DSE601: MACROECONOMICS
B.Com. Hons. Semester-VI
Unit 6: IS-LM Framework

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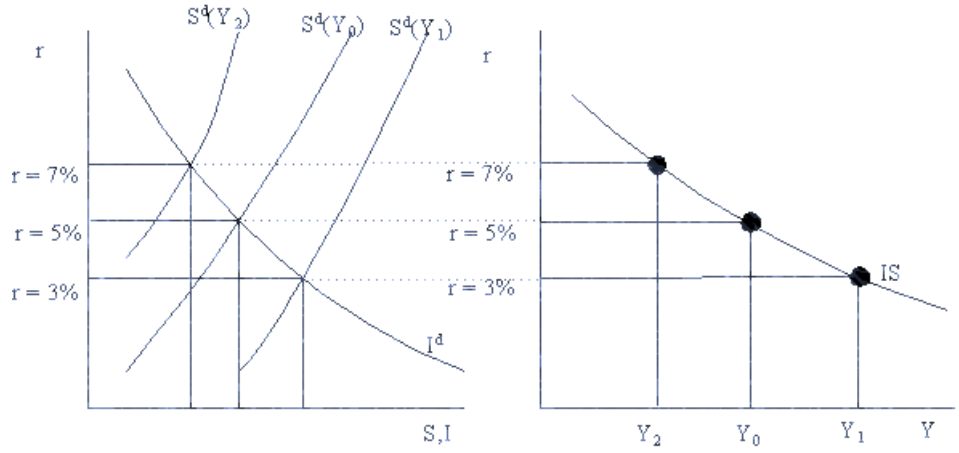
Derivation of the IS curve

The IS curve is a locus of points showing alternative combinations of interest rates and income (output) at which the goods market clears. That is why the IS curve is called the goods market equilibrium schedule.

The IS curve represents all combinations of income (Y) and the real interest rate (r) such that the market for goods and services is in equilibrium. That is, every point on the IS curve is an income/real interest rate pair (Y,r) such that the demand for goods is equal to the supply of goods (where it is implicitly assumed that whatever is demanded is supplied) or, equivalently, desired national saving is equal to desired investment. The graphical derivation of the IS curve is given below.



Consider an initial equilibrium in the goods market where r = 5% and income is equal to Y_0. This equilibrium is illustrated in the graph on the right with r on the vertical axis and Y on the horizontal axis as the big black dot (middle dot). Now suppose Y increases to Y_1 (say supply increases). This increase in Y shifts the desired savings curve down and right lowering the equilibrium real interest rate to 3%. The new equilibrium in the goods market with higher income and a lower real interest rate is illustrated in the graph on the right as the big blue dot (bottom dot). Similarly, if Y decreases from Y_0 to Y_2 then the savings curve shifts up and left and the equilibrium real interest rises. The new equilibrium in the goods market with lower income and a higher real interest rate is illustrated in the graph on the right as the big red dot (top dot). Notice that as income increases (decreases) the real interest must fall (rise) in order to maintain equilibrium in the goods market. This is the relationship that is represented in the downward sloping IS curve.

Every point on the IS curve represents an intersection between desired national saving and desired investment for some income/interest rate pair (Y,r). As such the IS curve is derived holding the determinants of saving and investment, other than Y and r, fixed. When these

factors change the IS curve will shift. Since points on the IS curve represent points where aggregate demand is equal to aggregate supply any factor that increases the demand for goods and services will shift the IS curve up and to the right and any factor that decreases the demand for goods and services will shift the IS curve down and to the left. From the savings/investment diagram it follows that any shift of the savings or investment curve that increases the real interest rate, holding Y fixed, will shift up the IS curve. Functionally, the IS curve is represented as

$$IS(FY^{e}, WL, G, FMPK^{e})$$

(+) (+) (+) (+)

Pluses (+) above the exogenous variables indicate that increases in the variables shift the IS curve up and to the right (increases demand).

Major Properties of IS Curve:

The major Properties about the IS curve are the following:

1. The IS curve is the schedule of combinations of the interest rate and the level of income such that the goods market is in equilibrium.

2 The IS curve is negatively sloped because an increase in the interest rate reduces planned (desired) investment spending and therefore reduces aggregate demand, thereby lowering the equilibrium level of income.

3. The smaller the investment multiplier and the less sensitive investment spending is to interest rate changes, the steeper is the IS curve.

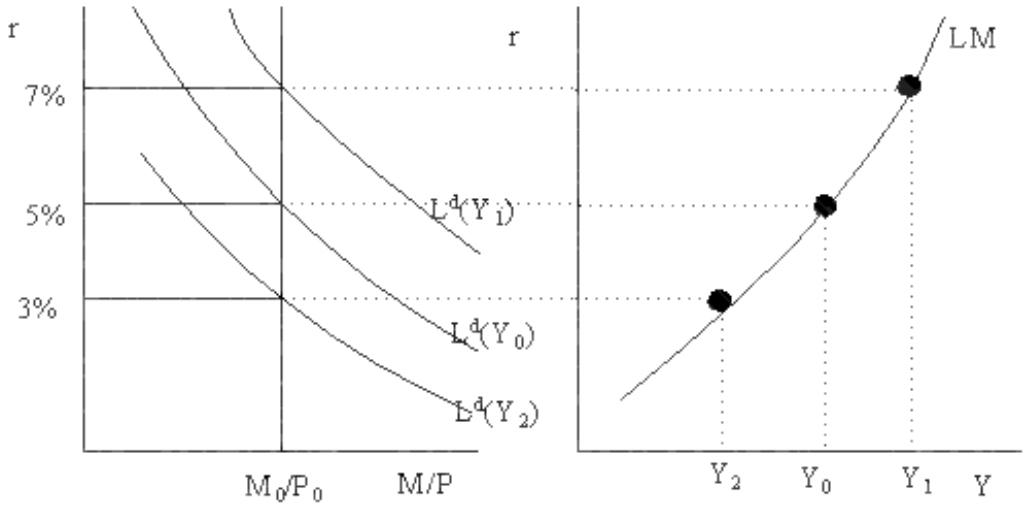
4. The IS curve is shifted by changes in autonomous spending. An increase in autonomous spending, such as investment spending or government expenditure shifts the IS curve to the right.

5. At points to the right of the IS curve, there is excess supply in the goods market, at points to the left of the curve, there is excess demand for goods.

Derivation of the LM curve

The LM curve is a locus of points showing alternative combinations of the rate of interest and the level of income that bring about equilibrium in the money market. In other words, the LM schedule, or the money market equilibrium schedule, shows all combinations of interest rates and levels of income such that the demand for money is equal to its supply.

The LM curve, "L" denotes Liquidity and "M" denotes money, is a graph of combinations of real income, Y, and the real interest rate, r, such that the money market is in equilibrium (i.e. real money supply = real money demand). The graphical derivation of the LM curve is illustrated below.



The left-hand side of the graph illustrates money market equilibrium for a given level of Y. For example, when $Y = Y_0$ the equilibrium real interest rate is 5%. The right-hand-side of the graph gives the LM curve. The LM curve is plotted with the real interest rate on the vertical axis and real income (GDP) on the horizontal axis. Each point on the LM curve represents a money market equilibrium for a particular real interest rate and income pair (r, Y). For example, the money market equilibrium at (r=5%, $Y=Y_0$) is given by the black (middle) dot on the LM curve.

At a higher level of income, $Y_1 > Y_0$, the money demand curve shifts up and right and a new equilibrium occurs at r = 7%. This equilibrium is represented by the blue (upper) dot on the LM curve. Similarly, at a lower level of income $Y_2 < Y_0$ the money demand curve shifts down and left and a new equilibrium occurs at r = 3%. This equilibrium is given the by the red (lower) dot on the LM curve.

The above analysis shows that the LM curve is an upward sloping curve in the graph with r on the vertical axis and Y on the horizontal axis. Every point on the LM curve represents an intersection between the real money supply (M/P) and real money demand (L^d). The LM curve will shift whenever the variables we hold fixed, other than Y, in the money-supply/money-demand diagram change. These variable are M/P and ^{e}. In particular, if M/P increases holding expected inflation fixed then r falls in the money market and so the LM curve shifts down and right. Similarly, if expected inflation increases real money demand falls, lowering the interest rate, and the LM curve shifts down and to the right. Functionally, we represent the LM curve as

$$LM\left(\frac{M_0}{P_0}^{(+)},\ \pi^{e}\right)^{(+)}$$

The (+) sign indicates that an increase in the variables shifts the LM curve down and to the right

Major Properties of LM Curve:

The following are the properties about the LM curve:

1. The LM curve is the schedule of combinations of interest rates and levels of income such that the money market is in equilibrium.

2. When the money market is in equilibrium, so is the bond market. The LM curve therefore is also the schedule of combinations of interest rates and levels of income such that the bond market is in equilibrium.
3. The LM curve is positively sloped. Given the fixed money supply an increase in the level of income which increases the quantity of money demanded, has to be accompanied by an increase in the interest rate. This reduces the quantity of money market equilibrium.

Discuss joint determination of national income and rate of interest in open economy through IS and LM curves

IS – LM curve model involves the determination of national income and rate of interest through joint equilibrium of goods market and money market.

Since in an open economy a part of increase in income is spent on imports rather than on domestically produced goods, IS curve of an open economy is steeper than that of a closed economy. This means that for a given reduction in interest rate, a smaller increase in output and income is required to restore equilibrium in the goods market.

Besides, IS curve of the open economy also includes net exports (NX) as a component of aggregate demand for goods. The real exchange rate of the national currency, which determines the prices of exports and imports and thereby determine net exports also affects the open economy IS curve.

For example, depreciation of real exchange rate of the national currency which raise exports and lowers imports results in increase in net exports and will therefore cause an outward shift in the IS curve to the right. Similarly, increase in foreign income which will raise foreign spending on our goods will lead to the increase in net exports, which is a component of aggregate demand, will also cause a shift in the IS curve to the right.

LM curve which represents money market equilibrium at various rates of interest and level of income is represented by the following equation:

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

where M/P stands for supply of real money balances, and L(r, Y) for demand for money which is determined by rate of interest (r) and level of income (Y).

The intersection of open-economy IS and LM curves determine jointly the income and rate of interest in the open economy. This is shown in Figure 25.1. It will be seen that open economy IS and LM curves interest at joint E and determine Y_0 equilibrium level of income and r equilibrium rate of interest.

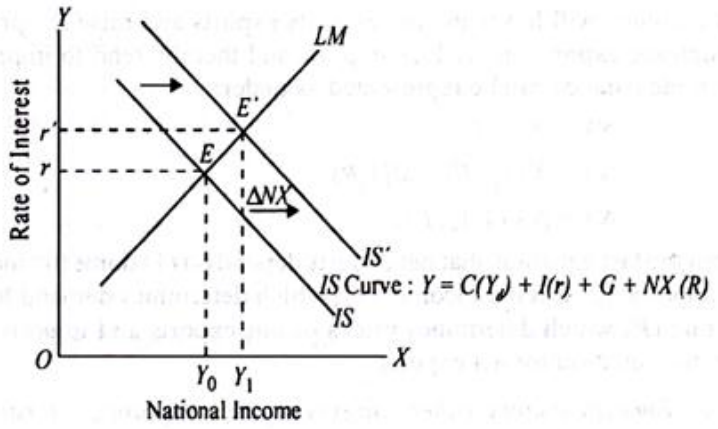


Fig. 25.1. *Determination of Income in the Open Economy through IS and LM Curves*

Impact of Increase in Net Exports (NX):

Since equilibrium level of income in the open economy depends on foreign income (Y_f) and real exchange rate (R), changes in foreign income or real exchange rate will affect equilibrium level of income. For example, if foreign income increases, it will raise the foreign spending on domestic goods or, in other words, it will increase our net exports.

The increase in net exports (NX) will cause a shift of IS curve to the right. This is shown in Figure 25.1 where as a result of increase in foreign income, say of the United States, which is our important trade partner. IS curve shifts from IS to IS' With this it will be seen that

equilibrium level of income has risen to Y_1 and rate of interest to r'. It should be noted that increase in income also implies increase in output and employment.

On the other hand, if there is recession in foreign economies, as was the case of American economy during 2001-03, it will reduce their imports and thereby reduce foreign demand for our exports. This will cause a leftward shift in the IS curve. As a result, our level of income and output will fall. Besides, rate of interest will also decline.

Effect of Depreciation in Exchange Rate:

Let us now see how depreciation in real exchange rate of the national currency, say Indian rupee, affects our national income. This can also be explained with the help of Figure 25.1. Depreciation in exchange rate encourages exports and discourages imports and thereby leads increase in net exports. Since net exports increases at each level of income, IS curve shifts to the right, say to IS' in Figure 25.1. Thus, as a result of depreciation in real exchange rate, equilibrium level of income will increase.

Conclusion:

In the Table 25.1 given below, we summaries the effects of changes in domestic spending, foreign income and depreciation in real exchange rate on domestic income and net exports. It may be noted that + sign indicates increase and – sign indicates decrease.

It will be seen from this table that increase in domestic spending leads to increase in domestic income and to decrease in net exports. Increase in domestic spending leads to greater aggregate demand for goods and services and have therefore favourable effect on the level of domestic income.

Since a part of increase in domestic spending is made on imports of goods from abroad, it increases imports and, given the exports, will cause a decrease in net exports of the economy.

Table 25.1. Effects of changes in domestic spending, foreign income and real depreciation on domestic income and net exports

	Increase in Domestic Spending	Increase in Foreign Income	Depreciation in real Exchange Rate
Domestic Income	+	+	+
Net Exports	–	+	+

Increase in foreign income causes an increase in foreign demand for our goods (i.e. exports) which are a component of aggregate demand and has therefore a favourbale effect on the level of domestic income. Likewise, as increase in foreign income leads to more exports and, given the imports, will cause an increase in net exports.

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