrium level of income  $Y$ .
  - (d) Suppose that government purchases are raised from 100 to 150. How does the IS curve shift? What are the new equilibrium interest rate and level of income?
  - (e) Suppose instead that the supply is raised from 1,000 to 1,200. How much does the LM curve shift? What are the new equilibrium interest rate and level of income?
  - (f) With the initial values for monetary and fiscal policy, suppose that the price level rises from 2 to 4. What happens? What are the new equilibrium interest rate and level of income?