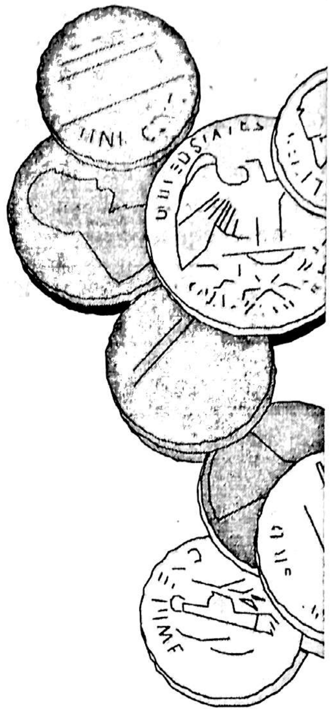
Chapter 14

The Keynesian Theory of Money and Interest



INTRODUCTION

In Chapter 13, we have discussed the classical theory of money and interest. In this chapter, we will discuss the Keynesian theory of money and interest.[1] Keynesian theories of demand for money and interest rate determination mark two significant developments in the theory of money and interest in the post-classical era.

14.1 THE CLASSICAL AND NEOCLASSICAL VIEWS ON HOLDING MONEY: A PRECURSOR

Before we discuss the Keynesian theory of demand for money, let us have a quick v classical and the neoclassical views on holding money. This will be helpful in underst background in which Keynes had formulated his own theory of demand for money. Here 'holding money' and 'demand for money' are used as synonyms.

The classical economists treated money only *as a medium of exchange*. In their opi fore, people hold money only for transaction purposes. They held the view that people any idle cash balance in excess of their transaction demand because it involves loss of i classical economists did not recognise the asset function or the *store-of-value functio*

[1] The readers interested in complete picture of the monetary theory are advised to read Chapters together.

The classical money demand function is written as

$$M_d = kY$$

(where $M_d = M/P$, *i.e.*, demand for real cash balance).

The neoclassical or the Cambridge theory of money did recognise the asset function of money, but did not go beyond. According to this theory, people hold cash balance because it performs medium-of-exchange and store-of-value functions. Although the Cambridge cash-balance approach did recognise the 'asset' function of money, it did not look at the idle cash balance *vis-à-vis* alternative forms of income earning financial assets, especially bonds. Also, the Cambridge version did recognise the fact that expected future prices and interest rate could affect the demand for money, but it does not go further to investigate the relationship between the interest rate and demand for money.

Keynes extended Cambridge theory to include *holding bonds and securities as an alternative to holding idle cash balance as an asset.* In his own theory of demand for money, Keynes emphasised the asset function of money *vis-à-vis* another form of asset—bonds. More importantly, he linked the demand for money to the variations in the interest rate and introduced, thereby, another kind of demand for money, i.e., *speculative demand for money.* In Keynesian sense, the element of speculation arises due to uncertainty about interest rate fluctuations. According to Keynes, when people make choices between the idle cash balance and income-yielding bonds under the condition of uncertainty, they speculate on the interest rates. According to Keynes, the money which people hold to buy bonds in future expecting bond prices to go down is the *speculative demand for money.* This is Keynes' innovative contribution to the theory of demand for money.

14.2 THE KEYNESIAN THEORY OF DEMAND FOR MONEY

Keynes built his theory of demand for money, *i.e.*, his **'liquidity preference'[2] theory**, on the Cambridge cash-balance approach to the demand for money. It is, in fact, an extension of the Cambridge theory of money. According to Keynes, money is demanded for three motives.

(i) Transaction motive,
(ii) Precautionary motive, and
(iii) Speculative motive.

The three motives and their determinants are discussed below.

14.2.1 The Transaction Demand for Money

Keynes's approach to the transaction demand for money is virtually the same as the Cambridge cash-balance approach to holding money. The need for holding money arises because there is a time gap between the receipt of income and expenditure. Income is received periodically—weekly, monthly or annually—whereas it is spent on goods and services almost regularly as and when need arises. For example, individuals getting their salary on monthly basis do not spend the entire income on the first day of the month. They hold some money for telephone and electricity bills and house tax, and so on, to be paid as and when the demand is received.

The transaction demand for money is positively related to the level of income. It is important to note here that Keynes assumed prices (P) to remain constant. Therefore, his demand for money

[2] The terms 'liquidity preference,' 'demand for money,' and 'holding money' are used synonymously.

implies demand for real cash balance and income refers to real income. People know by their experience the amount of money they need for transacting their planned expenditure. The higher the level of income, the higher the demand for money. This micro logic of demand for money is extended to the aggregate demand for money for transaction purpose. In fact, the aggregate demand for transaction money is the sum of the individual demands. According to Keynes, the aggregate transaction demand for money is a positive function of the national income. That is,

$$M_t = f(Y) \tag{14.1}$$

where M_t is transaction demand for money and Y is real income.

In the Keynesian system, the proportion of income held for transaction motive is *constant* or *fairly stable* in the short run. It implies that, given the income and its distribution, the short-run relationship between income and transaction demand for money can be specified as

$$M_t = kY \tag{14.2}$$

where k denotes a constant proportion of income demanded for transaction purpose.

The relationship between income and transaction demand for money is graphically depicted in Fig. 14.1. The straight line marked $M_t = kY$ shows the relationship between the income and transaction demand for money. The slope of this line = $\Delta M_t/\Delta Y = k$ *(constant)*. However, the assumption that k remains constant has been questioned by some economists. This aspect will be discussed in the next chapter.

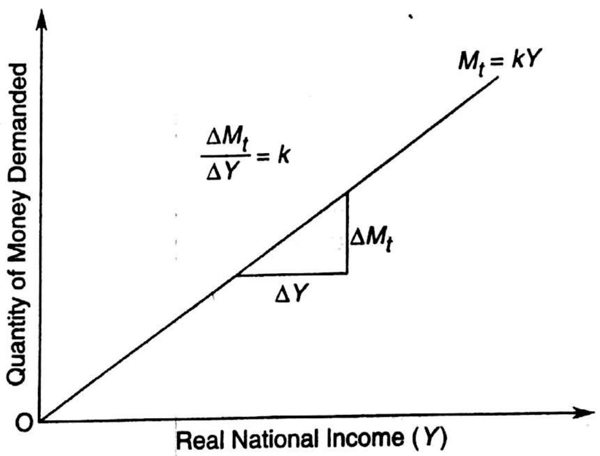


Fig. 14.1 The Transaction Demand for Money (M_t)

In the Keynesian system, money demanded for planned and committed transactions is assumed to be *interest-inelastic* because, whatever the rate of interest, people cannot stop paying grocer's bill, house-rent, electricity and telephone bills, school fees, and medical bills, etc. However, some economists[3] argue that when the rate of interest is very high, even in the short run, the demand for money starts responding to the rising rate of interest. This situation is illustrated in Fig. 14.2. The transaction demand for money is shown to be interest-elastic beyond the rate of interest i_3. The reason is, a high rate of interest means a high cost of holding idle cash balance. Therefore, individuals begin to rationalise their expenses and postpone nonessential purchases and businessmen

[3] See, for example, A. H. Hansen, *Monetary Theory and Fiscal Policy,* (McGraw-Hill, 1949), pp. 66-67.

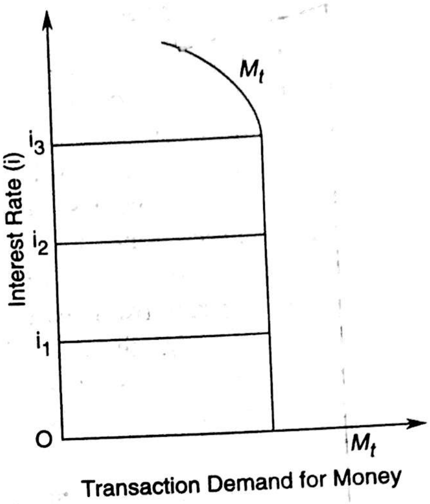


Fig. 14.2 The Interest and Transaction Demand for Money (M_t)

begin to reduce their inventories. However, the analysis of the Keynesian theories that follows is based on the assumption that M_t *is interest-inelastic* throughout.

14.2.2 The Precautionary Demand for Money

Keynes argued that both households and business firms hold some money in excess of their transaction demand to provide for unforeseen contingencies. The need for contingent expenditure arises due to such unforeseen and unpredictable events like fire, theft, sickness, loss of job, accidents, death of the bread winner and market eventualities. Besides, when unforeseen opportunities arise, for instance, market changes like a sudden temporary fall in prices of bonds and consumer durables people take advantage of it to promote their interest. To protect and to promote their interest against such contingencies and unforeseen opportunities, people do hold some idle cash balance. The money held for this motive is called *precautionary demand for money.*

Like transaction demand for money, precautionary demand for money is also closely and positively related to the level of income. The higher the level of income, the higher the demand for money for precautionary motive. This relationship is expressed in functional form as

$$M_p = f(Y) \tag{14.3}$$

where M_p is the *precautionary demand for money.*

The money demanded for precautionary motive also becomes interest-elastic if the interest rate rises beyond a certain level. It is rather more interest-elastic than the transaction demand.

Since both transaction and precautionary demands for money are a function of the income, Keynes lumped them together which can be expressed as $M_t + M_p = M_T$. Thus, the Keynesian total transaction demand for money can be expressed as

$$M_T = f(Y) = kY \tag{14.4}$$

Till this point, there is no significant difference between the classical and Keynesian theories.

14.2.3 The Speculative Demand for Money

According to Keynes, people hold a part of their income also in the form of idle cash balance for *speculative purpose*. The desire to hold idle cash balance for speculative purpose arises from the desire to take advantage of the changes in the *money market*, specifically, the asset market. In Keynes' view, it is rational to hold idle cash balance instead of holding a bond if the rate of interest is expected to rise in future. If the interest rate does increase in future, the bond prices go down. Then the person who holds the idle cash can buy the bond at a lower price and make a capital gain. Besides, he earns a higher rate of return on the bonds. The higher rate of return arises because he earns a given income on a bond which has a price lower than its face value. If interest rate does not increase, those who hold idle cash balance lose interest on it. Thus, if a person decides to hold idle cash balance in expectation of rise in the interest rate under the condition of uncertainty, the person is speculating. Speculation involves an element of risk. Keynes called this kind of cash balance holding as *speculative demand for money.*

The speculative demand for money is not without a rationale. Suppose a person has Rs 1000 in excess of his transaction demand for money. He has only two options with respect of his excess cash balance—either to hold it as idle cash or buy a very long-term or perpetual bond yielding a fixed income of Rs 50 per annum. Assuming that he is a gain maximiser, how does he make his choice? One widely used method of evaluating his options is to compare the sterile cash balance with the market value of the bond. The market value of the bond is simply the **present value** of income stream expected from the bond. The formula[4] for obtaining the present value (V), or the capitalised value, of a constant income stream is given below.

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[4] The formula has been arrived at as follows. As discussed in Chapter 10, the market value (V) of a constant future income *stream* can be obtained as follows.

$$V = \frac{R}{(1+i)} + \frac{R}{(1+i)^2} + \frac{R}{(1+i)^3} + \ldots\ldots + \frac{R}{(1+i)^n} \quad \text{(i)}$$

By multiplying both sides of Eq.(i) by $(1 + i)$, we get

$$V(1+i) = R + \frac{R}{(1+i)} + \frac{R}{(1+i)^2} + \ldots\ldots + \frac{R}{(1+i)^{n-1}} \quad \text{(ii)}$$

or,

$$V + V(i) = R + \frac{R}{(1+i)} + \frac{R}{(1+i)^2} + \ldots\ldots + \frac{R}{(1+i)^{n-1}}$$

By subtracting Eq. (i) from Eq. (ii), we get

$$V + V(i) - V = R - \frac{R}{(1+i)^n} \quad \text{(iii)}$$

or,

$$V(i) = R - \frac{R}{(1+i)^n}$$

Dividing both sides of Eq. (iii) by i, we get

$$V = \frac{R}{i} - \frac{R}{(1+i)^n} \times \frac{1}{i} \quad \text{(iv)}$$

Since income from the bond is perpetual, $(1 + i)^n$ tends to infinity and the term $R/(1 + i)^n \times 1/i$ in Eq. (iv) tends to zero. The Eq. (iv) is reduced to

$$V = \frac{R}{i}$$

$$V = \frac{R}{i} \tag{14.5}$$

where, R is the annual return and i is the market rate of interest.

Assuming a market rate of interest to be given at 5% p.a., the present value (V) of a perpetual income of Rs 50 can be obtained by the formula given in Eq. (14.5) as

$$V = \frac{\text{Rs }50}{5/100} = \frac{\text{Rs }50}{0{\cdot}05} = Rs.\ 1000 \tag{14.6}$$

The amount thus calculated (i.e., Rs 1000) is the *capitalised value* of the fixed income stream of Rs 50 per annum over a long period. This is also the market value of the bond because those who want to earn an annual income of Rs. 50 will be willing to buy the bond at a price of Rs 1000. Under these conditions, one may or may not buy the bond because Rs 1000 in the form of cash is as good as buying a bond for Rs 1000.

Let us now see what happens if a bond holder speculates market rate of interest to fall in future to 2.5 percent p.a. At this rate of interest, the market value of the bond will increase to Rs. 2000 computed as below.

$$V = \frac{50}{0.025} = \text{Rs } 2000$$

He will buy the bond and sell it at a future date (when his expectations materialise) at Rs 2000 and make a capital gain of Rs 1000. Thus, when a fall in the market rate of interest is expected, the preference for bond increases and, therefore, speculative demand for money increases.

On the contrary, if the market rate of interest is expected to increase to 10%, the market value of the bond decreases to Rs. 500 as shown below.

$$V = \frac{50}{0.10} = \text{Rs. } 500$$

Thus, with the increase in the market rate of interest, the market value of the bond decreases and involves a capital loss of Rs 500. Therefore, the preference for bond will decrease and the speculative demand for money will decrease too. This implies that as the rate of interest increases, the speculative demand for money decreases.

The ***conclusion*** that emerges from these calculations can be stated as follows. *The market value of bonds and the market rate of interest are inversely related. A rise in the market rate of interest leads to an increase in the market value of the bond, and vice versa.* This means that the speculative demand for money (M_{sp}) and interest are inversely related. This relationship can be expressed as

$$M_{sp} = f(i),\ (\Delta M_{sp}/\Delta i < 0) \tag{14.7}$$

The nature of relationship between the speculative demand for money and the market interest rate is graphically depicted in Fig. 14.3. The M_{sp}-curve is the demand curve for speculative demand for money. It shows an inverse relationship between the rate of interest and the speculative demand for money.

The Liquidity Trap Keynes has hinted at a *remote possibility* of a situation when the market rate of interest falls to a 'critical' minimum level, say to i_1 in Fig. 14.3, and the liquidity preference curve becomes flat. It implies that the speculative demand for money becomes infinitely large or elastic when the rate of interest goes below a 'critical' minimum level—a level below which people prefer to hold idle cash balance and banks pull down their shutters. Keynes called this kind of a situation as 'liquidity trap.'

The phenomenon of liquidity trap can be explained as follows. There are two kinds of speculators, called 'factors', in the stock markets—bulls and bears. These factors—bulls and bears—operate also in the money market. Bulls are those who expect interest rate to go down and bond prices to go up in future. Therefore, they convert their idle cash balances into bonds. Bears, on the other hand, expect interest rates to go up and bond prices to go down. Therefore, they off load their bonds and accumulate idle cash balance. These bullish and bearish factors explain the liquidity preference curve. The behaviour that explains the *liquidity trap* is the preference for unlimited idle cash balance when the rate of interest falls much below the 'normal' level. At this stage, even the bulls turn bears. They too start believing that the interest rate would not go any further down as it has reached its 'critical' minimum level.[5] Instead, they begin to expect that the interest rate would rise and, therefore, bond prices will go down causing a capital loss. Therefore, they too start selling their bonds and accumulating cash balance. It is a situation when everybody prefers idle cash balance to bond holding. Under this condition, even if monetary authority increases money supply to lower the rate of interest the entire extra money supply gets trapped in liquidity as extra idle cash balance. This is what Keynes called 'liquidity trap'.

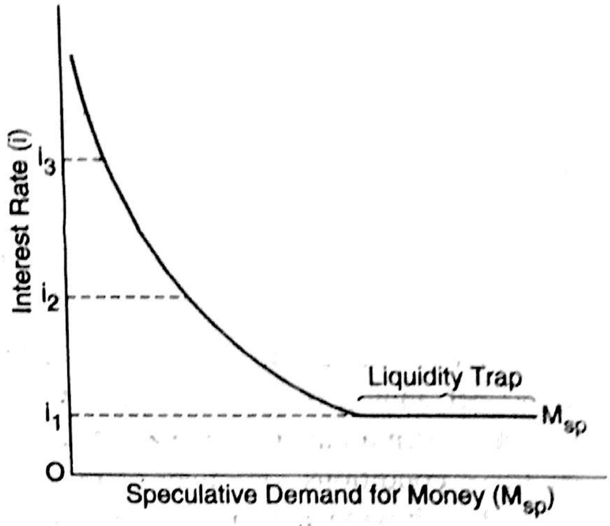

Fig. 14.3 The Speculative Demand for Money

14.2.4 The Keynesian Demand-for-Money Function

Having described the various components of aggregate demand for money and their determinants we present here the final form of the Keynesian theory of demand for money. According to Keynes the aggregate demand for money consists of two components:

(i) The transaction (including precautionary) demand (M_T), and
(ii) Speculative demand (M_{sp}).

Thus, the aggregate demand for money (M_d) can be expressed as

$$M_d = M_T + M_{sp} \tag{14.8}$$

Since $M_T = kY$ and $M_{sp} = f(i)$, given the income and interest rate, the Keynesian aggregate money demand function can be expressed as

$$M_d = kY + f(i) \tag{14.9}$$

5. The rate of interest is said to be at its critical minimum when even if monetary authorities were to expand the money supply, the rate of interest would not fall as the entire additional money supply would be held by the people as idle cash balance in anticipation of the rise in the interest rate.

The relationship between the aggregate demand for money and the interest rate is crucial to the Keynesian theory of demand for money and the theory of interest. The relationship between the two is shown by a total-money-demand curve (M_d) in relation to the interest rate. The derivation of M_d curve has been illustrated in Fig. 14.4. Panel (a) of the figure shows the transaction demand for money (M_T) in relation to the interest rate. Since transaction demand for money is assumed to be interest-inelastic, M_T is shown by a straight vertical line. As shown in the figure, whether the interest rate is i_1, i_2 or i_3, the transaction demand for money remains constant at M_T.

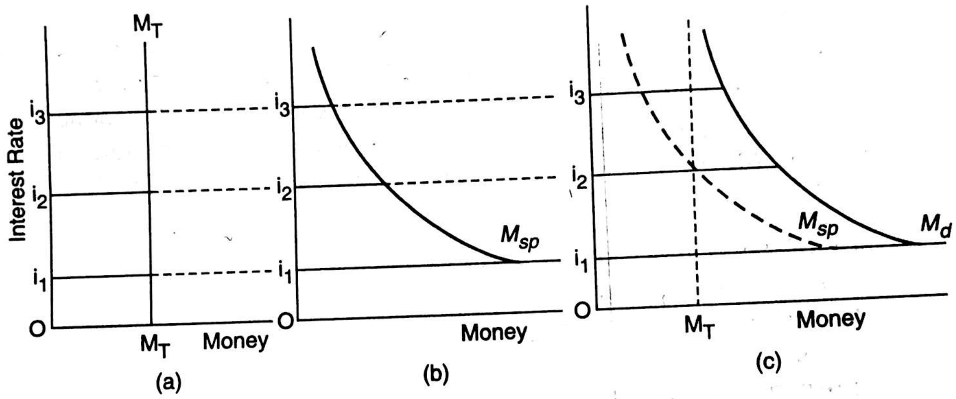

Fig. 14.4 The Total Demand for Money

Panel (b) presents the speculative demand for money (M_{sp}) in relation to the interest rate. The M_{sp} is inversely related with the interest rate.

Panel (c) presents the total demand for money (M_d). The total-money-demand curve, i.e., M_d curve, is simply a horizontal summation of M_T and M_{sp} curves. The M_T and M_{sp} curves of panels (a) and (b) are reproduced in panel (c) and shown by the dotted lines. The M_d curve gives the total demand for money (M_d) in relation to the interest rate. The curve M_d is the Keynesian demand curve for money.

14.2.5 Criticism of the Keynesian Theory of Demand for Money

The Keynesian theory of demand for money was undoubtedly a radical improvement over the classical and neoclassical theories of money. His theory has however been criticised on the following grounds.

First, Keynes' division of demand for money between transaction, precautionary and speculative motives is unrealistic. For, the people do not maintain a separate purse for each motive. They have one purse for all purposes. Besides, empirical evidence shows that, contrary to Keynes' postulate, even the transaction demand for money is interest-elastic.

Secondly, critics reject the Keynesian postulate that there exists a 'normal' rate of interest and the current rate of interest may not necessarily be the same as the normal rate: there may always be a difference between the two. According to Keynes, the speculative demand for money is governed by the difference between the 'normal' and the current rates of interest. But, the critics argue that if the current rate of interest remains stable over a long period of time, people tend to take it to be the normal rate. Consequently, the difference between the current rate and the normal rate disappears. With it, disappears the basis for speculation and the speculative demand for money.

Thirdly, Keynes assumed unrealistically that the people hold their financial assets in the form of either idle cash balance or bonds. In fact, people hold their assets in a combination of both the assets.

14.3 THE KEYNESIAN THEORY OF INTEREST AND MONEY MARKET EQUILIBRIUM

Having discussed the Keynesian theory of demand for money, we discuss now the Keynesian theory of interest rate determination and the money market equilibrium. According to the Keynesian theory of interest, market rate of interest is determined by the aggregate demand for money and the total supply of money. And, the equilibrium rate of interest is determined at the rate at which money market is in equilibrium. Money market is in equilibrium where

$$M_d = M_s$$

The determination of the equilibrium rate of interest is illustrated in Fig. 14.5. The derivation of the demand curve for money (M_d) has already been explained in the foregoing section. It is reproduced in Fig. 14.5, as shown by the M_d-curve.

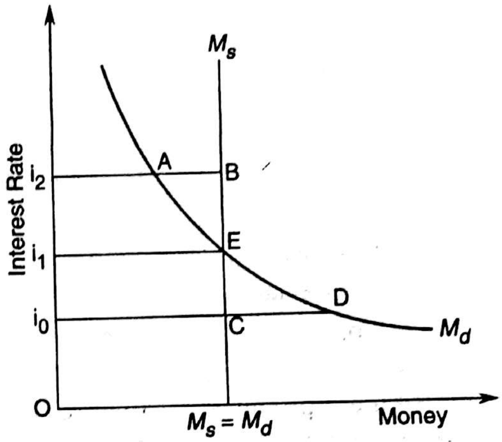

Fig. 14.5 Determination of the Interest Rate: The Keynesian Theory

As regards the supply of money, in the Keynesian model, the supply of money (M_s) is assumed to remain constant in the short run. It is constant because the supply of money in any country is determined by the central bank of the country in view the overall monetary needs of the country. The supply of money in India, for example, is determined by the Reserve Bank of India. Central banks do not increase or decrease the supply of money in response to the variation in the rate of interest. Therefore, the supply of money in any time period is assumed to be given, as shown by the vertical line M_s in Fig. 14.5. It is therefore deemed to be *interest-inelastic*.

As Fig. 14.5 shows, the money demand curve (M_d) and money supply schedule (M_s) intersect at point *E*. At this point, $M_s = M_d$. Therefore, the equilibrium rate of interest is determined at i_1. This rate of interest is supposed to be stable. For, at any other rate of interest, $M_d \neq M_s$. For example, if the interest rate rises to i_2 for some reason in any period of time, M_d will decrease by *AB*. The reason is, with the increase in the interest rate, bond prices go down and the speculative demand for money decreases. This situation of disequilibrium sets the market forces in motion to restore the equilibrium. *How*? When the interest rate goes up, people prefer to hold bond because of its low price and reduce their idle cash balances. The bearish factor in the market speculates a fall in the interest rate and the consequent rise in the bond price—an expectation that will fetch capital gain. This creates demand for an idle cash balance. This implies movement from point *A* towards point *E* on the M_d-curve forcing down the interest rate. As a result, the excess supply of money disappears and equilibrium is restored.

Similarly, when the rate of interest falls, for some reason, from i_1 to i_3, the speculative demand for money increases because at a lower rate of interest the preference for cash holding increases. As a result, the aggregate demand for money (M_d) increases by CD. Consequently, demand for money exceeds supply of money by CD. Since there is shortage of money in the money market, people begin to expect a rise in the interest rate and, therefore, demand for money begins to decrease and continues to decrease until the equilibrium point E is restored.

14.4 CHANGES IN THE MONEY MARKET AND THE INTEREST RATE

The changes in the conditions on the demand and supply sides of the money market bring about a change in the interest rate. In this section, we will discuss first the effects of the changes in money demand on the interest rate and then that of the change in money supply.

14.4.1 Change in Demand for Money and Interest Rate

Demand for money may change due to either change in transaction demand or change in speculative demand or both. We discuss here first the effect of change in the transaction demand for money on the interest rate and then that of speculative demand for money.

Change in Transaction Demand for Money The transaction demand for money may change for endogenous and exogenous reasons. Going by the Keynesian theory, however, let us assume that it changes endogenously due to a change in income. We have noted above (see Eq. 14.9.) that

$$M_d = kY + f(i)$$

Given the money demand function, let us suppose that income (Y) changes, speculative demand for money remaining constant. The change in income will cause a change the transaction demand for money by the factor k. As a result, the demand curve for money shifts upward or downward. The shift in the demand curve causes a change in the interest rate. When income increases, for any reason, the transaction demand for money increases which shifts the demand curve upward and the interest rate goes up and vice versa.

Fig. 14.6 presents the case of increase in income and its effect on the demand for money and on the interest rate. Suppose that the level of income in some period of time is Y_1. At this level of income, the transaction demand for money is M_{T1} and the total-money-demand curve associated with income Y_1 is given by the curve M_{d1}. The vertical line M_s represents the given supply of money. As the figure shows, the money demand and supply curves intersect at E_1 and the equilibrium rate of interest is determined at i_1.

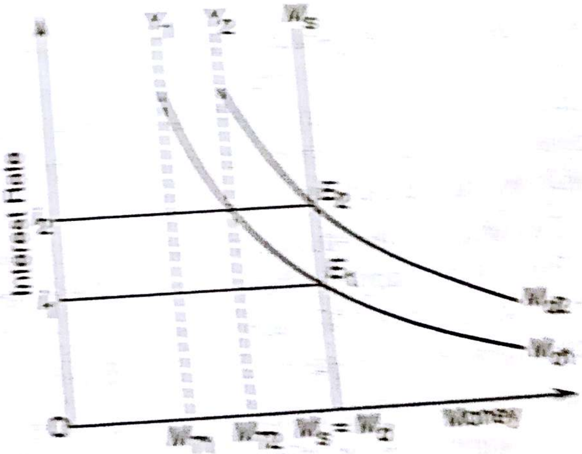

Fig. 14.6 Change in Income, Demand for Money and Interest Rate Determination

Given this equilibrium condition, let the level of income increase to Y_2 so that the transaction demand for money increases to M_{T2}. The

...lative demand for money remaining the same, M_d-curve shifts rightward to the position of M_{d2}. The curve M_{d2} intersects the money supply curve (M_s) at point E_2. Thus, the equilibrium rate of interest rises to i_2. The rise in the interest rate from i_1 to i_2 is the effect of increase in the transaction demand for money on the rate of interest.

Where does the additional transaction cash balance come from? As Fig. 14.6 shows, with the rise in the level of income from Y_1 to Y_2, the transaction demand for money increases from OM_{T1} to OM_{T2}. It shows also that at both the equilibrium rates of interest—i_1 and i_2—the total demand for money, M_d, remains the same and it equals the total supply of money, M_s. So a question arises: Where does the additional transaction cash balance come from? The answer is: It comes from the speculative cash balance. That is, speculative cash balance is reduced to meet the additional transaction cash balance. This point can be verified from Fig.14.6. It can be seen in the figure that at equilibrium interest rate i_1, transaction cash balance is OM_{T1} and speculative cash balance is $M_D - M_{T1} = M_{T1}\ M_D$. When M_D increases causing an upward shift in M_D curve and the equilibrium interest rate rises to i_2, transaction cash balance increases from OM_{T1} to OM_{T2}, that is, it increases by $M_{T1}\ M_{T2}$. On the other hand, the speculative demand for money decreases from $M_D - M_{T1}$ to $M_D - M_{T2}$. That is, it decreases by $M_{T1}\ M_{T2}$. Note that the increase in transaction cash balance ($M_{T1}\ M_{T2}$) equals the decrease in speculative cash balance ($M_{T1}\ M_{T2}$).

How does it happen? When income level (Y) increases, the transaction demand for money increases inevitably. The bondholders then begin to sell their bonds to acquire the required transaction cash balance. In the process of converting bonds into transaction cash balance, bond prices go down and the interest rate goes up. This process continues until people acquire the required transaction cash balance. At the end of the process, the transaction cash balance increases to its required level and speculative cash balance decreases by the same amount. Finally, as shown in Fig. 14.6, a new point of equilibrium (E_2) is reached with (a) a higher transaction cash balance (OM_{T2}), (b) a lower speculative cash balance ($M_{T2}\ M_d$), and (c) a higher rate of interest (i_2).

Change in the Speculative Demand for Money Let us now assume that the speculativ
demand for money changes, all other things remaining the same—especially the transaction deman
for money and the interest rate. This change in speculative demand for money causes a shift i
the speculative demand for money.

Why does the M_{sp}-curve shift? The speculative demand for money is based on peoples' expe
tations regarding the changes in the normal rate of interest. If people expect a fall in the inter
rate below its *normal level*, they expect bond prices to go up and therefore they demand m
money for speculative purposes. The increase in speculative demand for money causes a rightw
shift in the M_{sp}-curve.

The shift in the speculative-money-demand curve and its effect on the interest rate are illustr
in Fig. 14.7. Suppose that, in some time period, the total demand for money (M_d) and the t
supply of money (M_s) are given as shown in Fig. 14.7 and the equilibrium rate of intere
determined at i_1. Suppose this is the normal rate of interest.

rise

Now suppose that, given the normal rate of interest, majority of the people expect it to fall
a small number of people expect it to ~~rise~~ fall. As a result, speculative demand for money increas
This causes a shift in the demand curve for speculative money. As a result, the total-money-deman
curve (M_d) shifts rightward intersecting the money-supply line (M_s) at point E_2 and a nev

equilibrium rate of interest is determined at i_2. This may not always be the case. If the rise in the demand for speculative money is more than $M_d\ M_s$, the new equilibrium rate of interest will be higher than i_2. A similar analysis can be performed by assuming a fall in the interest rate due to, say, recession in the economy. The result will then be opposite.

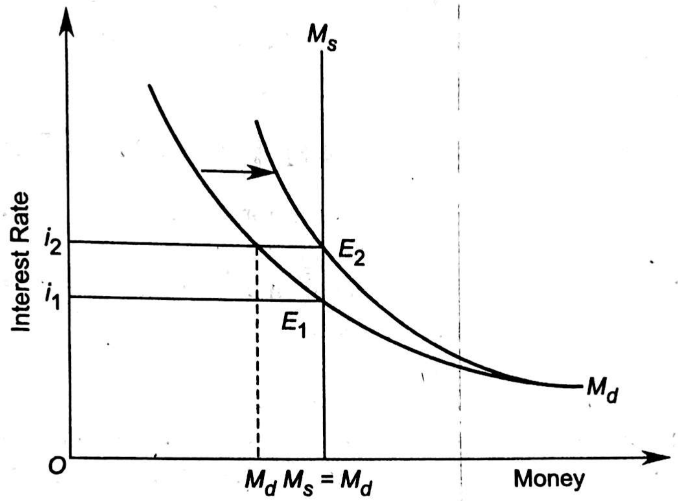

Fig. 14.7 Change in Speculative Demand for Money and Interest

14.4.2 Change in Money Supply and Interest

We had so far assumed that money supply (M_s) remains constant. But, in reality, money supply keeps changing. Let us now analyse the change in the money supply and its effect on the interest rate. It may be noted at the outset that the money supply and the interest rate are inversely related. An increase in the money supply, given the money demand curve, causes a decrease in the interest rate and *vice versa*. This relationship between the money supply and the interest rate is depicted in Fig. 14.8.

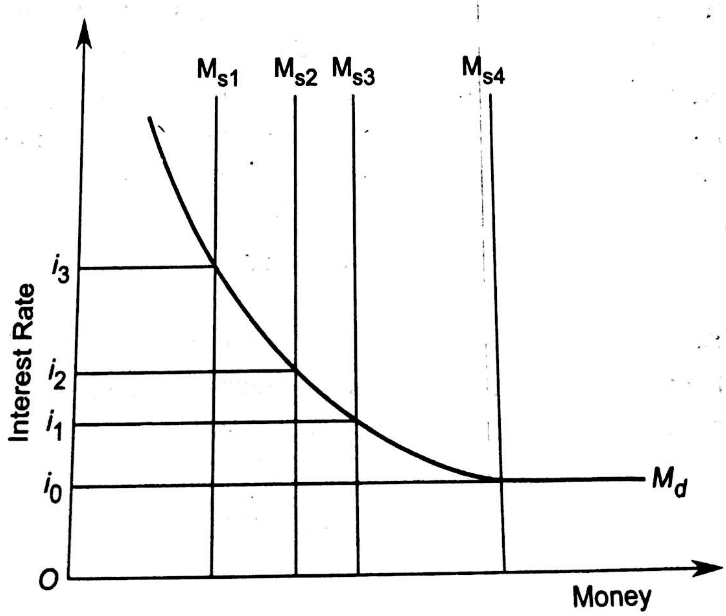

Fig. 14.8 Change in Money Supply and Interest Rate

Let us suppose that the total money-demand curve is given as M_d as shown in Fig. 14.8 and the money supply is given at M_{s1}. Given the money demand curve and money supply, the equilibrium rate of interest is determined at i_3. Let the central bank now increase the money supply so that the money supply curve shifts to M_{s2}. With the increase in money supply to M_{s2}, the interest rate falls to i_2, Therefore, the people tend to hold more cash balance for speculative purposes. As the money supply increases to M_{S4}, the interest rate falls to i_0. It is here that the stage of **liquidity trap** is reached. At this stage, no increase in money supply can push the interest rate further down.

14.5 CRITICISM OF THE KEYNESIAN THEORY OF INTEREST

The Keynesian theory of interest is undoubtedly superior to the classical and loanable funds theory of interest. Ironically, however, the Keynesian theory of interest has been criticised on the grounds Keynes criticised the classical theory. We may recall here Keynes' criticism of the classical theory of interest (see Chapter 13). Briefly speaking, Keynes argued that the classical theory of interest is indeterminate. Keynes' argument against the classical theory of interest can be summarised as follows. Since $S = f(Y)$, saving schedule cannot be known unless income (Y) schedule is known. Since $Y = f(I)$, income schedule cannot be known unless investment function is known. Since $I = f(i)$, investment schedule cannot be known unless interest rate (i) is known. And, interest rate (i) cannot be known unless saving and investment schedules are known. Thus, according to Keynes, the indeterminateness of the variables make the classical theory of interest indeterminate.

According to Hansen, 'exactly the same criticism applies to Keynesian theory in its simpler form.'[6] He reiterates, 'Keynes' criticism of the classical theory applies equally to his own theory.''[7] His argument may be summarised as follows. 'According to the Keynesian theory the rate of interest is determined by the intersection of the supply schedule of money ... and the demand schedule for money ... .' This theory 'also is indeterminate' because, even if money supply is fixed by the monetary authority, 'the liquidity preference schedule will shift up or down with changes in the income level.' In the Keynesian system, we cannot know the liquidity preference schedule unless we know the income level. Income level cannot be known unless we know the speculative demand for money and speculative demand for money cannot be known unless interest rate is known. Thus, 'the Keynesian theory, like the classical, is indeterminate.'[8]

Leijonhufvud remarked that the Keynesian theory of interest is 'incredibly tortuous formulation.'[9] According to him, the main trouble lies in his definition of 'savings' as 'non-consumption' taken from the 'pure' theories of interest. This definition might be appropriate in the pure theories of interest, but not in the Keynesian system. Keynes' 'ex-ante savings' is not clearly distinguished from the demand for money for speculative purpose and demand for non-monetary assets.

Concluding Remarks The Keynesian theory of interest presented in this chapter, simple though, marks a radical departure from the classical theory of interest. The Keynesian theory has however its own weakness and shortcomings which have led many economists to make several

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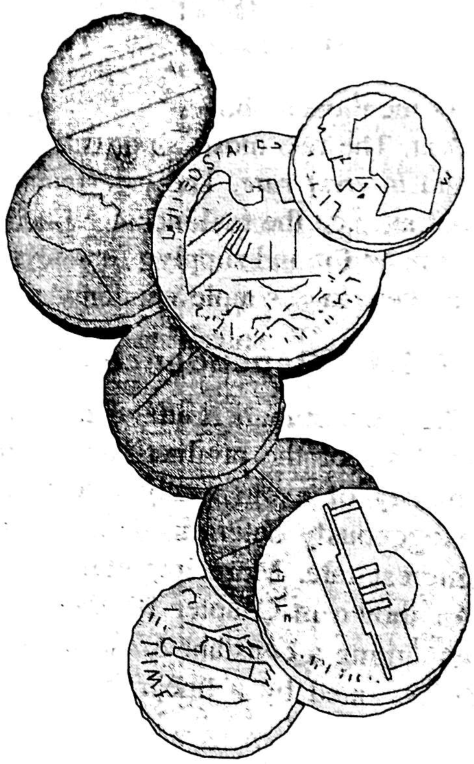
6. Alvin H. Hansen, *Guide to Keynes,* (McGraw-Hill, NY, 1953), p.140.
7. *ibid.* p.141.
8. Hansen, A.H., *ibid.*
9. Alex Leijonhufvud, *On the Keynesian Economics and the Economics of Keynes,* (London, Oxford University Press), 1968, p.28.

Chapter 16

The *IS-LM* Model in Two-Sector Economy



INTRODUCTION

Recall that Keynes had developed his product market theories in isolation of the product market, and money market theories in isolation of the product market, whereas the activities and variables of the two sectors are interrelated, interdependent and interactive. Therefore, changes in the variables of one sector affect the activities of the other sector. In simple words, changes in product market affect the money market equilibrium and *vice versa*. The Keynesian theory ignores the effect of changes in the money market on the product market and the effect of changes in the product market on the money market. Therefore, his theories related to the product and money markets are considered to be partial and incomplete. It was J.R. Hicks who highlighted this fact and developed his own model[1] in 1937—just one year after the publication of Keynes's *The General Theory*. He integrated Keynesian theories of product and money markets to show how equilibrium of both the sectors coincide at the same level of income and interest rate. His model is widely known as the ***IS-LM* model.** In this model, the term *IS* represents the product sector equilibrium condition ($I = S$) and the term *LM* represents

1. In his paper, "Mr. Keynes and the Classics: A. Suggested interpretation", *Econometrica,* 5 (April 1937), reproduced in W. Filner and B. F. Haley (eds.), *Readings in the Theory of Distribution* (Richard D. Irwin, 1946); L. Lindauer (ed.), *Macroeconomic Readings* (Free Press, 1968); E. Shapiro (ed.), *Macroeconomics: Selected Readings* (Harcourt, Brace and World, 1970); and in M.G. Mueller (ed.), *Readings in Macroeconomics* (Holt, Rinehart and Winston Corp., 1971).

the money market equilibrium condition ($L = M$), where L stands for *liquidity preference* or money demand (M_D) and M stands for money supply (M_S).

It is important to note here that Hicks has developed his *IS-LM* model in the framework of a simple, two-sector economy. The economists have, however, extended his model to three-sector and four-sector models also. In this chapter, we elaborate on the Hicksian *IS-LM* model in a simple, two-sector economy, including household and firm sectors only. The three-sector and four-sector *IS-LM* models are discussed in the two subsequent chapters.

We begin by showing the interdependence of the product and the money markets. We will then describe the Hicksian *IS-LM* model and show how an economy attains its general equilibrium. This is done by deriving the *IS* and *LM* curves and then presenting the general equilibrium model. Finally, we discuss the shift in the *IS* and *LM* curves and its impact on the general equilibrium.

16.1 THE INTERDEPENDENCE OF PRODUCT AND MONEY MARKETS

As mentioned above, working of the product and the money markets is interlinked and interdependent. The two most important variables that interlink the working of the two sectors are *investment* and *interest rate*. The investment (I) is a product-market variable—it determines the level of real output, i.e., the real income. And, the interest rate (i) is a money-market variable determined by the demand for and supply of money. Let us now look at the interdependence of the product and money markets in a simple economy model.

16.1.1 Dependence of Product Market on Money Market

The product market attains its equilibrium at the level where $Y = C + I$. Recall that in the Keynesian analysis of the product-market equilibrium, I was assumed to be a constant factor or an autonomously or exogenously determined variable. In reality, however, I is not only autonomously or exogenously determined: it is determined within the system also by the level of income and the interest rate. More importantly, given the income, investment (I) depends on the rate of interest. As shown in Chapter 10, there is an inverse relationship between the interest rate and investment. Assuming a constant $\Delta I/\Delta i$, the inverse relationship between the investment (I) and the interest rate (i) is stated by a linear investment function[2] of the following form.

$$I = \bar{I} - hi, \ (h > 0) \tag{16.1}$$

where, $\bar{I}$ = 'autonomous investment,' i = interest rate and $h = \Delta I/\Delta i$.

The implication of the *investment function* in the interdependence of the product and money markets can be shown as follows. Recall that the product market is in equilibrium where

$$Y = C + I$$

Here, C (consumption) is the function of income, and I (investment) is the function of interest. For the sake of brevity, let us denote consumption function as $C(Y)$ and investment function as $I(i)$. By substitution, the product market equilibrium condition can be rewritten as

$$Y = C(Y) + I(i) \tag{16.2}$$

[2] For simplicity sake, we assume a linear investment function. One may, however, use a non-linear investment function with the same results.

Eq. (16.2) implies that unless i (interest) is determined, I cannot be determined and unless I is determined Y cannot be determined. It means, unless i is determined, the equilibrium level of Y cannot be determined.

Also, recall (from Ch. 14) that interest rate (i) is determined in the money market and equilibrium rate of interest is determined where $M_d = M_s$. For interest rate to remain stable, money market must be in a stable equilibrium. It may thus be concluded that *unless money market reaches its equilibrium and interest rate (i) is determined, product market cannot attain its equilibrium.* This shows the dependence of the product market on the money market.

16.1.2 Dependence of Money Market on Product Market

Let us now look at the dependence of the money market on the product market. In the Keynesian system, money market reaches its equilibrium where

$$M_s = M_d$$

and interest rate (i) is determined where $M_S = M_D$.

As we have noted in Chapter 14, $M_d = M_t + M_{sp}$, where $M_t = kY$ and $M_{sp} = f(i)$. Therefore,

$$M_d = kY + f(i) \tag{16.3}$$

Eq. (16.3) implies that unless Y is determined, kY cannot be determined and, therefore, M_d cannot be determined. And, unless M_d is determined, money market equilibrium cannot be determined and interest rate (i) would not be determined. It may thus be concluded that *unless product market reaches its equilibrium and Y is known, money market cannot reach its equilibrium.* This shows the dependence of the money market on the product market. It needs to be emphasised here that *unless both product and money markets reach equilibrium simultaneously, the economy cannot attain its general equilibrium nor can any of the two sectors be in equilibrium.*

16.2 THE *IS-LM* MODEL: AN ELEMENTARY EXPOSITION

After having shown theoretically the interdependence of the product and money markets, we move on to present Hick's *IS-LM* model and show how product and money markets interact to reach their equilibrium simultaneously and also the same level of income and interest rate. The *IS-LM* model combines the equilibrium conditions of the product and money markets to arrive at the general equilibrium[3]. In order to show general equilibrium, Hicks had derived two curves, namely *IS* and *LM* curves. The *IS* curve (meaning $I = S$) represents the product market equilibrium and the *LM* curve (meaning $L = M$) represents the money market equilibrium, both at different rates of interest and level of the aggregate product or national income. In deriving his *IS* curve, Hicks made an important deviation from the Keynesian approach. While Keynes assumed investment (I) to be autonomous and determined exogenously, Hicks assumes that I is determined endogenously and is the function of the rate of interest i.e., $I = f(i)$.

3. The term 'general equilibrium' is used to denote the simultaneous equilibrium of all elements of the economy including individual products, individual decision-makers (households, firms, labour, etc.), money market, at both micro and macro levels. However, here the term 'general equilibrium' has been used in this book throughout to denote the simultaneous equilibrium of the product and money markets.

Likewise, his *LM*-schedule shows the equilibrium path of the money market at different rates of interest and levels of income. He has then combined the two schedules to show the general equilibrium of the economy. This has come to be widely known as the *IS-LM* model.

16.2.1 The Basic Model

In his *IS-LM* model, in its simplest form, Hicks integrates the equilibrium conditions of the product and money markets and produces condition for the general equilibrium. He incorporates a money-market variable, interest (i), into the income determination model by replacing Keynes' constant I with the investment function. With these modifications in the Keynesian model, Hicks defines the equilibrium level of income as

$$Y = C(Y) + I(i)$$

This function yields the *IS*-curve. It shows the relationship between Y and i at different equilibrium levels of saving and investment ($I = S$) and the product market equilibrium at different levels of Y and i.

Similarly, the *IS-LM* model incorporates income, Y, the main product-market variable, in the money market model by linking total demand for money to Y. This is done by using an M_t-function of the form $M_t = kY$, and an M_{sp}-function as $M_{sp} = L(i)$ into the money market model.[4] The money-market equilibrium condition is then written as

$$M_s = M_d = kY + L(i) \tag{16.4}$$

Eq. (16.4) yields the *LM*-schedule which shows the relationship between Y and i at different equilibrium levels of M_d and M_s. It shows also the money market equilibrium at different levels of Y and i.

Finally, the *IS-LM* model brings the *IS* and *LM* functions together and lays down the condition for the general equilibrium as

$$IS = LM \tag{16.5}$$

or

$$C(Y) + I(i) = kY + L(i)$$

If $C(Y)$, $I(i)$, kY, and $L(i)$ functions are known, the equilibrium values of Y and i can be easily obtained.

The *IS-LM* model can be presented both algebraically and graphically assuming $C(Y)$, $I(i)$, kY and $L(i)$ functions to be given. While algebraic determination of the general equilibrium gives a technically more sound and precise analysis, graphical presentation brings out inter-variable linkages and working system of the product and money markets. However, we present first the *IS-LM* model graphically. The *IS-LM* model is presented graphically in the following three stages:

1. Derivation of the *IS* curve,
2. Derivation of the *LM* curve, and
3. Presentation of the *IS-LM* model of General Equilibrium.

Derivation of the IS Curve ***The IS curve or schedule[5] is a curve which shows the relationship between the rate of interest and the equilibrium level of national income, that is, S = I a***

4. This chapter onwords, we will use $L(i)$ for M_{sp}-function.

5. We will use the words 'curve' and 'schedule' interchangeably.

different rates of interest. Derivation of the *IS* curve requires, therefore, the knowledge of the functional relationship between interest and investment, between saving and investment at equilibrium and between saving and income. All these functional relations, except one between the interest rate and investment, have already been discussed in the previous chapters. The nature of relationship between the investment and the interest rate is given in the investment function (16.1). In order to derive the *IS* schedule, let us recall here all the functional relations that figure in the analysis of the product market equilibrium. According to the Keynesian theory, product market equilibrium, $I = S$.

Since

$$I = I(i)$$

and

$$S = Y - C(Y),$$

the product-market equilibrium condition can be specified as

$$I(i) = Y - C(Y) \qquad \textbf{(16.6)}$$

In order to present these functions graphically, let us suppose that these functions are estimated factually and are given as follows.

$$I = 200 - 2000i$$

$$C(Y) = 10 + 0.5Y$$

$$S = Y - (10 + 0.5Y)$$

or

$$S = -10 + 0.5Y$$

The derivation of the *IS*-schedule on the basis of these functions is illustrated graphically in Fig. 16.1. This figure is divided in four quadrants.[6] The use of these quadrants for the derivation of the *IS* schedule are narrated below.

Quadrant (a) presents the investment function: $I = 200 - 2000i$. The investment schedule shows an inverse relationship between the interest rate and investment. Recall that the product market is in equilibrium where $I = S$. This condition must hold for all the levels of investment at different rates of interest. For instance, as Fig. 16.1 shows, given the investment function, investment at the interest rate of 8 percent, is Rs 40 billion. So, for the product market to be in equilibrium, savings must equal Rs 40 billion. And, when the interest goes down to 6 percent, investment rises to Rs 80 billion. So, for the product market to be in equilibrium, savings must rise to Rs 80 billion. This relationship between the different levels of investment and savings is presented by the $I = S$ line in quadrant (b) of Fig. 16.1 with savings measured on the vertical axis and investment on the horizontal axis with the same scale as in quadrant (a). Since $S = I$ at all the levels of investment, the $I = S$ line is a straight 45°-line.

The 45°-line in quadrant (b) gives the equilibrium levels of savings which will keep the product market in equilibrium, at different levels of investment. It implies that when investment increases,

6. There are several different ways of deriving the *IS* schedule. The most common practice is to divide the diagram in *four quadrants*, each quadrant showing the functional relations between (a) interest and investment, (b) saving and investment, the equilibrium condition, (c) savings and income, and finally (d) relationship between interest rate and equilibrium levels of income. Different authors arrange different quadrants in different ways. We have used here a more logical and straightforward arrangement of the quadrants. Some authors adopt an intuitive approach to derive the *IS* curve directly from the income determination graph showing $AD = AS$ (for example, see) Mankiw, N.G., *Macroeconomics, op. cit.*, Ch. 10 and Blanchard, O, *Macroeconomics* (Pearson Education, 4th Edn.), Ch. 5.

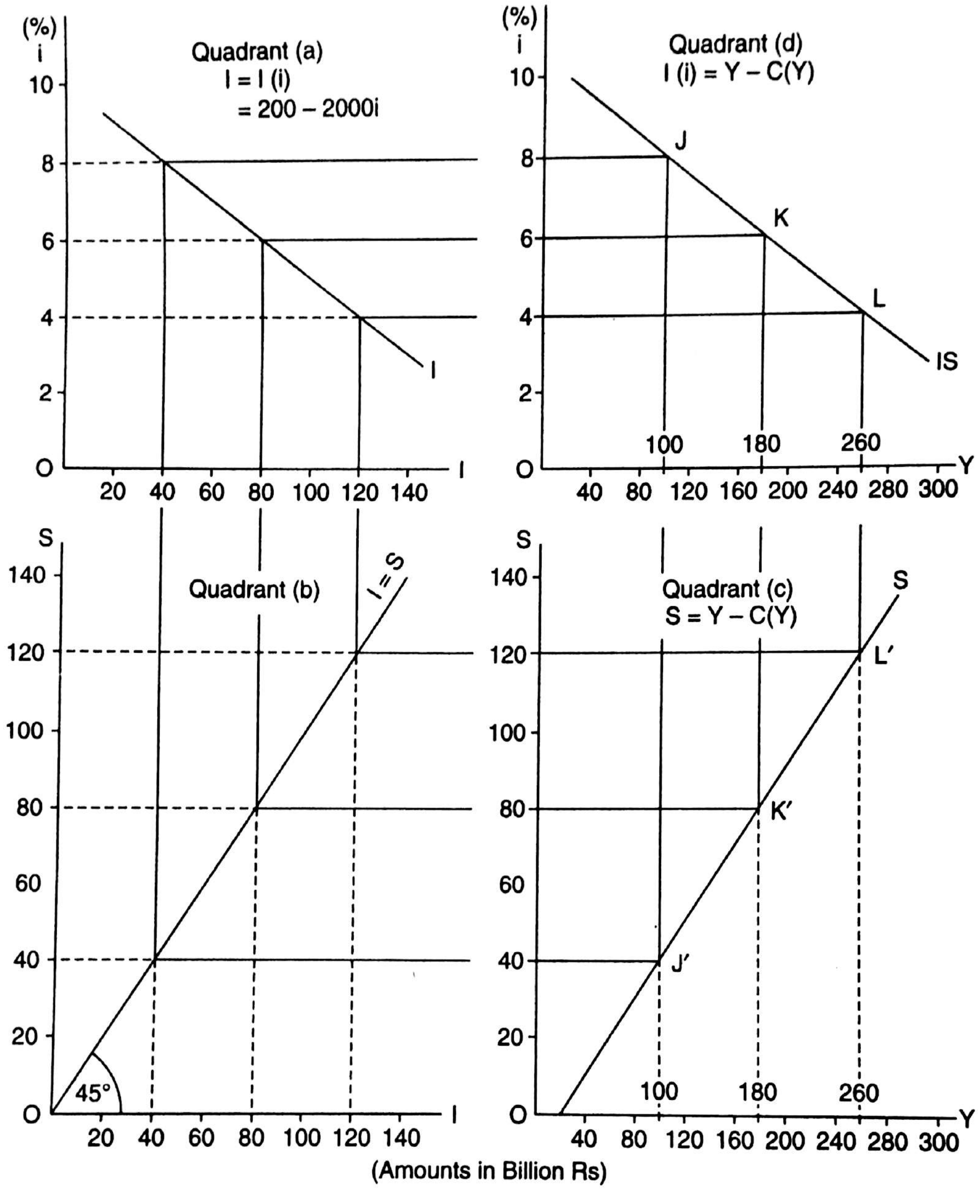


Fig. 16.1 Derivation of the *IS*-Curve

savings must increase to the same extent. Since $S = Y - C(Y)$ (or $S = -10 + 0.5Y$), income must increase for planned savings to increase. This relationship is given by the saving function in quadrant (c) with savings measured on the vertical axis and income on the horizontal axis. The saving function plotted in quadrant (c) gives the measure of the equilibrium levels of income at different levels of $I = S$. For example, at 8 percent interest, saving equal investment at Rs 40 billion. As shown in quadrant (c), a saving and investment of Rs 40 billion produces an equilibrium level of income of Rs 100 billion as shown by the point J'. Similarly, when interest rate goes down to 6%, $I = S$ rises to Rs. 80 billion. This level of $S = I$ generates income (Y) of Rs. 180 billion, as shown by the point K'. Similarly, point L' can be located on the saving function $S = Y - C(Y)$.

Now what we need to do is to link the equilibrium levels of income with the corresponding interest rate and derive the *IS* schedule. The *IS* schedule has been obtained in quadrant (d) by linking the interest rates and the equilibrium levels of income. Note that interest rate is measured on the vertical axis of quadrant (d) on the same scale as used in quadrant (a), and income (Y) is measured on the horizontal axis on the scale in quadrant (c).

The *IS* schedule has been derived as follows. Suppose that the equilibrium rate of interest is 8 percent. At this interest rate, $S = I$ at Rs 40 billion. The saving schedule in quadrant (c) shows that at the equilibrium level of saving and investment of Rs 40 billion, the equilibrium level of income is Rs 100 billion. When we link up this level of income with the interest rate of 8 percent, we get point J in quadrant (d). When interest fall to 6%, $S = I$ rises to Rs. 80 billion. With the rise in $S = I$ to Rs. 80 billion, the equilibrium level of Y rises to Rs. 180 billion. By linking this level of income to interest rate 6% in quadrant (d), we get a point K. We can similarly locate points L. By joining points J, K and L, we get the *IS*-schedule. *The IS curve is a locus of points showing equilibrium points of the product market at various combinations of* interest rate (i), investment (I), savings (S), and income (Y).

The *IS* curve has two *important implications. One,* it represents all the various combinations of interest (i) and income (Y), and investment (I) and saving (S) that keep the product market in equilibrium. The product market will not be in equilibrium at any point away from the *IS* curve. The reason is, all other points violate the equilibrium condition (I = S) of the product market. For example, at any point to the right of the *IS* curve, $S > I$, and at any point to the left of the *IS* curve, $S < I$. So the product market equilibrium has to be only on the *IS* curve. *Two,* the *IS* curve has a negative slope which implies that the level of the national income is inversely related to the interest rate.

Derivation of the LM Curve ***The LM curve shows the relationship between the interest rate and the equilibrium level of national income with money market in equilibrium.*** The *LM*-schedule can be derived straightaway from the money market equilibrium condition.

$$M_s = M_d$$

where, $M_d = M_t + M_{sp}$

$M_t = kY$

$M_{sp} = L(i)$

Thus, the money market equilibrium condition can be written as

$$M_s = kY + L(i) \tag{16.7}$$

Eq. (16.7) gives the *LM function.* It can be used to derive the *LM* curve. The derivation of the *LM* curve is illustrated in Fig. 16.2. This figure is also divided in four quadrants. Quadrant (a) presents a *hypothetical* Keynesian M_{sp} curve. The curvilinear M_{sp} function[7] for speculative demand for money is based on a function $M_{sp} = L(i)$. Quadrant (b) shows the relationship between *speculative* demand (M_{sp}) and *transaction* demand (M_t) for money. It gives the measure of M_t at the equilibrium of the money market, given the total supply of money (M_s). Since at equilibrium $M_s = M_d = M_t + M_{sp}$, with M_s constant, M_t decreases when M_{sp} increases and *vice versa*. In simple words, given the money supply, there is inverse relationship between M_t and M_{sp} i.e., if one increases, the other decreases. This relationship is shown by a line marked $M_t = M_s - M_{sp}$. The

[7] Here, we assume a nonlinear type of M_{sp} function, e.g., $M_{sp} = ai^{-2}$. In the following section, however, we will use, for convenience sake, a straight-line function for speculative demand for money.

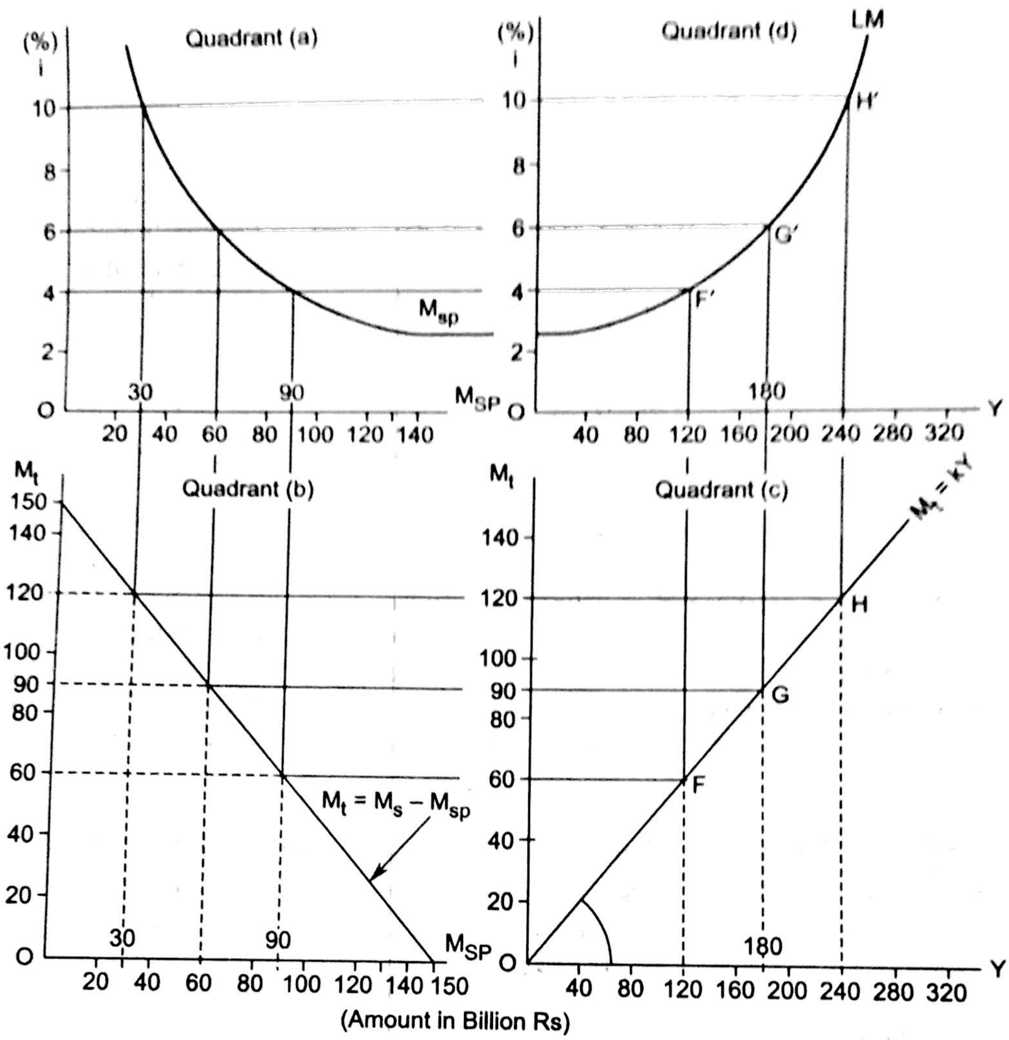


Fig. 16.2 Derivation of the *LM* Curve

significance of this line is that it gives M_t when M_{sp} is known at a given interest rate. For instance, given the supply of money (M_s), say, at Rs 150 billion and M_{sp} at Rs 60 billion at interest rate of 6 percent, the transaction demand for money, $M_t = 150 - 60 =$ Rs 90 billion.

Quadrant (c) shows the derivation of M_t-demand curve at different levels of income (Y), assuming M_t-function to be given as $M_t = kY$ (where $k = 0.5$). The M_t-curve gives the relationship between M_t and Y given the M_t-function. Given the M_t-function, if interest rate (i) is known, M_{sp} and M_t can be easily known, given the supply of money. And, when M_t is known, the equilibrium level of income (Y) corresponding to M_t can be known. For example, if interest rate is 10 percent, then M_{sp} = Rs 30 billion and M_t = Rs 150 billion − Rs 30 billion = Rs 120 billion. Given the M_t function as $M_t = 0.5Y$, the equilibrium level of income can be obtained as

$$M_t = 0.5Y$$
$$Y = M_t/0.5$$

Since M_t = 120 billion,

$$Y = 120/0.5 = \text{Rs } 240 \text{ billion}$$

The equilibrium combination of M_t and Y at interest rate 10% is shown by point H in quadrant (c). Similarly points G and F show the combination of M_t and Y at interest rates 6 percent and 4 percent, respectively. By drawing a line through points F, G and H, we get M_t-function.

Quadrant (d) of Fig. 16.2 shows the derivation of the LM curve. The LM curve is derived by linking the different interest rates and the equilibrium levels of income as shown in quadrant (d). For example, at the interest rate of 10 percent, M_{sp} = Rs 30 billion, M_t = Rs 120 billion and the equilibrium level of income is Rs 240 billion. By linking the equilibrium income of Rs 240 billion with the interest rate of 10 percent, we get point H' in quadrant (d). Similarly, when the interest rate decreases to 6 percent, M_{sp} rises to Rs 60 billion, and M_t decreases to Rs. 90 billion. By linking the equilibrium income of Rs 180 billion with the interest rate of 6 percent, we get a point G'. A number of such other points, for example, points F' can be located. By joining these points we get the LM curve, as shown in quadrant (d). *The LM is a locus of points showing equilibrium points of the money market at different levels of interest, income and demand for money.*

It is *important* to note here that all possible money market equilibria lie on only the LM curve and at no other point. The reason is, all other points violate the equilibrium condition ($M_d = M_s$) of the money market.

16.2.2 The Product and Money Market Equilibrium: The Graphical Method

Having derived the IS and LM curves, we can now integrate them to find the general equilibrium, i.e., the simultaneous equilibrium of the product and money markets at the same interest rate and the level of income. Fig. 16.3 presents the IS and LM curves derived in figures 16.1 and 16.2, respectively. The IS curve shows the equilibrium levels of Y at different levels of i with the condition that $I = S$. Similarly, LM curve shows the equilibrium levels of Y at different levels of with the condition that $M_d = M_s$.

As shown in Fig. 16.3, the IS and LM curves intersect at point E. Point E gives the unique combination of i and Y that satisfies the equilibrium conditions of both the product and the money markets, that is, $I = S$ and $M_d = M_s$ at the same interest rate (i) and income (Y). Point E is, therefore, the point of *general equilibrium.* At point E, both product and money markets are in equilibrium at interest rate 6 percent and income of Rs 180 billion.

At all other interest rates, there is divergence between the IS and LM curves. This divergence creates the condition of disequilibrium.

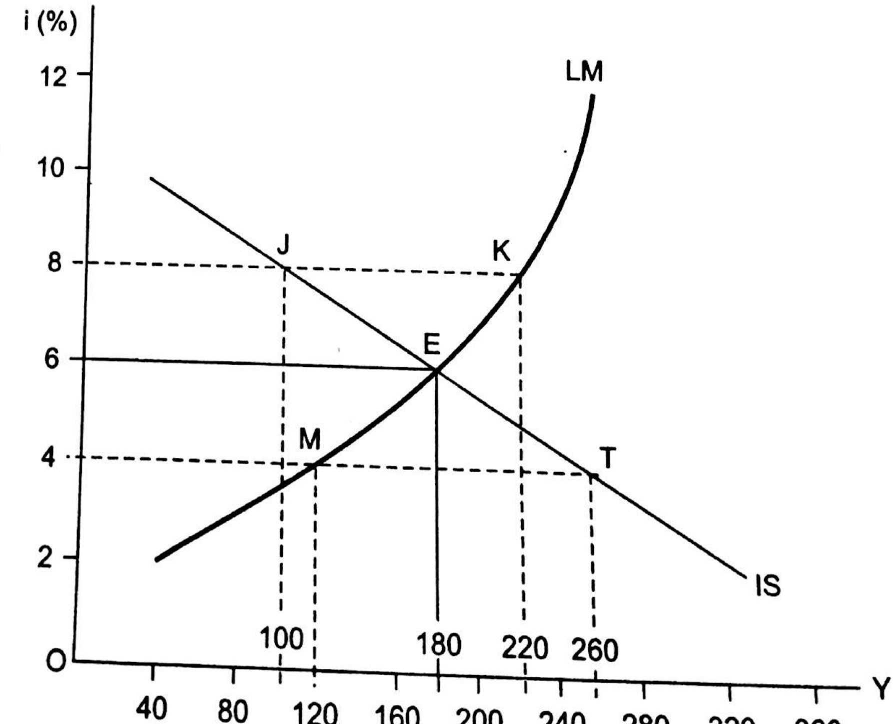


Fig. 16.3 The General Equilibrium of Product and Money Markets

For instance, suppose market rate of interest is given at 8%. At this interest rate, $I = S$ at the income level of Rs 100 billion, as indicated by point J. But, for the money market to be in equilibrium at this rate of interest, an income level of Rs 220 billion would be required, as indicated by point K. Thus, at interest rate of 8 percent, product and money markets are not in equilibrium at the same level of income. There is, therefore, no general equilibrium at this interest rate. Similarly, at interest rate of 4%, money market is in equilibrium at point M, with corresponding income of Rs. 120 billion, and product market is in equilibrium at point T, with corresponding income of Rs. 260 billion. The economy is, therefore, in disequilibrium. The system has, however, a tendency to converge to point E, the point of the general equilibrium. In fact, the disequilibrium conditions themselves create conditions for the sectoral adjustment making the economy move towards the point of general equilibrium. The adjustment mechanism of the markets to the conditions of the general equilibrium will be discussed in Section 16.4. Let us first look at algebraic derivation of the conditions for the general equilibrium.

16.3 ALGEBRAIC VERSION OF THE *IS-LM* MODEL

In this section, we present the *IS-LM* model in its algebraic form. We will first derive the fundamental equations that give the *IS* and *LM* curves and then combine them to present the general equilibrium model.

16.3.1 Derivation of *IS* Function: Algebraic Method

The *IS* function can be derived by using both the equilibrium conditions of the product market. The two equilibrium conditions are: (i) $AD = AS$, and (ii) $I = S$. We will show here the derivation of the *IS* curve by using both the conditions of the product-market equilibrium.

Derivation of IS Curve by the Equilibrium Condition AD = AS In order to derive the *IS* curve, let us recall the *product market model*. The product market is in equilibrium where

$$AD = Y = C(Y) + I(i) \tag{16.8}$$

Let us suppose that the terms $C(Y)$ and $I(i)$ are given in functional form as:

$$C(Y) = a + bY \tag{16.9}$$

$$I(i) = \bar{I} - hi \tag{16.10}$$

where $h = \Delta I/\Delta i$.

Given the consumption function in Eq. (16.9) and investment function in Eq. (16.10), the equilibrium condition for the product market given in Eq. (16.8) can be written as

$$Y = a + bY + \bar{I} - hi \tag{16.11}$$

$$= \frac{1}{1-b}(a + \bar{I} - hi)$$

Eq. (16.11) gives the IS schedule Recall that the term $1/(1\text{-}b)$ in Eq. (16.11) is the investment multiplier. Denoting *investment multiplier* by alphabet 'm', Eq. (16.11) can also be written as

$$Y = m(a + \bar{I} - hi) \tag{16.12}$$

Eq. (16.12) can be used to derive the *IS*-schedule. This can be shown by a numerical example.

Numerical Example Let us suppose that Eqs. (16.9) and (16.10) are given, respectively, as

$$C(Y) = 10 + 0.5Y \tag{16.13}$$

$$I(i) = 200 - 2000i \tag{16.14}$$

The product market equilibrium condition given in Eq. (16.11) can now be expressed in terms of Eqs. (16.13) and (16.14) as

$$Y = 10 + 0.5Y + 200 - 2000i$$

$$= \frac{1}{1-0.5}(10 + 200 - 2000i)$$

$$= 2\,(210 - 2000i)$$

$$Y = 420 - 4000i \tag{16.15}$$

Eq. (16.15) gives the IS-schedule in its numerical form. Since we have assumed a linear investment function, Eq.(16.15) gives a liner *IS*-schedule. The *IS*-schedule drawn on the basis of Eq. (16.15) is presented in Fig. 16.4.

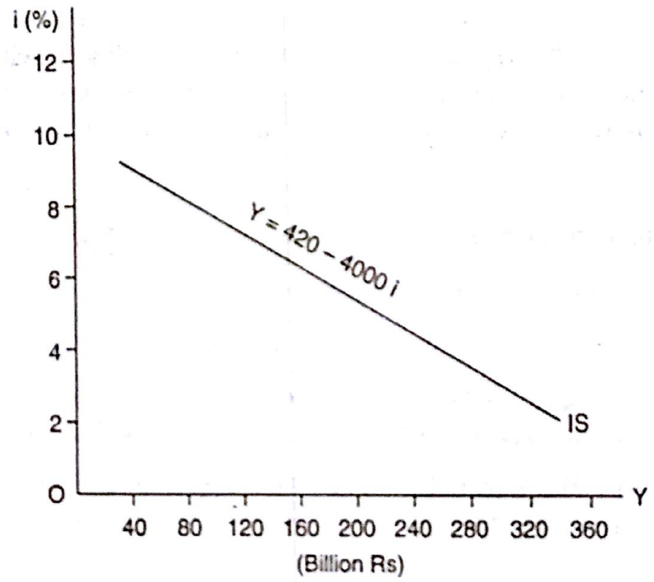


Fig. 16.4 Derivation of *IS*-schedule: Algebraic Method

Derivation of IS Curve by Equilibrium Condition I = S The *IS*-schedule given in Fig. 16.4 can also be derived on the basis of the other equilibrium condition of the product market, that is, $I = S$. We have assumed above an investment function as $I = 200 - 2000i$. As regards the saving function, $S(Y)$, it can be derived from the consumption function $C(Y) = 10 + 0.5Y$. We know that

$$S(Y) = Y - C(Y)$$

By substitution, we get

$$S = Y - (10 + 0.5Y) \tag{16.16}$$

$$= -10 + 0.5Y$$

Given the investment and saving functions, the equilibrium condition of the product market ($I = S$) can be expressed as:

$$200 - 2000i = -10 + 0.5Y \tag{16.17}$$

$$210 = 2000i + 0.5Y$$

Given Eq. (16.17), we get

$$Y = 420 - 4000i \tag{16.18}$$

Note that Eq. (16.18) is the same as Eq. (16.15) and will produce the same *IS*-schedule as shown in Fig. (16.4).

16.3.2 Derivation of *LM* Schedule: Algebraic Method

To derive *LM* schedule, let us recall here the condition for money market equilibrium. The money market equilibrium condition is reproduced here with some modification.

$$M_d = \overline{M}^s$$

where,

$$M_d = M_t + M_{sp}$$

$$M_t = kY, \ (k > 0)$$

$$M_{sp} = L(i)$$

In the Keynesian system, the M_{sp} demand function is a curvilinear schedule with a part made of straight horizontal line, that is, the part showing *liquidity trap* [see quadrant (a) of Fig. 16.2]. For convenience sake, however, we assume a straight-line demand function for M_{sp} given as

$$M_{sp} = \overline{L} - li$$

where $\overline{L}$ and l are constants, i is interest rate and $l = \Delta M_{sp}/\Delta i$.

Given the M_t and M_{sp} functions, the M_d-function can be expressed as

$$M_d = kY + (\overline{L} - li) \tag{16.19}$$

As regards the money supply ($\overline{M}^s$), it is assumed to remain constant in the entire analysis of the money market equilibrium. The price level (P) is also assumed to remain constant. Therefore, the *nominal* money supply ($\overline{M}^s$) equals the *real money* supply often denoted as $\overline{M}^s/P$. The money-market equilibrium condition can now be expressed as

$$\overline{M}^s = M_d$$

or

$$\overline{M}^s = kY + (\overline{L} - li) \tag{16.20}$$

Eq. (16.20) gives the money market equilibrium at different levels of income (Y) and the rate of interest (i). By rearranging the terms in Eq. (16.20), we get the *LM*-function as

$$Y = \frac{1}{k}(\overline{M}^s - \overline{L} + li) \tag{16.21}$$

Eq. (16.21) gives the *LM* function which can be used to derive the *LM* curve. Note that Eq. (16.21) produces a linear *LM* schedule unlike one given in Fig. 16.2.

Numerical Example Eq. (16.21) above gives the *LM schedule*. This can be shown by a numerical example. Let us assume that money-market model is given as

$$\overline{M}^s = 150 \tag{16.22}$$

$$M_t = kY = 0.5Y \tag{16.23}$$

$$M_{sp} = \bar{L} - li = 150 - 1500\,i \quad (16.24)$$

$$M_d = kY + \bar{L} - li = 0.5Y + 150 - 1500\,i. \quad (16.25)$$

By substituting relevant values from this model into Eq. (16.21), we get the *LM* function as

$$Y = \frac{1}{0.5}\,(150 - 150 + 1500\,i)$$

$$Y = 3000\,i \quad (16.26)$$

Alternatively, the money-market equilibrium condition can also be expressed as:

$$M_d = \bar{M}^s$$

$$0.5Y + 150 - 1500\,i = 150$$

$$0.5Y = 1500\,i$$

$$Y = 3000\,i \quad (16.27)$$

Note that both the formulations produce the same equation for the *LM* curve. The *LM* schedule derived from Eqs. (16.26) and (16.27) is presented in Fig. 16.5. Note also that function (16.27) produces a linear *LM* shcedule, unlike the one drawn in Fig. 16.2. This is so because we have assumed a linear M_{sp}-function.

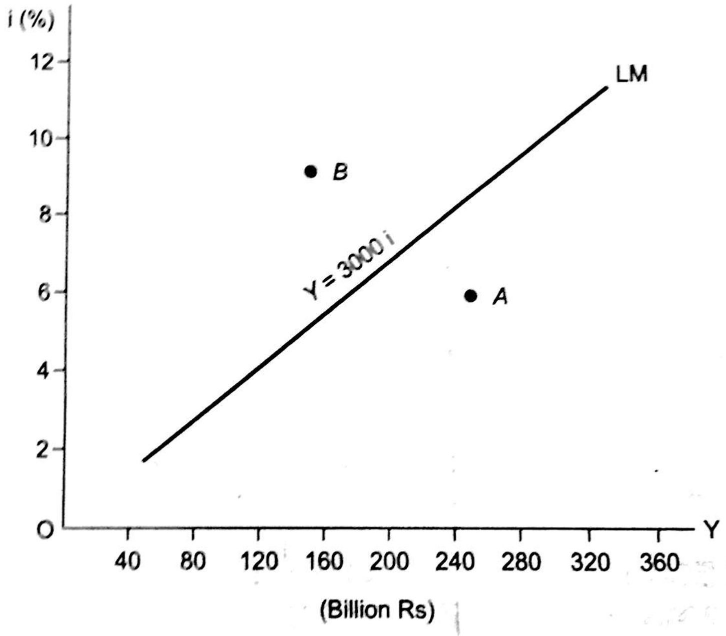


Fig. 16.5 Derivation of *LM* Schedule: Algebraic Method

16.3.3 Integrated Equilibrium of Product and Money Markets

Having derived the *IS* and *LM* functions, we may now combine the two functions and find the value of *Y* and *i* that conform to the general equilibrium—the equilibrium of the product and money markets at the same levels of *Y* and *i*. As noted earlier, the general equilibrium takes place where

$$IS = LM \quad (16.28)$$

Recall the *IS* and *LM* functions given in Eqs. (16.15) and (16.26), respectively.

...nction: $Y = 420 - 4000\, i$

...function: $Y = 3000\, i$

By substituting these equations into Eq.(16.28), we get the equilibrium interest rate as

$$420 - 4000\, i = 3000\, i \tag{16.29}$$
$$7000\, i = 420$$
$$i = 0.06$$

Eq. (16.29) gives the equilibrium rate of interest at 6%.

The equilibrium Y can now be obtained by substituting 0.06 for i in the IS or LM function. For instance, consider the IS function.

$$Y = 420 - 4000\, i$$
$$= 420 - 4000\,(0.06)$$
$$= 180$$

It means that, at the interest rate of 6%, the equilibrium level of income is Rs. 180 billion. The final conclusion that emerges from this exercise is that, given the IS and LM functions, the economy reaches equilibrium at the interest rate of 6% and national income of Rs 180 billion.

Alternative Method The IS and LM functions can be alternatively rewritten, respectively, as

IS function: $\quad Y + 4000\, i = 420 \qquad (1)$

LM function: $\quad Y - 3000\, i = 0 \qquad (2)$

Now we have two simultaneous equations with two unknowns, Y and i. The model can, therefore, be solved by the method of solving simultaneous equations. By subtracting Eq. (1) from Eq. (2), we get

$$7000\, i = 420$$
$$i = 0.06 \quad \text{(i.e., 6 percent rate of interest).}$$

By substituting 0.06 for i in Eq. (1) or (2), we can obtain the equilibrium value of Y. For example, using Eq. (2), we get

$$Y = 3000\,(0.06) = 180.$$

That is, the equilibrium level of Y is Rs 180 billion.

16.4 FROM DISEQUILIBRIUM TO EQUILIBRIUM—THE DYNAMICS OF ADJUSTMENT

Let us now look into the adjustment process by which an economy moves from the state of disequilibrium to its equilibrium. The economy is in disequilibrium on any other point than the point of intersection of the IS and LM schedules. In respect of disequilibrium analysis, *two important principles* need to be borne in mind for further analysis.

One, at any point that lies below and to the right of the LM schedule, say, at point B in Fig. 16.6, $M_d > M_s$. And, at any point that lies above and to the left of the LM schedule, say, at point A, $M_s > M_d$. Thus, any point away from the LM schedule marks the points of disequilibrium. Money market is in equilibrium, i.e., $M_d = M_s$, only at points that lie on the LM schedule.

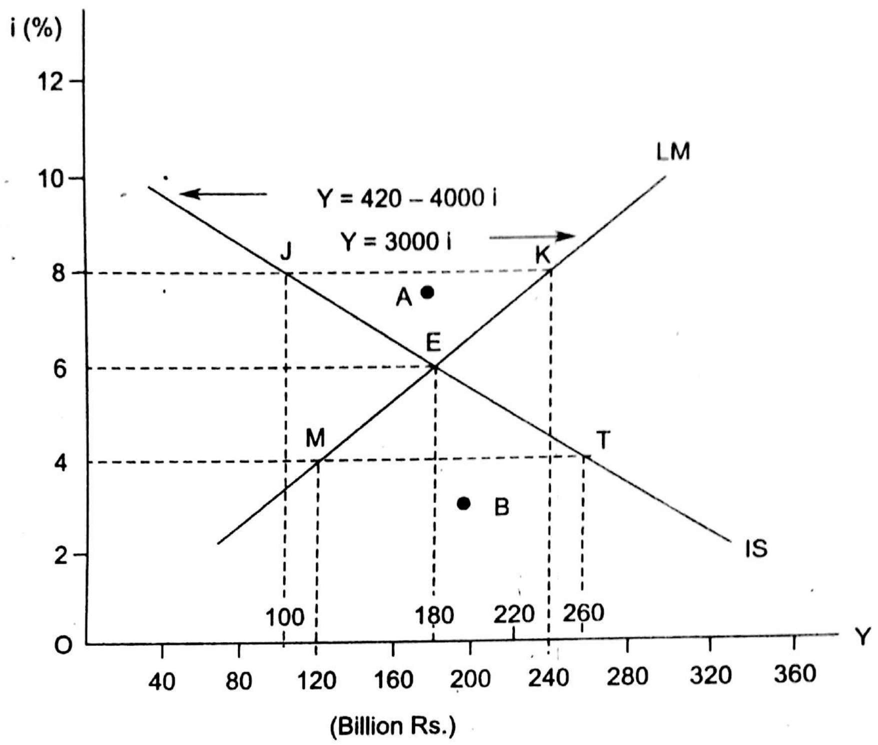


Fig. 16.6 The Process of Adjustment Towards the General Equilibrium

Two, at any point that lies below and to the left of the *IS* schedule, say, at point *B,* in Fig. 16.6, nned investment exceeds the planned savings. And, at any point that lies above and to the right the *IS* schedule, say, at point *A,* planned investment falls short of planned savings. The product rket is in equilibrium, i.e., $I = S$, only at the points that lie on the *IS* schedule.

Given these principles, let us now introduce the condition for disequilibrium and explain the cess of adjustment. It must be noted at the outset that the conditions of disequilibrium them-/es create the conditions for equilibrium. The process of adjustments is illustrated in Fig. 16.6. resents the *IS* and *LM* curves drawn in Figs. 16.4 and 16.5, respectively. The *IS* and *LM* curves rsect at point *E* determining the general equilibrium at Y = Rs 180 billion and interest rate at 6 cent. Now let us suppose that the interest rate rises to 8 percent. A line drawn horizontally from percent) intersects the *IS* curve at point *J* and the *LM* curve at point *K.* It means that, at 8 cent interest, the product market is in equilibrium at point *J* where Y = Rs 100 billion and I = On the other hand, the money market is in equilibrium at point *K* where $M_d = M_s$ at the income el of Rs 240 billion. Obviously, the equilibrium of the two markets is not consistent with the dition of the general equilibrium. This marks the condition of general disequilibrium.

Let us now look at the process by which product and money markets interact to make the em converge to the point of general equilibrium, i.e., point *E.* Going by the ***first principle,*** since t *J* lies above and to the left of the *LM* schedule, $M_s > M_d$, at 8 percent interest rate. By nption, M_s is given at Rs. 150 billion (Eq. 16.22). The amount by which money supply exceeds noney demand can be worked out as follows.

point *J,* product market is in equilibrium at Y = Rs 100 billion. The total demand for money s level of income can be obtained from the M_d-function given in Eq. (16.25), as

$$M_d = 0.5Y + 150 - 1500\ i$$

In our example, Y = Rs. 100 billion and i = 8 percent or 0.08. By substituting these values Y and i, in this equation, we get

$$M_d = 0.5\ (100) + 150 - 1500\ (0.08)$$
$$= 80 \text{ (i.e., Rs 80 billion)}$$

Since money supply is given at Rs 150 billion (see Eq. 16.22), it exceeds the demand for mo (i.e., Rs 80 billion) by Rs. 70 billion. This state of disequilibrium creates the conditions for and in motion a process of adjustment.

The process of adjustment begins as follows. Let us begin with the **product market**. The exc money supply, not needed for transaction, will flow to the bond market pushing up the bond pri Since bond prices and the interest rate are inversely related, interest rate (i) will go down (be 8 percent). The fall in the interest rate will affect both the product and the money markets. fall in the interest rate will affect the product market by increasing investment (I) because I = Increase in I will increase Y which will increase the transaction demand for money. The proc market equilibrium point J will shift downward along the *IS*-schedule towards point E.

In the **money market**, on the other hand, M_d will increase on account of two factors increase in transaction demand for money due to increase in Y, and (ii) M_{sp} will increase du the fall in the interest rate. As a result, the money market equilibrium tends to shift from poi towards point E. This adjustment process continues until the system reaches the general equilibr point E. Here, equilibrium rate of interest is 6 percent, $I = S$, and $L = M$ or $M_d = M_s$.

A similar analysis can be performed for an interest rate lower than the equilibrium interest of 6 percent. For example, suppose, for some reason, the rate of interest falls from the equilibr rate of 6 percent to 4 percent. *At 4 percent interest rate, the product market is in equilibriur point T (in Fig. 16.6) which gives the equilibrium level of income at Rs 260 billion.* Given M_d-function (Eq. 16.25), at Y = Rs 260 billion, the total demand for money equals Rs 220 bill (i.e., $M_d = 0.5 \times 260 + 150 - 1500 \times 0.04$). This demand for money (Rs 220 billion) exceeds supply of money (Rs 150 billion). It means that, people face shortage of transaction cash balan Therefore, they begin to sell their bonds and securities. Consequently, bond and security prices down and interest rate goes up. Due to the rise in the interest rate, I begins to decrease, and witl decreases the level of income (Y). Following the fall in Y, the transaction demand for mo decreases. This process continues until the system reaches the general equilibrium point E, wh interest rate is 6 percent, $I = S$ and $L = M$ or $M_d = M_s$.

16.5 SHIFT IN *IS* AND *LM* CURVES AND THE GENERAL EQUILIBRIUM

The general equilibrium is determined by the intersection of the *IS* and *LM* curves. Therefore, point of general equilibrium shifts due to a shift in the *IS* and *LM* curves. The *IS* and *LM* cu shift upward or downward depending on the direction of change in their determinants—saving investment in case of the *IS* curve, and money demand and money supply in case of the *LM* cu Following the shifts in *IS* and *LM* schedules, there is a shift in the point of general equilibri In this section, we will analyse the shifts in the *IS* and *LM* schedules in turn and the conseq shift in the general equilibrium. Essentially, we will examine the effect of change in savings investment and in money supply and demand on the general equilibrium.

16.5.1 The Shift in the *IS* Curve

Let us first analyse the shift in the general equilibrium caused by the shift in the *IS* schedule, assuming *LM* curve to be given. The shift in *IS* schedule is caused by the shift in the investment schedule (*I*) due to an autonomous investment[8]. Let us now suppose that the *I*-schedule shifts from I_1 to I_2 as shown in quadrant (a) of Fig. 16.7. The shift in the *I*-schedule implies an increase in investment at all the rates of interest. Therefore, shift in investment schedule is parallel. For instance, given the interest rate i_2, if *I*-schedule shifts upward from I_1 to I_2, it means that investment rises from OI_1 to OI_2, as shown in quadrant (a). Similarly, at the interest rate i_1, investment increases from OI_2 to OI_3. Note that $I_1I_2 = I_2I_3$. This means a parallel shift in the *I*-schedule.

With the increase in investment, the equilibrium levels of savings must increase too to match with a higher level of investment. Savings must increase from OS_1 to OS_2 at the interest rate i_2 and from OS_2 to OS_3 at the interest rate i_1, as shown in quadrant (b). This rise in the equilibrium levels of

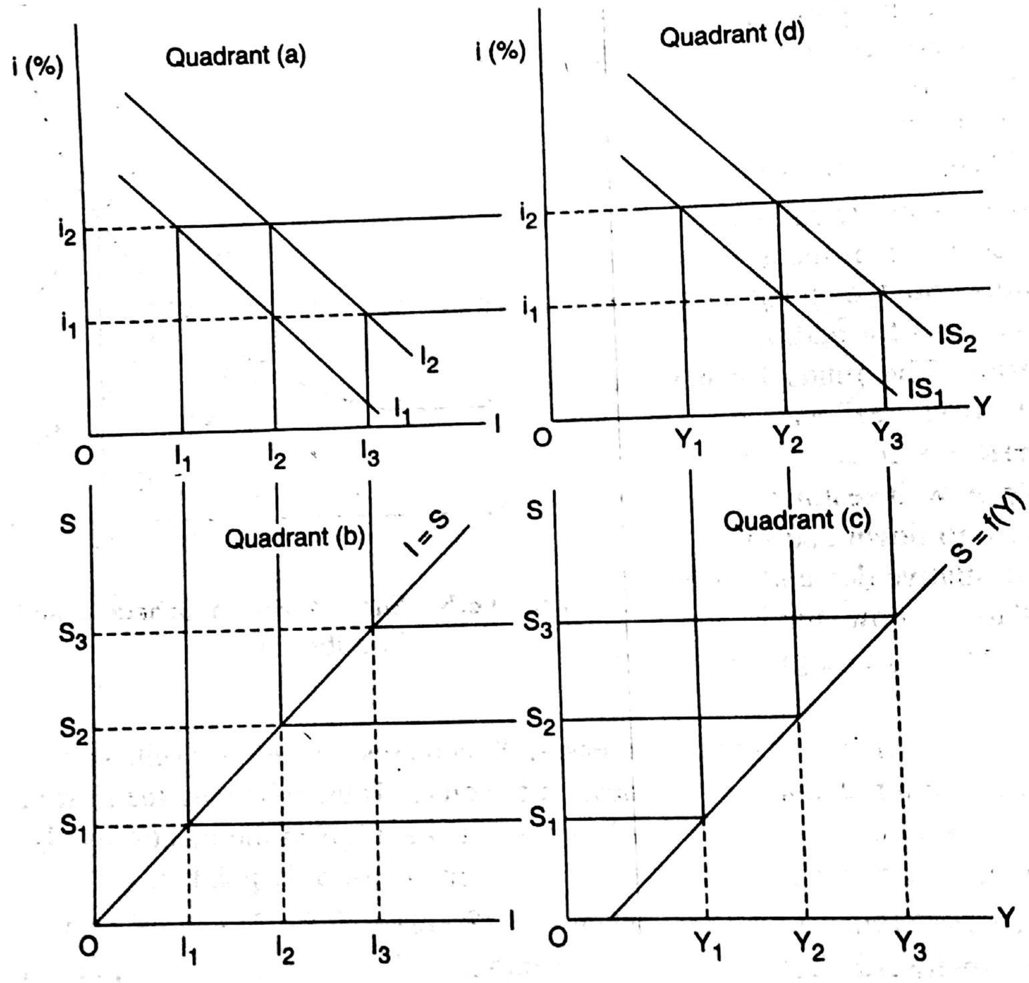


Fig. 16.7 Shift in the *I*-schedule and in the *IS* Curve

8. An outward shift in the *I*-schedule, implies that autonomous investment increases by a constant amount at each interest rate. This shift in *I*-schedule may be supposed to have been caused by exogenous factors like change in technology and hence a rise in the productivity of capital (indicated by an upward shift in *MEC* schedule), businessmen's expectations of market expansion in future, increase in foreign investment (in an open economy), and so on, all other things remaining the same.

saving and investment increases the equilibrium level of income. For example, given the interest ra i_2, when investment increases from OI_1 to OI_2, the level of income increases, as shown in quadra (c), from OY_1 to OY_2 and savings increase from OS_1 to OS_2 to match with investment. Similarly, given the interest rate i_1, when investment increases from OI_2 to OI_3 the level of output increase from OY_2 to OY_3 and savings increase from OS_2 to OS_3. By linking the new levels of income (Y with the corresponding rates of interest, we get a new *IS* curves shown by the schedule IS_2 in quadrant (d).

Shift in the General Equilibrium The shift in the general equilibrium, is illustrated in Fig. 16.8. Suppose that, at some point in time, the product and the money markets were both in equilibrium at point *E*, the point of intersection between IS_1 and *LM* curves. At point *E*, the equilibrium rate of interest is i_1 and the equilibrium level of income is Y_1, with $I = S$ and $M_s = M_d$.

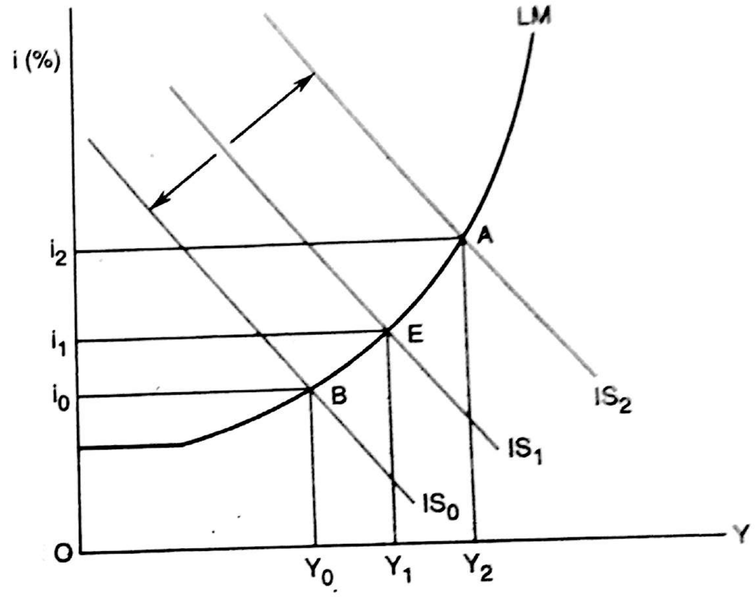


Fig. 16.8 Shift in the *IS* Schedule and the General Equilibrium

Let the IS_1 curve now shift upward to IS_2 for some extraneous reasons, the *LM* schedule remaining the same. The upward shifts in the *IS* schedule shifts the general equilibrium point from *E* to *A* which indicates a rise in the interest rate (*i*) from i_1 to i_2 and equilibrium income from Y_1 to Y_2.

An upward shift in the *IS* schedule implies also a rise in investment at a given level of savings. So the question arises: Where does the fund for additional investment come from? The funds for new investment come from reallocation of asset portfolio. Investors sell their bonds to acquire funds for new investment. As a result, bond prices go down and interest rate goes up and speculative demand for money goes down. This is how funds for new investment are obtained at a given level of *S* and *Y*.

More importantly, when investment increases, *Y* increases too. As a result, savings increase, on one hand, and transaction demand for money, on the other. Thus, following the shift in the *IS* curve, all the variables of the model—*I, i, Y, S*, M_d—move upward, given the money supply. That is, both product and money market equilibria move from point *E* towards point *A*.

A reverse process comes into force when the *IS* curve shifts downward from IS_1 to IS_0 for some reason. A downward shift in the *IS* curve implies fall in *I* and, therefore, fall in *Y*. Following the decrease in *Y*, the transaction demand for money decreases. This results in excess liquidity, given the supply of money. The excess liquidity finds its way into the bonds and securities markets. As a result, bond and security prices go up and the interest rate goes down. This process continues till the product and money markets reach point *B*.

16.5.2 The Shift in LM Curve

Let us now examine the effect of a leftward shift in the *LM* curve on the general equilibrium, assuming a given *IS* curve. The *LM* curve shifts left-ward due to (i) increase in speculative demand for money, interest rate given, (ii) decrease in the supply of money, and (iii) decrease in the transaction demand for money. The shift of the *LM* curve by each of these factors is explained and illustrated in turn. Let us begin by explaining the shift in the *LM* curve due to shift in the M_{sp}-schedule. For our analysis here, we assume a curvilinear M_{sp}-function.

Shift in M_{sp} Schedule and LM Curve The shift in the *LM* curve due to a shift in M_{sp} schedule is illustrated in Fig. 16.9. Suppose that the M_{sp}-schedule is given as M_{sp1} in quadrant (a) of Fig. 16.9. Given the interest rate i_2, the speculative demand for money is *OL* and transaction demand for money is *OR*, as shown in quadrant (b). Suppose that the interest rate remains stable at i_2 and speculative demand for money increases from *OL* to *OK*. This kind of increase in the speculative cash balance makes the M_{sp}-schedule shift to the right to the position of M_{sp2}. Therefore, given the money supply, transaction demand for money decreases by the same amount. For

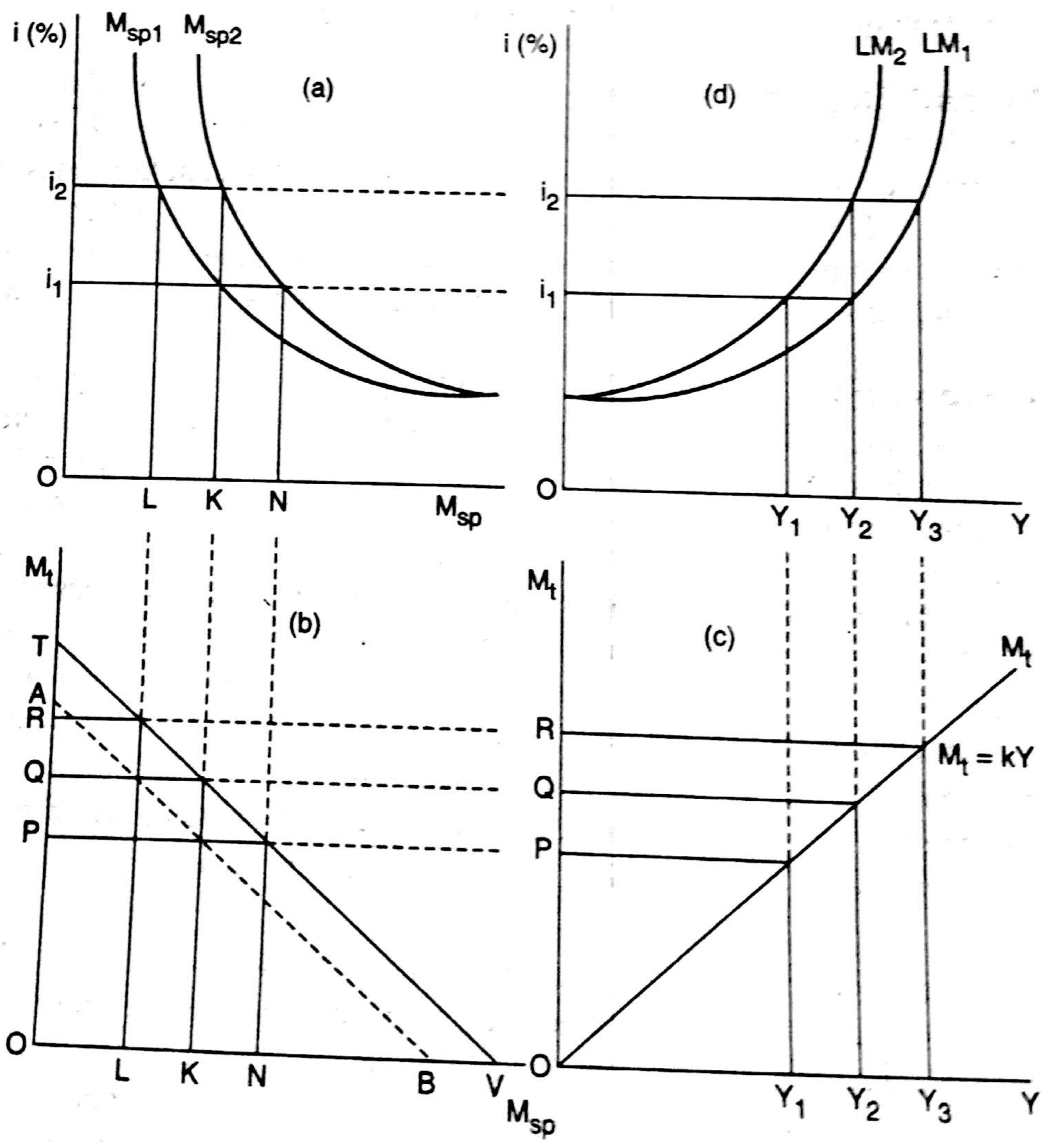


Fig. 16.9 Shift in the M_{sp} Curve and in the *LM* Curve

instance, when speculative cash balance increases by *LK*, the transaction demand for money decreases by *RQ*, as shown in quadrant (b).

With the fall in the transaction demand for money (M_t), the level of income must fall because a smaller transaction cash balance can support only a smaller level of output. The effect of fall in M_t on the level of income (output) is demonstrated in quadrant (c). For instance, when M_t decreases by *RQ*, the equilibrium level of income decreases from Y_3 to Y_2 and when M_t falls by *QP*, then *Y* decreases from Y_2 to Y_1. The decrease in the level of income at each interest rate is shown in quadrant (d). When we link each interest rate with lower levels of the equilibrium income, we get a new *LM*-curve, i.e., LM_2. This shows the shift of the *LM* curve from LM_1 to LM_2. The shift shows a fall in the equilibrium levels of income at each rate of interest.

Change in Money Supply and Shift in LM Curve A shift in the *LM* curve is also caused by the change in money supply. If supply of money decreases, *all other things remaining the same*, the line *TV* representing M_t in quadrant (b) shifts inward, as shown by the dashed line *AB*. This will alter the combination of M_{sp} and M_t. In effect, M_t will decrease, M_{sp} remaining the same. Since a smaller M_t can support only a smaller output, the equilibrium level of income will decrease at each interest rate. This will make the *LM* curve shift leftward from LM_1 to LM_2. By the same logic, an increase in money supply will make the *LM* curve shift rightward.

Change in M_t and Shift in LM Curve Another factor which makes *LM* curve shift is the change in M_t. Since $M_t = kY$, a change in factor *k* changes M_t. If factor *k* decreases, the M_t-schedule in quadrant (c) rotates clockwise and if *k* increases, M_t-schedule rotates anti-clockwise. In both the cases, the *LM* shifts leftward or rightward depending on whether *k* increases or decreases. A decrease in *k* makes the M_t curve rightward and therefore a rightward shift in the *LM* curve. An increase in *k* causes a leftward shift in the M_t curve, and a leftward shift in the *LM* curve.

Shift in the General Equilibrium The shift in the general equilibrium due to shift in the *LM* curve is illustrated in Fig. 16.10. Let us suppose that the product and the money markets are simultaneously in equilibrium at point E_0 where the interest rate = i_0, $Y = Y_0$, $I = S$, and $M_d = M_s$. Now let the *LM* curve shift from LM_0 to LM_1, say, due to increase in the money supply, while the *IS* schedule remains the same. When the money supply increases, given the level of *Y*, it leads to excess liquidity. This excess liquidity finds its way into the bonds and security markets. As a result, the bond and security prices go up and the interest rate goes down. A decrease in the interest rate encourages new investment which increases income (*Y*). Increase in *Y* leads to rise in the transaction demand for money. On the other hand, the speculative demand for money increases too due to fall in the interest rate. Thus, the total demands for money (M_d) increases. This process continues till both the product and the money markets reach a new equilibrium point E_1. At point E_1, all the variables of the model are in balance with one another, at a lower rate of interest, i_1, and a higher level of income Y_2.

Consider now the decrease in the money supply and a leftward shift in the *LM* curve from its original position LM_0 to LM_2. Given the income Y_0, a fall in the money supply results in shortage of transaction cash balance. To acquire additional transaction cash balance, the bondholders sell their bonds. This causes fall in the bond prices and increase in the interest rate. Increase in the interest rate leads to fall in the investment which in turn causes a fall in *Y*. With the fall in *Y*, the transaction demand for money decreases. This process continues till both the money and product markets reach a new equilibrium point at E_2.

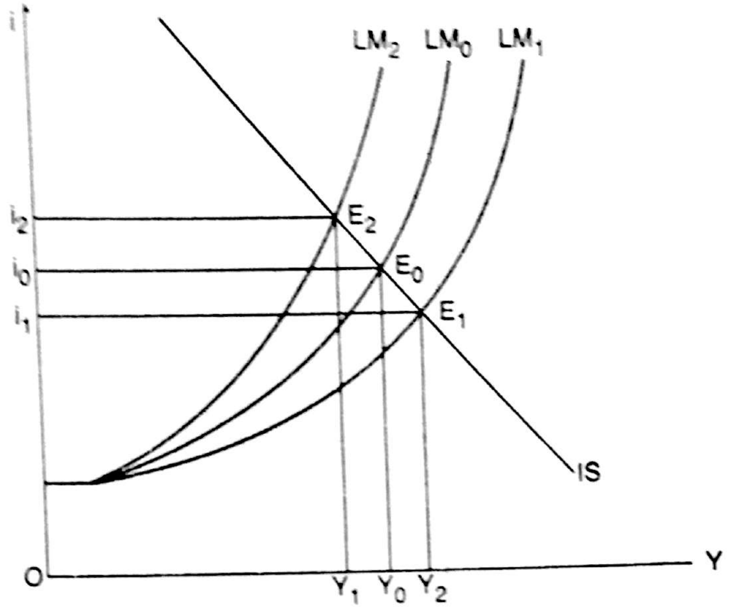


Fig. 16.10 Shift in the *LM* Curve and the General Equilibrium

16.5.3 Simultaneous Shift in the *IS* and *LM* Curves

We have discussed, in the preceding sections, the shift in the general equilibrium assuming first the shift in the *IS* curve and then the shift in the *LM* curve. In this section, we discuss the effect of a simultaneous shift in the *IS* and *LM* curves on the general equilibrium. For the sake of simplicity, we assume that both the curves shift in the same direction. The shift in the general equilibrium caused by the simultaneous shift in the *IS* and *LM* curves has been illustrated in Fig. 16.11. Suppose

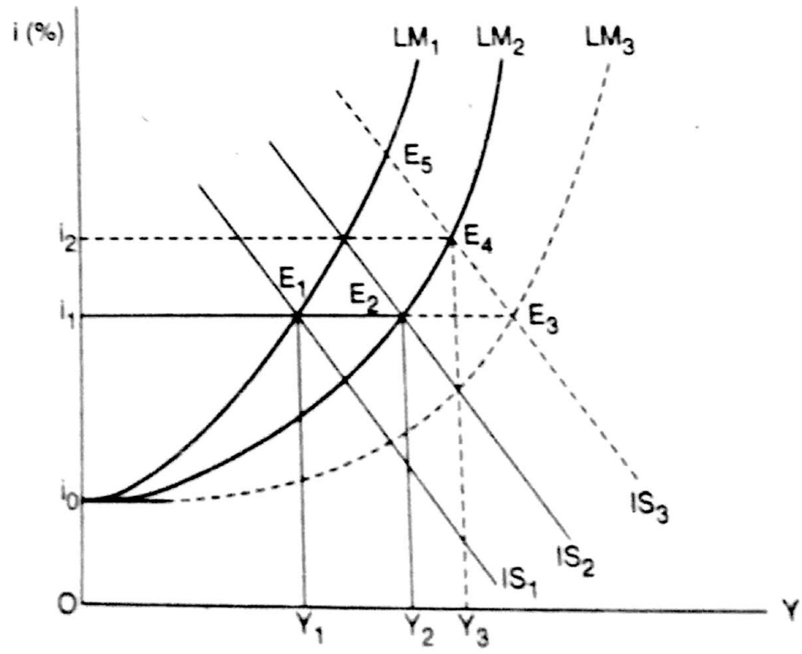


Fig. 16.11 Simultaneous Shift in the *IS* and *LM* Curves and the General Equilibrium

that the initial IS and LM curves are given as IS_1 and LM_1, respectively. The IS_1 and LM_1 intersect at point E_1—the point of general equilibrium—which determines the equilibrium le interest at i_1 and income at Y_1. Now, let the IS schedule shift from IS_1 to IS_2 and LM curv LM_1 to LM_2. The IS_2 schedule and LM_2 curve intersect at point E_2. Thus, the general equil shifts from point E_1 to E_2 and the equilibrium level of income increases from Y_1 to Y_2, intere remaining the same.

Note that the interest rate does not change—it remains the same (i_1). This is so becau magnitude of the shift in the IS and LM curves is the same at the given rate of interest, i equal shift in the IS and LM curves is indicated by the distance between E_1 to E_2. In r however, the shift in the IS and LM curves may not be the same. If the IS and LM curve with different magnitudes, even if in the same direction, the interest rate will change. For ex suppose that the LM curve shifts from LM_1 to LM_2 and the IS schedule shifts from IS_1 to I that case, equilibrium shifts to E_4 where interest rate rises from i_1 to i_2 and the equilibrium of income increases to Y_3. For the interest rate to be the same (i_1), the LM curve is requi shift to LM_3 and intersect with IS_3 at point E_3.

If the IS and LM curves shift in reverse directions, the change in the interest rate and ir will depend on both the direction and the magnitude of the shifts. For example, if IS_2 shifts and LM_2 shifts backward to LM_1, the new equilibrium will take place at point E_5 which ind a rise in the interest rate far beyond i_1 and fall in income below Y_2.

To sum up, a shift in IS and LM curves initiates a process of adjustment in the produc money markets. This process of adjustment brings about changes in the interest rate, demar money and income, and guides them to a new equilibrium. This is a theoretical possibility.

SUGGESTED READINGS

(For Readings, see at the end of Chapter 17).

QUESTIONS FOR REVIEW

1. Distinguish between the product and the money markets? Explain the interdependence of the two markets? How does it matter in the determination of the general equilibrium?
2. Define the IS curve. Derive it graphically. Explain the relationship between the interest rate and income.
3. What factors cause upward and downward shifts in the IS curve? Suppose autonomous investment increases, interest rate rema constant, how will it cause a shift in t curve. Illustrate graphically.
4. Suppose consumption and investment tions are given as:

$$C = 20 + 0.5Y$$

and $$I = 200 - 2000\,i$$

Find equilibrium level of income at in rates 8%, 6% and 5%.