$IS - LM$

The Keynesian Cross

Expenditures are $E = C+I+G$. People have a certain amount of **planned expenditure**, denoted PE. It represents how much the economy wants to spend for any level of income Y. Supposing I, G, and T are fixed (to be more accurate, they are *exogenous*), we have

$$PE = MPC(Y - \overline{T}) + \overline{I} + \overline{G}.$$

This means that PE and Y are the endogenous variables, and the rest are exogenous variables. So PE has a slope of MPC, which we will assume is in the interval $(0, 1)$.

Now put E on the y-axis and Y on the x-axis. In equilibrium we must have $E = Y$. If we draw a 45° line from the origin, this will represent all points for which $E = Y$, that is, all possible points where the goods market is in equilibrium — in other words, all possible levels of **actual expenditure**. Recall from midterm 1 that this must also be where $S = I(r)$.

If planned expenditure is less than actual expenditure, then firms have produced too much stuff and will decrease production until actual expenditure meets planned expenditure. And vice versa. So equilibrium output occurs when actual expenditure is equal to planned expenditure, i.e. where $Y = PE$.

Notice that PE will shift up if there is an increase in G, an increase in I, or a decrease in T. Thus, planned expenditure PE would intersect actual expenditure $E = Y$ at a higher Y.

If G increased by some amount, then Y will usually increase by *more* than that amount in the Keynesian cross graph. Specifically, a change in G has a **government purchases multiplier**, a change in I has an **investment multiplier**, and change in T has a **tax multiplier**, respectively given by

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

Example, if G increases by 100 and $MPC = .90$, then the fiscal multiplier is $1/.10 = 10$, so the total change in Y is 100×10.

The IS Curve

Let's un-fix investment. The (planned) **investment function**, denoted $I(r)$, is the relationship between real interest rates and investment. You would expect less investment with a higher interest rate (cost of borrowing), and more investment with a lower interest rate, so $I(r)$ downward sloping.

Suppose r rises. Then we move along $I(r)$ to a lower level of investment I. This means that PE shifts downwards to a lower equilibrium output. The ***IS* curve** shows this (downward sloping) relationship between r and Y. Recall from midterm 1 that $I(r) = S$ is what makes sure expenditure equals output. The IS curve shows the same thing – the level of income and the real interest rate that brings the goods market into equilibrium, that is, all points where $PE = Y = E$.

Recall that $PE = MPC(Y - \overline{T}) + \overline{I} + \overline{G}$. Anything unrelated to r that moves PE up will move the IS curve up. For example, since an increase in G will increase PE, it will also increase the Y where $E = Y$. We haven't done anything to affect r. So for any given level of r, we now have higher Y. So the IS curve shifts up. In summary, we have

- G up means IS shifts right,
- T down means IS shifts right,
- $I(r)$ up means IS shifts right,
- C up means IS shifts right.

Furthermore, the slope of the IS curve is determined by:

- The MPC. A lower MPC gives a steeper IS; a higher MPC gives a flatter IS.
- The slope of $I(r)$. A flatter $I(r)$ gives a flatter IS; a steeper $I(r)$ gives a steeper IS.

The LM Curve

Consider the money market. Suppose there is a fixed supply of real money balances, $\overline{M}/\overline{P}$. The theory of liquidity preference states that the interest rate is one determinant of how much money people choose to hold. Let $L(r, \overline{Y})$ be the demand for real money balances. (Since we are assuming P is fixed – this is still the short run – it follows that there is no inflation and therefore $r = i$. So this is the same as $f(i, Y)$ from midterm 1.) Have r be the endogenous variable, so r on the y-axis and M/P on the x-axis. People demand to hold more money when r is low, so $L(r, Y)$ is downward sloping; supply $\overline{M}/\overline{P}$ is vertical.

We know that the supply and demand for real money balances must be equal in equilibrium, so this is where $L(r, Y)$ and $\overline{M}/\overline{P}$ intersect. If the central bank reduces M, then $\overline{M}/\overline{P}$ will shift to the left. Then we will be at a higher real interest rate r. Since Y is exogenous, an increase in Y will shift $L(r, Y)$ up and the intersection will occur at a higher r.

The ***LM* curve** shows this (upward sloping) relationship among Y and r which represents all possible money market equilibria. When we decreased M, we had a higher r with the same Y. So a decrease in M shifts LM up (and vice versa).

- M up means LM shifts right,
- V up means LM shifts right,
- P down means LM shifts right,
- $L(r, Y)$ down (exogenously) means LM shifts right.

The $IS - LM$ Graph

We have two graphs that relate Y to r, one representing the goods market (IS) and the other representing the money market (LM). The equilibrium in the economy is where IS and LM intersect. This gives the real interest rate r^* that brings equilibrium to both the goods and the money markets, and resulting Y^*. In other words, r^* is both where expenditure equals output and where money demand equals money supply.

Note that shifting IS to the right will increase the real interest rate, whereas shifting LM to the right will lower the real interest rate. If the government wants to maintain a steady real interest rate, then they will have to engage in a combination of fiscal policy (to move IS) and monetary policy (to move LM).

Also note that since increasing G will increase r, it thus will also lower I, so the full value of the government purchases multiplier will not take place in the $IS - LM$ model – crowding out!

(7.10, 7.11, 7.12, 7.13, 7.14)

The Mundell-Fleming Model

This is pretty much $IS - LM$ for a small open economy with perfect capital mobility. Thus, we have a price taking economy for the world real interest rate r^w.

The IS^* and LM^* Curves

The goods market is represented with the IS^* equation

$$Y = MPC(Y - \overline{T}) + I(r^w) + \overline{G} + NX(e_r).$$

In other words, PE now contains the NX term and $I(r^w)$.

Since r^w cannot change in the SOE, any adjustments must be made through $NX(e_r)$ instead. So the IS^* curve shows the relationship between e_r and Y. Suppose e_r rises. Then we move along the $NX(e_r)$ curve to a lower NX. This makes PE fall, so we have a lower Y. Thus, e_r and Y are inversely related so that IS^* slopes downward. The IS^* could shift with

- If G increases, then IS^* shifts to the right.
- If T decreases, then IS^* shifts to the right.
- If C increases, then IS^* shifts to the right.
- If $I(r^w)$ increases, then IS^* shifts to the right.
- If $NX(e_r)$ increases (exogenously), IS^* shifts right.

Since we are stuck with r^w, the money demand function is now $L(r^w, Y)$. So the LM^* equation is

$$\frac{M}{P} = L(r^w, Y).$$

Notice that this equation *has nothing to do with* e_r. So no matter what e_r is, the normal LM curve will be at equilibrium at r^w and thus at some corresponding Y^*. Therefore LM^* is a vertical line at Y^* for any e_r.

- If M goes up, then we need Y to go up to increase $L(r^w, Y)$, so LM^* would shift to the right.
- If P goes up, then we need Y to go down to decrease $L(r^w, Y)$, so LM^* would shift to the left.
- If r^w goes up, then we need Y to go up so that $L(r^w, Y)$ doesn't change overall, so LM^* would shift to the right.

The equilibrium e_r is the one where LM^* and IS^* intersect, i.e. where the goods market and money market are in equilibrium.

Floating Exchange Rates

Most economies use a system of **floating exchange rates**, which is a fancy way of saying that market forces determine exchange rates. Exchange rates will adjust as necessary to achieve simultaneous equilibrium in the goods market and the money market. In this case, things work as you might. IS^* and LM^* shift under certain circumstances, and consequently there will be a new equilibrium at the new intersection.

But there are subtleties. Increasing G and reducing T will still shift IS^* to the right, but LM^* is unchanged, *so there is no increase in* Y – just a higher e_r. Changing M, however, shifts LM^* to the right and thus increases Y with decreasing e_r.

Fixed Exchange Rates

Under **fixed exchange rates**, the central bank announces a value of the exchange rate and does what it must in order to keep the exchange rate at this value. This is usually achieved by buying and selling domestic currency for foreign currencies. This means that the central bank's monetary policy is dedicated to keeping the exchange rate steady – in other words, the *exchange rate determines the money supply*. The LM^* curve shifts until it intersects IS^* at the desired fixed exchange rate.

Suppose the fixed exchange rate is 100 JPY per 1 USD. The current equilibrium however is 150 JPY per 1 USD. Then there is a profit opportunity, aka opportunity for **arbitrage**. Someone could buy 300 JPY for 2 USD and sell it back to the central bank for 3 USD. They would make a profit of 1 USD, and now the supply of USD is higher by 1 USD. This is done enough times and the rise in M will shift LM^* to the right, bringing the equilibrium rate to 100 JPY per 1 USD.

The same logic works in reverse if the current equilibrium is, say, 50 JPY per 1 USD. Traders sell 100 JPY on the market for 2 USD, then buy 100 JPY from the central bank for only 1 USD, giving them a profit of 1 USD. M is smaller because the central bank holds that dollar instead of it being in circulation.

So *monetary policy will have no effect on* Y *under a fixed exchange rate regime* because arbitrage will move the LM^* curve back to its original position. But *fiscal expansion works* – it will shift IS^* to the right; then the central bank will increase M to maintain equilibrium at e_r^* because it shifts LM^* to the right. Now equilibrium Y has successfully increased.

(8.1, 8.2, 8.4, 8.5, 8.6, 8.7, 8.8)

Upward Sloping SRAS and Policy

People have an **expected price level**, EP. If the actual price level P is higher than EP, then the output exceeds its natural level. On the other hand, if the price level is lower than the expected price level, then output falls short of its natural level. We can summarize this in the equation

$$Y = \overline{Y} + \alpha(P - EP).$$

In this case, the slope of SRAS is determined by $\alpha > 0$, and thus SRAS is upward sloping. Exogenous EP determines the position of SRAS. If $P = EP$, then $Y = \overline{Y}$.

One of the implications of this SRAS is that an increase in M might increase EP, thus moving SRAS to the left and undoing some or all of the stimulative effects of the increase in M. This is one reason why fiscal policy might be preferred to monetary policy. Some would also argue that monetary policy is ineffective if people aren't willing to borrow money even at the lowest possible interest rate, i.e. zero. This is called a *liquidity trap*.

If EP is growing out of control, then SRAS will continually shift to the left as EP continually increases in a vicious cycle. We get very low Y and very high P. The central bank can try to fight growing EP by announcing that it will limit the future growth of M, bringing down expected EP, making SRAS manageable. They might have to actually bring down M as well, which would reduce AD and generate a temporary recession.

Inside lag is the time it takes to see a problem and then implement a strategy to deal with it. **Outside lag** is the time it takes for the strategy to have its effect. Fiscal policy can have considerable inside lag because it might take politicians a long time to realize what needs to be done and to actually do it. There is outside lag as well because it usually takes long for fiscal stimulus to work its way through the economy.

Be comfortable with every problem in homework 9.