

IS AND LM FUNCTION:GENERAL EQUILIBRIUM OF PRODUCT AND MONEY MARKET

Introduction

Hicks-Hansen diagrammatic framework, known as the IS-LM model. The term IS is the shorthand expression of the equality of investment and saving which represents the product market equilibrium. On the other hand, the term LM is the shorthand expression of the equality of money demand (L) and money supply (M) and represents the money market equilibrium.

In order to analyse the general equilibrium of product and money markets, it is instructive to study the derivation of the IS and LM functions and their slopes for the understanding of the effectiveness of monetary and fiscal policies.

Product Market Equilibrium:

The product market is in equilibrium when desired saving and investment are equal. Saving is a direct function of the level of income,

$$S = f(Y) \quad \dots(1)$$

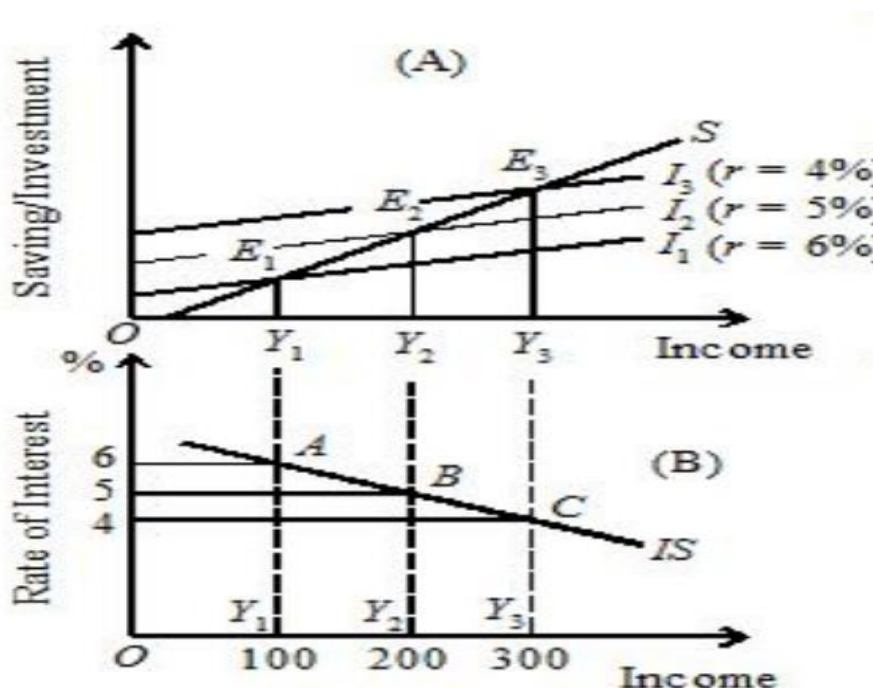
Investment is a decreasing function of the interest rate,

$$I = f(r) \quad \dots(2)$$

From (1) and (2), we have $S=I$.

The IS schedule reflects the equilibrium of the product market. It shows the combinations of interest rate and income levels where saving-investment equality takes place so that the product market of the economy is in equilibrium. It is also known as the "real sector" equilibrium.

Deriving the IS curve:



The derivation of the IS curve is shown in Figure . In Panel (A) of this figure, the saving curve S in relation to income is drawn in a fixed position on the Keynesian assumption that the rate of interest has little effect on saving. The saving curve shows that saving increases as income increases, viz., saving is an increasing function of income. Investment, on the other hand, depends on the rate of interest and the level of income. Given a level of interest rate, the level of investment rises with the level of income. At a 5 per cent rate of interest, the investment curve is I_2 . If the rate of interest is reduced to 4 per cent, the investment curve will shift upward to I_3 . The rate of investment will have to be raised to reduce the marginal efficiency of capital to equality with the lower rate of interest. Thus the investment curve I_3 shows more investment at every level of income. Similarly when the rate of interest is raised to 6 per cent, the investment curve will shift downward to I_1 . The reduction in the rate of investment is essential to raise the marginal efficiency of capital to equal the higher interest rate. In Panel (B) we derive the IS curve by marking the level of income at various interest rates. Each point on this IS curve represents a level of income at which saving equals investment at various interest rates. The rate of interest is represented on the vertical axis and the level of income on the horizontal axis. If the rate of interest is 6 per cent, the S curve intersects the I_1 curve at E_1 in Panel (A) which determines OY_1 income. From this income level which equals Rs 100 crores we draw a dashed line downward to intersect the extended line from 6 per cent at point A in Panel (B). At interest rate 5 per cent, the S curve intersects the I_2 curve at E_2 so as to determine OY_2 income (Rs 200 crores). In the lower figure, the point B corresponds to 5 per cent interest rate and Rs 200 crores income level. Similarly, the point C corresponds to the equilibrium of S and I_3 at 4 per cent interest rate. By connecting

these points A, B and C with a line, we get the IS curve. The IS curve in Figure 1(B) slopes downward from left to right because as the interest rate falls, investment increases and so do income and saving. In other words, there is a negative relationship between income and interest rate in the real sector of the economy.

The Slope of the IS Curve:

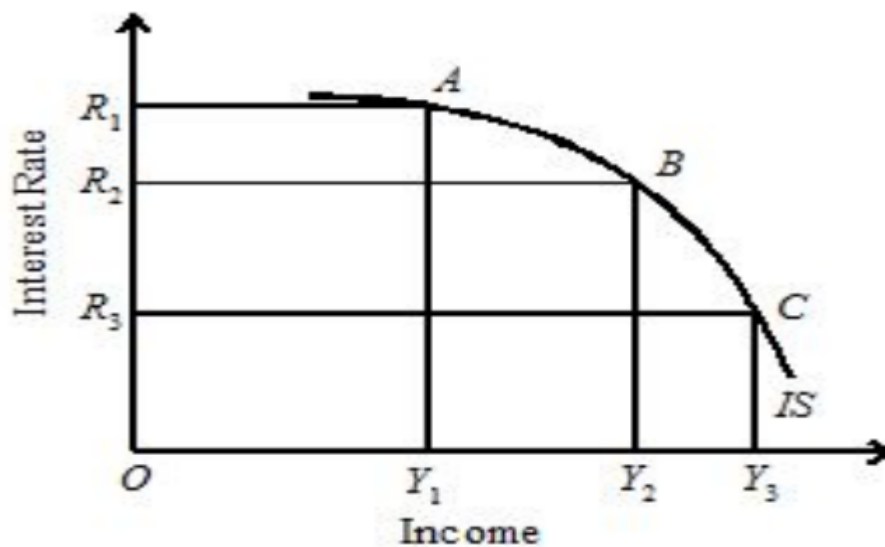


Fig. 2

This negative slope of the IS curve reflects the increase in investment and income as the rate of interest falls. The slope of the IS curve depends on two factors: first, the sensitiveness (elasticity) of investment and saving to changes in the interest rate, and second, on the size of the multiplier. If investment is very sensitive to the rate of interest, the IS curve is very flat. This is shown by the segment AB of the IS curve in Figure 2 where a small fall in the rate of interest from R_1 to R_2 leads to a large increase in investment and consequently in saving via proportionately large rise in income from Y_1 to Y_2 . The IS curve is interest elastic in the AB segment of the IS curve.

On the other hand, if investment is not very sensitive to the rate of interest, the IS curve is relatively steep. In terms of Figure 2, when the rate of interest falls more from R_2 to R_3 , the increase in investment is small and so do saving and income increase by a relatively smaller amount Y_2Y_3 . The BC segment of the IS curve is less interest elastic. Any further fall in the rate of interest from R_3 will lead to no change in income because the IS curve is vertical in that range. It is interest inelastic.

The shape of the IS curve also depends upon the size of the multiplier. If the size of the multiplier is large, the larger is the effect on income of a rise in investment and fall in saving. Thus income is more sensitive to changes in the interest rate and the IS curve is flatter.

Shifts in the IS curve:

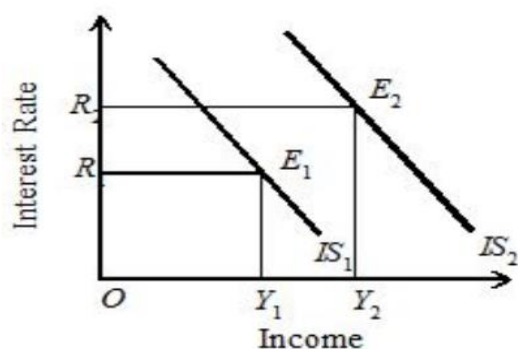


Fig. 3

The IS function shifts to the right with a reduction in saving. Reduction in saving may be the result of one or more factors leading to increase in consumption. Consumers may like to buy a new product even by reducing saving. The community's wealth may increase due to government's policy and the wealth holders do not like to save the same amount than before. Consumers may start buying more in anticipation of shortages or price rise thereby reducing saving.

The IS function also shifts to the right by an autonomous increase in investment. The increase in investment may result from expectations of higher profits in the future, or from innovation, or from expectations concerning increase in the future demand for the product, or from a rise of optimism in general. Moreover, government's expenditure and tax policies have the effect of shifting the IS function.

In all these cases, the IS function will shift to the right, equal to the decrease in the supply of saving times the multiplier or the increase in the investment times the multiplier. With the increase in the autonomous investment (or reduction in saving), the IS curve shifts from IS_1 to IS_2 and the new equilibrium is established at point E_2 which indicates a higher level of income Y_2 at a higher interest rate R_2 , as shown in Figure 3.

In the opposite case when investment falls or saving increases, the IS function will shift to the left and the equilibrium will be established at a lower level of income and interest rate. This situation can be explained by assuming IS_2 , as the original curve.

The Money Market Equilibrium:

The money market is in equilibrium when the demand and supply of money are equal. Denoting L for money demand and M for money supply, the money market is in equilibrium when $L=M$. The demand for money $L=LT+LS$ where LT is the transactions demand for money which is a direct function of the level of income, $LT=f(Y)$. L_s is the speculative demand for money which is a decreasing function of the rate of interest, $LS=f(r)$. Thus in money market equilibrium, $M=LT(Y)+LS(r)$.

Deriving the LM Curve:

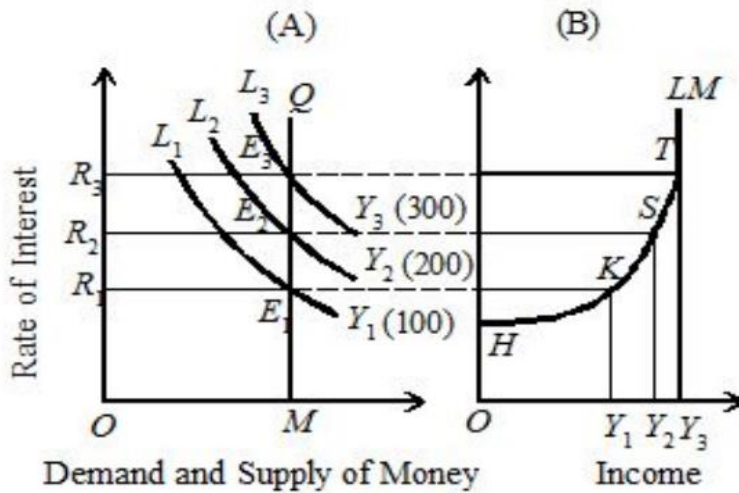


Fig. 4

The LM curve shows all combinations of interest rate and levels of income at which the demand for and supply of money are equal. In other words, the LM schedule shows the combinations of interest rates and levels of income where the demand for money (L) and the supply of money (M) are equal such that the money market is in equilibrium.

The LM curve is derived from the Keynesian formulation of liquidity preference schedules and the schedule of supply of money. A family of liquidity preference curves L_1Y_1 , L_2Y_2 and L_3Y_3 is drawn at income levels of Rs 100 crores, Rs 200 crores and Rs 300 crores respectively in Figure 4 (A). These curves together with the perfectly inelastic money supply curve MQ give us the LM curve. The LM curve consists of a series of points, each point representing an interest-income level at which the demand for money (L) equals the supply of money (M). If the income level is Y_1 (Rs 100 crores), the demand for money (L_1Y_1) equals the money supply (QM) at interest rate R_1 . At the Y_2 (Rs 200 crores) income level, the L_2Y_2 and the QM curves equal at R_2 interest rate. Similarly at the Y_3 (Rs 300 crores) income level, the L_3Y_3 and QM curves at R_3 interest rate. The supply of money, the liquidity preference, the level of income and the rate of interest provide data for the LM curve shown in Figure 4(B).

Suppose the level of income is Y_1 as marked out on the income axis in Figure 4(B). The income of Rs 100 crores generates a demand for money represented by the liquidity preference curve L_1Y_1 . From the point E_1 where the L_1Y_1 curve intersects the MQ curve, extend a dashed line horizontally to the right so as to meet the line drawn upward from Y_1 and K in Figure 4(B). Points S and T can also be determined in similar manner. By connecting these points K , S and T , we get the LM curve. This curve relates different income levels to various interest rates.

The Slope of the LM Curve

The LM curve slopes upward from left to right because given the supply of money, an increase in the level of income increases the demand for money which leads to higher rate of interest. This, in turn, reduces the demand for money and thus keeps the demand for money equal to the supply of money. The smaller the responsiveness of the demand for money to income, and the larger the responsiveness of the demand for money to the rate of interest, the flatter will be the LM curve. This means that a given change in income has a smaller effect on the interest rate.

The LM curve is steeper, if a given change in income has a larger effect on the rate of interest. In this situation, the responsiveness of the demand for money to income is larger and is smaller for the interest rate. If the demand for money is insensitive to the interest rate, the LM curve is vertical that is, it is perfectly inelastic. This is shown in Panel (B) of Figure 4 as the portion from T above on the LM curve. In this case, a large change in the interest rate is accompanied by almost no change in the level of income to maintain money market equilibrium. If the demand for money is very sensitive to the rate of interest, the LM curve is horizontal. This is shown by the portion of LM curve which starts from H on the vertical axis in Panel (B) of Figure 4. The LM curve is perfectly elastic in relation to the rate of interest. In other words, a small change in the interest rate is accompanied by a large change in the level of income to maintain the money market equilibrium. This portion of the LM curve at the extreme left is equivalent to the Keynesian liquidity trap, already explained in the Keynes's theory of interest.

Shifts in the LM Curve:

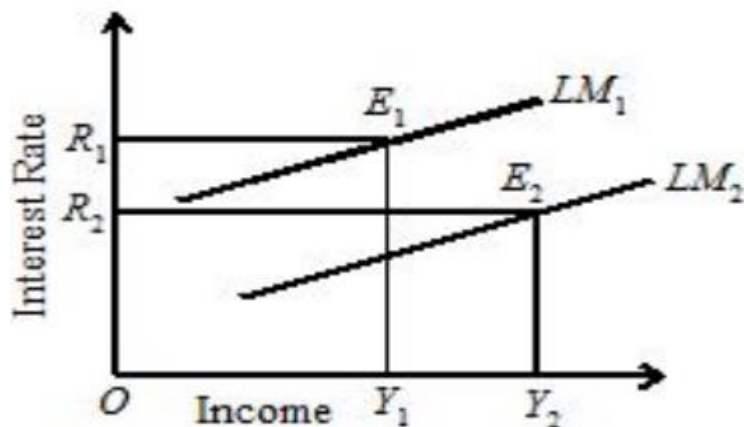


Fig. 5

The LM function shifts to the right with the increase in the money supply, given the demand for money, or due to the decrease in the demand for money, given the supply of money. If the central bank follows an expansionary monetary policy, it will buy securities in the open market. As a result, the money supply with the public increases for both transactions and speculative purposes. This shifts the LM curve to the right.

A decrease in the demand for money means a reduction in the quantity of balances demanded at each level of income and interest rate. Such a decrease in the demand for money balances creates an excess of the money supplied over the money demanded. This is

equivalent to an increase in money supply in the economy which has the effect of shifting the LM curve to the right.

This is depicted in Figure 5. With the increase in the money supply, the LM1 curve shifts to the right as LM2 which moves the economy to a new equilibrium point E2 . The increase in the money supply brings down the interest rate to R2 in the money market. This, in turn, increases investment thereby raising the level of income to Y2 . Contrariwise, a decrease in the money supply, or an increase in the demand for money will shift the LM function to the left such that a new equilibrium is established at a higher interest rate and lower income level. This case can be explained by assuming LM2 as the original curve.

General Equilibrium of Product And Money Market:

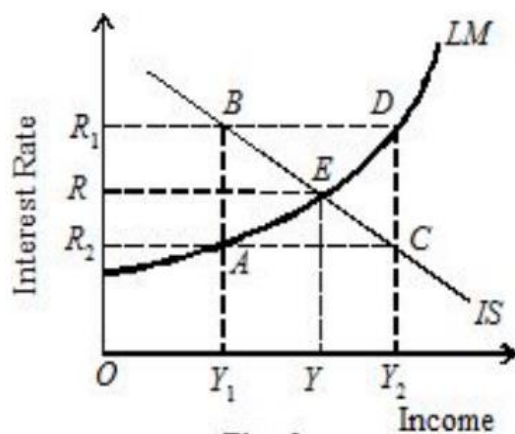


Fig. 6

So far we have analysed the conditions that have to be satisfied for the general equilibrium of the product and money markets in terms of the IS and LM functions. Now we study how these markets are brought into simultaneous equilibrium. It is only when the equilibrium pairs of interest rate and income of the IS curve equal the equilibrium pairs of interest rate and income of the LM curve that the general equilibrium is established. In other words, when there is a single pair of interest rate and income level in the product and money markets that the two markets are in equilibrium. Such an equilibrium position is shown in Figure 6 where the IS and LM curves intersect each other at point E relating Y level of income to R interest rate. This pair of income level and interest rate leads to simultaneous equilibrium in the real or goods (saving-investment) market and the money (demand and supply of money) market. This general equilibrium position persists at a point of time, given the price level. If there is any deviation from this equilibrium position, certain forces will act and react in such a manner that the equilibrium will be restored .

Consider point A on the LM curve where the money market is in equilibrium at Y1 income level and R2 interest rate. But the product market is not in equilibrium. In the product market, the interest rate R2 is lower. The product market can be in equilibrium at Y1 income level only at a higher interest rate R1 corresponding to point B on the IS curve. Consequently at point A, there is excess of investment over saving since point A lies to the

left of the IS curve. The excess of I over S indicates excess demand for goods which raises the level of income. As the level of income rises, the need for transactions purposes increases. In order to have more money for transactions purposes, people sell bonds. This tends to raise the interest rate. This moves the LM curve from point A upward to point E where a combination of higher interest rate R and higher income level Y exists. On the other hand, rising interest rate reduces investment and an increasing income raises saving. This helps to bring about the equality of I and S at point E where the general equilibrium is re-established by the equality of IS and LM.

Now consider point C on the IS curve in Figure 6 where the product market is in equilibrium at R2 interest rate and Y2 income level. The money market is not in equilibrium. It can be in equilibrium at Y2 income level only at a higher interest rate R1 corresponding to point D on the LM curve. At point C, the demand for money (L) is greater than the supply of money (M) because point C reflects lower rate of interest R2 than is required for the equality of L and M. Thus there is excess demand for money at R2 interest rate. The excess demand for money leads people to sell bonds but there is less demand for bonds which tends to raise the interest rate. When the rate of interest begins to rise, the product market is thrown into disequilibrium because investment falls. Falling.

investment leads to falling income which in turn reduces saving. This process ultimately brings the equilibrium of the product market when $I=S$ at point E. On the other hand, falling income reduces the transactions demand for money and ultimately brings about the equality of LM at point E where the equilibrium is re-established by the equality IS and LM curves, at R interest rate and Y income level.

Change in General Equilibrium:

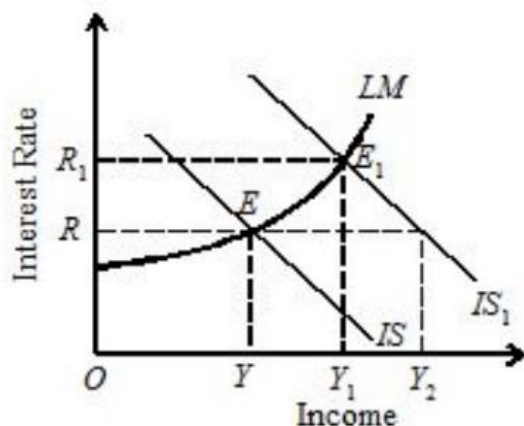


Fig. 7

The general equilibrium of the product and money markets discussed above is based on the static equilibrium analysis. It started from a point of disequilibrium and again reached the equilibrium point of the equality of IS and LM functions. But the general equilibrium combination of Y income level and R rate of interest may change either due to a shift in the IS function or the LM function, or by both the functions shifting simultaneously. The IS function may shift due to changes in the saving function or the investment function. The shifts in the LM function may be caused by changes in the money supply or liquidity preference.

The shifting of the IS curve to the right and the consequent equilibrium with the given LM curve is illustrated in Figure 7. With the increase in the autonomous investment (or reduction in saving), the IS curve moves from IS to IS_1 and the new equilibrium is established at point E_1 which indicates a higher level of income Y_1 at a higher interest rate R_1 . If the interest rate had not increased but remained at R level, the increase in investment would have raised income from Y to Y_2 level. But this much increase in income would not take place. This is because with the increase in income, the demand for money for transactions purposes will raise the interest rate to R_1 level where the IS and LM functions intersect at point E_1 . Thus the expansionary effect of increase in investment is dampened by the rise in the interest rate and the income rises by less than the full multiplier. In the opposite case when investment falls or saving increases, the IS function will shift to the left and the equilibrium will be established at a lower level of income and interest rate. This situation has not been depicted in Figure 7. With the increase in the money supply, the LM curve shifts to the right as LM_1 which moves the economy to a new equilibrium point E_1 where the IS curve intersects the LM curve in Figure 8. The increase in the money supply brings down the interest rate R_1 in the money market. This, in turn, increases investment thereby raising the level of income to Y_1 . Thus the effect of the increase in money supply is to shift the LM function to the right and a new equilibrium is established at a lower interest rate and higher income level.

But how much income will rise as a result of an increase in the money supply depends on

(1) how much the interest rate falls which in turn depends on the elasticity of speculative demand for money, and

(2) how much investment rises as a result of any given fall in the interest rate which in turn depends on the interest-elasticity of investment demand function.

Contrariwise, a decrease in the money supply or an increase in the demand for money will shift the LM function to the left such that a new equilibrium is established at a higher interest rate and lower income level. This case has not been depicted in Figure 8.

Simultaneous Shifts in the IS and LM functions:

We have seen above that with the increase in investment when the IS curve shifts to the right, both the rate of interest and the level of the income tend to rise, given the LM curve. On the other hand, when an increase in money supply shifts the LM curve to the right, it lowers the rate of interest and raises the income level, given the IS curve.

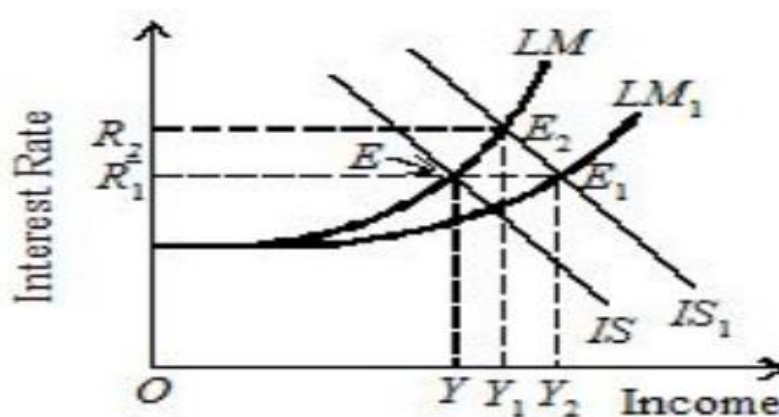


Fig. 9

Now suppose both the IS and LM curves shift to the right simultaneously as a result of the increase in investment and money supply respectively. How will these expansionary fiscal and monetary policies affect the level of income and the rate of interest? This is illustrated in Figure 9 where the increase in investment shifts the IS curve to IS_1 and the increase in the money supply shifts the LM curve to LM_1 . Consequently, the new equilibrium position is E_1 where the IS_1 and LM_1 curves intersect. The rate of interest remains at the old level R_1 but the income increases from Y to Y_2 . Given the money supply with no change in the LM curve, an increase in investment would raise both income and the rate of interest. This is shown in the figure when the IS_1 curve intersects the LM curve at E_2 and the interest rate rises to R_2 and income to Y_1 . But the rise in income is slowed down because of the rise in the interest rate. If the money supply increases by so much as to prevent the rise in the interest rate, the increase in income will be equal to the full expansionary effect of the rise in investment. This is depicted in the figure by the shifting of the LM curve to the right as LM_1

which intersects the IS1 curve at E1 . The income increases to Y2 but the rate of interest remains at the same level R1 . So there has been full income-expansionary effect of the increase in investment as a result of the simultaneous increase in money supply by just the amount necessary to prevent the rise in the interest rate. Table I summarises the causes and directions of shifts in the IS and LM curves.

Table I : Causes and Directions of Shifts in IS and LM curves

<i>Cause</i>	<i>Curve</i>	<i>Direction</i>
Increase in investment or consumption	<i>IS</i>	Right
Decrease in investment or increase in savings	<i>IS</i>	left
Increase in money supply or decrease in money demand	<i>LM</i>	left
Decrease in money supply or increase in money demand	<i>LM</i>	right

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