Chapter 8

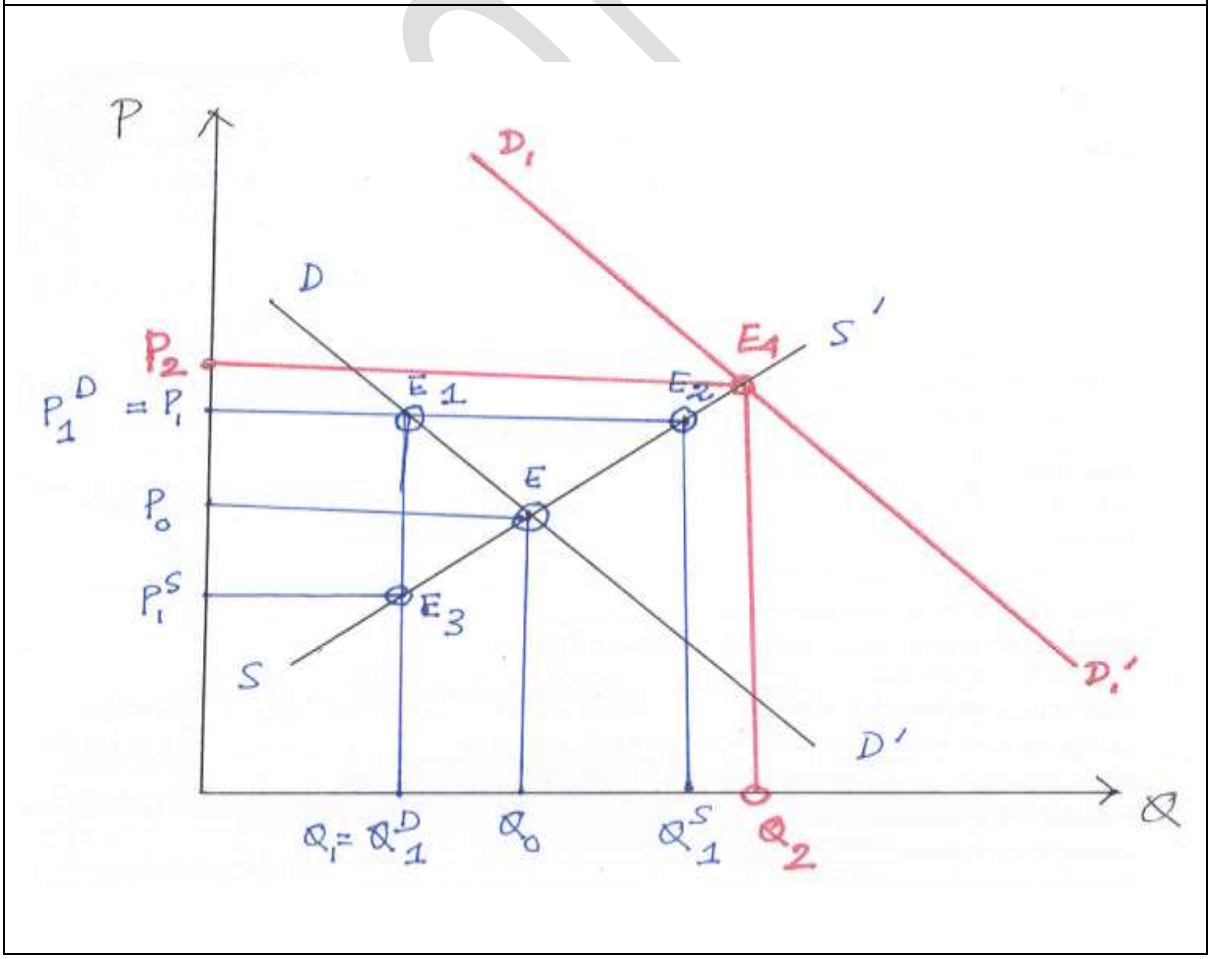
The Demand Side in Keynesian Macroeconomics

8.1 What has Microeconomic Theory 101 taught us?

In Microeconomics 101 life is simple. Equilibrium is determined by the intersection of demand and supply curves. These curves are normally well-behaved - the demand curve is negatively sloped and the supply curve is positively sloped. These curves intersect at a positive price and only once. Thus, the equilibrium exists and is unique. It is stable in the sense that there are forces within the system so that a perturbation from the equilibrium will normally be self-correcting. But how is it ensured?

Let us consider the following figure 8.1 describing demand curve (DD') and supply curve (SS') of a commodity, say oranges. Two curves intersect at point E. What is the equilibrium condition? There are two equivalent ways one can describe equilibrium condition (denoted by point E in the figure), viz., (a) quantity demanded = quantity supplied; or (b) demand price = supply price. Note that since two curves are well-behaved with a negatively sloped demand curve and a positively sloped supply curves and without any kink anywhere, these two conditions are equivalent and P_0 and Q_0 are equilibrium price and quantity, respectively.

Figure 8.1: Demand and Supply of Oranges



But what happens when by some accident, the economy moves away from E? Consider a price $P_1 > P_0$. At P_1 while quantity demanded is Q_1^D (at E_1) and quantity supplied is Q_1^S (at E_2). Since $Q_1^S > Q_1^D$; thus, there is excess demand and price will come down. In case we consider a point which is to the south of E, then $Q_1^S < Q_1^D$ and price will go up. This process of price adjustment in presence of excess demand / supply makes the equilibrium stable. This process is called the Walrasian process, named after the Nineteenth century French economist Léon Walras (1834 – 1910).

But we can interpret the whole process of adjustment in terms of quantity as well. Consider the quantity Q_1. At Q_1 the demand price is given by P_1^D and supply price is P_1^S. Since $P_1^D > P_1^S$, quantity will be adjusted rightwards and the economy will move towards the stable equilibrium at E. This process of quantity adjustment is called Mashrallian process, named after the British economist Alfred Marshall (1842 - 1924). Note that, in our simple story there is equivalence between Marshallian adjustment of quantity movements and Walrasian adjustment of price movements.

As we have noticed, in this simple world of basic microeconomics, life is quite. The equilibrium in the market for orange satisfies three properties of equilibrium, viz., (a) it exists; (b) it is unique; and (c) it is stable.

The next question comes in when one of the parameter values change, what happens to the equilibrium P_0 and Q_0? Illustratively, when income (I) of the consumer increases, since it is a parameter of the demand curve, the whole demand curve shifts outwards to D_1D_1'. As a result the new equilibrium is E_4. Comparing the old equilibrium E and E_4, one finds that there are increases in both the equilibrium quantity (Q_0 to Q_2) and price (P_0 to P_2). This method of comparing two different equilibria, before and after a change in some underlying exogenous parameter is called "comparative static" analysis.

Moving forward, these two methods of (a) determining equilibrium conditions; and (b) its comparative static analysis are going to be used extensively in macroeconomic models.

8.2 Macroeconomic Models

8.2.1 Birth of Keynesian Macroeconomics

When we consider the markets in isolation we call it as “partial equilibrium analysis”. In such a domain of partial equilibrium analysis, what is true for orange should be true for any commodity / service / factor, e.g., apple, money, bond or labour, as long as we are able to find out the relevant well-behaved demand and supply curves and as long as we know how to measure the relevant quantity and price. In such a world, there is hardly any necessity of macroeconomics, which is really the study of aggregate economic variable. The broad story line of such a macroeconomics is as follows – the economy has great forces of self-equilibration which via its price system would ensure all the three nice properties of any

economy-wide equilibrium. In case the current situation is off-equilibrium, relevant prices would change and the economy is back to the original equilibrium. The price system would, thus act as the God and would ensure a method in the madness of various economic agents each pursuing her own narrow economic goals. Thus, the economy may experience some bad times temporarily but over time things are back to normalcy. Put technically, there may be phases of recession (defined as two consecutive quarters of negative GDP growth) but not a long period of recession (called depression). Broadly the macroeconomics of pre 1930s can be caricatured into such a category. This stand of macroeconomics is popularly called Classical School of Macroeconomics.

The Great Depression of the 1930s that affected the global advanced economies questioned the existence and efficiency of the price system as the God. In order to appreciate the context, let us remind ourselves about the happening of 1930s. Worldwide, the bad times of the great depression lasted about five years – from 1929 to until about 1933. American economist Christina Romer from the University of California, Berkley documented the US experience in great detail and reported that the industrial production in the United States declined 47 per cent and real GDP fell 30 per cent during this five year period; also the wholesale prices declined by 33 per cent (a phenomenon called "deflation").[1] Apart from the US, various other countries were also affected; e.g., Great Britain, Germany, France, Canada, Switzerland, Czechoslovakia, Italy, Belgium, Netherlands, Sweden, Denmark, Poland, Argentina, Brazil, Japan, India, and South Africa – to name a few. It is in this historical context that the British economist John Maynard Keynes came up with his 1936 *locus classicus*, *The General Theory of Employment, Interest and Money* (popularly called the General Theory). In some sense the birth of modern macroeconomics can be traced from this book. Keynes was aware that the book that he was writing could change the form and content of the existing macroeconomic theories. On New Year's Day in 1935 Keynes in a letter to George Bernard Shaw wrote, "I believe myself to be writing a book on economic theory which will largely revolutionize - not, I suppose, at once but in the course of the next ten years - the way the world thinks about economic problems ….I can't expect you or anyone else to believe this at the present stage, but for myself I don't merely hope what I say. In my own mind I am quite sure." At this juncture a very brief biography of Keynes may be in order (Box 1).

Box 1

John Maynard Keynes: A biographical Sketch

Keynes was born in Cambridge on June 5, 1883 and attended King's College, Cambridge, where he earned his degree in mathematics in 1905. After leaving Cambridge, Keynes took a position with the civil service in Britain. In this role, he collected the material for his first book in economics, *Indian Currency and Finance,* in which he described the workings of India's monetary system. In fact he later played a key role behind the establishment of the Reserve Bank of India in 1934. He returned to Cambridge in 1908 as a lecturer, but later took a leave of absence to work for the British Treasury. By 1919 he became the UK Treasury's principal representative at the peace conference at Versailles. He

[1] Romer, Christina (2003): "Great Depression", article prepared for *Encyclopaedia Britannica*, available at https://eml.berkeley.edu/~cromer/Reprints/great_depression.pdf (accessed on June 6, 2018).

resigned because he thought the Treaty of Versailles was overly burdensome for the Germans. After resigning, he returned to Cambridge to resume teaching. A prominent speaker, Keynes was a member one of the famous Bloomsbury Group, which included Virginia Woolf and Bertrand Russell. At the 1944 Bretton Woods Conference, where the International Monetary Fund and the World Bank were established, Keynes was one of the architects of the post-war system of fixed exchange rates. Keynes died on April 21, 1946. In 1999, to mark his legacy, 'TIME' magazine listed him on the 'Most Important People of the Century' list. 'The Economist' described him as the 'Britain's Most Famous 20th Century Economist.

Keynes was well-known for his sharp, witty and profound short comments on various issues. The following quotes of Keynes may give some inkling about a great mind:

- "When my information changes, I alter my conclusions. What do you do, sir?"
- "The long run is a misleading guide to current affairs. In the long run we are all dead."
- "Capitalism is the astounding belief that the most wickedest of men will do the most wickedest of things for the greatest good of everyone."
- "The ideas of economists and political philosophers, both when they are right and when they are wrong are more powerful than is commonly understood. Indeed, the world is ruled by little else. Practical men, who believe themselves to be quite exempt from any intellectual influences, are usually slaves of some defunct economist."

Ideologically Keynes was never a left-wing intellectual. If one considers the fact that when he was writing the General Theory in early 1930s, the Bolshevik Revolution in USSR is already more than a decade old, his position can perhaps be caricatured as some sort of a convex combination of the capitalism and government intervention, as he himself had said, "The political problem of mankind is to combine three things: economic efficiency, social justice and individual liberty."

Reference:

Skidelsky, Robert (2003): *John Maynard Keynes: 1883–1946: Economist, Philosopher, Statesman*, London: MacMillan.

Reserve Bank of India (1970): *The Reserve Bank of India* (1935-51): Volume 1, Mumbai: Reserve Bank of India.

While it may be impossible to summarize the basic tenets of Keynesian Macroeconomics within a chapter, it may not be exaggeration to say that Keynes brought back the roles of demand and monetary and fiscal policies in macroeconomics. This chapter is devoted to introducing Keynesian Macroeconomics. But before we do so, a brief discussion of the macroeconomic model is in order.

8.2.2 Macroeconomic Models

Pick up any of the Newspaper, it has some economic news. Illustratively, In the Indian Financial Daily *The Economic Times* of July 1, 2018, the President of India, Mr Ram Nath Kovind is reported to have said, "Indian economy is set for a surge and in the next decade, probably even by 2025, India is expected to double the size of the GDP to USD 5 trillion."[2] Now, this is a statement and the question remains what is the causal story / channel though which this

[2] //economictimes.indiatimes.com/articleshow/64814140.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst (accessed on June 9 2018).

statement may turn out to be true. It might be that India has a large population and a large population may lead to higher output then the casual story runs from population to GDP. But then somebody may point out a huge population may be a drag on the economy and that this line of causation is wrong. Still someone else might say that given the current condition of India, more population may mean more educated population, perhaps also with more entrepreneurial spirit; thus, within next seven years or so, the size of Indian economy be double. End of the day, one gets opinions and counter opinions. How does then one find the truth? Economic theories, enshrining a logical proposition among a set of tractable variable, is perhaps the answer.

What is the task of a model? At some level it takes us to explain reality in terms of a few tractable variables. Thus, an economic model is different from a chronicle of a macroeconomic event; also it should not give us laundry list of innumerable reasons / happenings to explain an economic phenomenon. Professor Avinash Dixit of Princeton University has put it aptly in a recent lecture:

> "The art of scientific research differs from that of writing, painting, music etc. In the art of research, creativity cannot be free and unfettered; it is constrained by facts. You cannot have "surrealistic" science that violates reality. However, reality is complex, and its understanding is not always or even often best achieved by full detailed description. Art therefore enters the choice of what to include and what to leave out of one's analysis. It also enters the choice of techniques to use in the analysis. In theoretical modeling, …. this can be various mathematical methods (algebra, geometry, calculus, etc.), and sometimes just plain words" (Dixit, 2015).[3]

A theoretical macroeconomic model is, thus, a causal story. Consequently, in economic models a distinction is made between variables and parameters. In our well-known negatively sloped demand curve, quantity demanded of good i (Q_i^D) depends upon its own price (P_i) given the income of the consumer (I) and prices of related goods j (P_j). We can express this mathematically as a generic functional form either as

$$(8.1) \quad Q_i^D = f(P_i;\ P_j, I)$$

or as a linear functional form,

$$(8.2) \quad Q_i^D = a_0 + a_1 P_i + a_2 P_j + a_3 I.$$

In these cases, Q_i^D and P_i are variables and P_j and I are parameters.

Basic economic theory dictates the signs of first derivatives of the above relationships. Illustratively, in so far as equation (8.1) is concerned, microeconomic theory tells us the following: $\delta Q_i^D / \delta P_i < 0$; $\delta Q_i^D / \delta P_j >=< 0$ depending on the relationship between commodity i and j, and $\delta Q_i^D / \delta I > 0$, where δ denotes the partial derivatives. Alternatively, the same phenomenon can be captured in terms of the linear equation (8.2) by assigning

[3] Dixit, Avinash (2015): "Some Notes on the Art of Theoretical Modeling in Economics", Lecture at Lingnan University, Hong Kong. Graduate Student special class, 15 April 2015; available at https://www.princeton.edu/~dixitak/Teaching/ArtOfModeling.pdf (accessed on July 2, 2018).

appropriate signs to the coefficients, viz., $a_1 < 0$; $a_2 <=> 0$; $a_3 > 0$. In economics, the signs are essentially dictated by theory. In this chapter macro relationships and the signs of the partial derivatives (or coefficients in case of linear equations) will be dictated by the various / appropriate theories.

Before we come to various macroeconomic theories, four comments are in order.

First, while the world "macro", derived from the Greek word "Makro" meaning "long or large", literally speaking we do not add up the behaviours of two micro units to arrive at their macro behaviour. In fact, for all practical purpose, we will think of a representative agent (household / firm) and assume away all aggregation problems.

Second, how do we test for the validity of the theory? Economic reality is often contaminated by interplay of various parameters. Even if oranges are chapter now, its demand may not go high if (hypothetically speaking) some new medical study finds oranges are not good for your nails and peoples taste might have undergone change accordingly. In physical sciences the testing of theories are somewhat straightforward is the researcher can create laboratory condition. Illustratively, in high school when we are asked to test Newton's first law of motion that "an object in motion stays in motion with the same speed and in the same direction unless acted upon by an unbalanced force", we need to have a frictionless plane. But while frictionless plane is not to be found in reality, in laboratory condition the researcher can create a plane with very low friction. Similar laboratory experiments are difficult to do in macroeconomics. How then can one distinguish a good theory from a bad one? Leading twentieth century philosopher of Science, Karl Popper (1902 - 1994) emphasized the importance of "falsifiability", or "refutability", or "testability" in distinguishing a good theory from a bad one. The falsifiability of a theory can come a stylized fact or empirical testing or even episodic chronicles.[4] The evolution of macroeconomic theories often followed the trend of falsifiability. In empirical testing often a branch of economics called econometrics (which uses statistical models to arrive at an empirical regularity) is used.

Third, in this chapter we primarily will be concerned with deterministic models, as against stochastic models. What is the key difference between these two types of models? In deterministic models, the outcome of the model is fully determined by the parameter values and the initial conditions, while in stochastic models there are some inherent randomness so that the same set of parameter values and initial conditions (of the deterministic model) could lead to an battery of outputs. Admittedly, stochastic macroeconomic models are more realistic but these are much more complex and hence difficult to solve. Thus, as an easy approximation of the reality this chapter will primarily use deterministic macro models.

Fourth, time is a crucial dimension in macroeconomics that is often not mentioned categorically and hence becomes a cause of confusion. For example, in a normal day assume

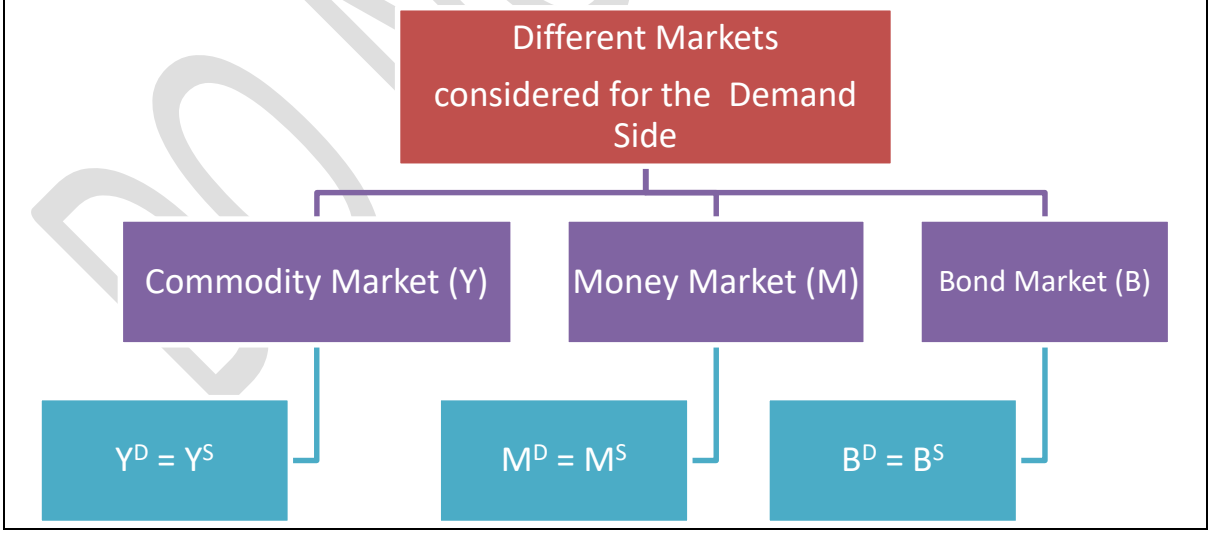
[4] Karl Popper's two books *(viz., The Logic of Scientific Discovery*, 1959; London, Routledge; and *Conjectures and Refutations: The Growth of Scientific Knowledge*, 1963, London: Routledge) played important role in this context.

you go to office by public transport which is cheaper than hiring a cab, which is faster than public transport. If one day you are required to go office early, you might not change your bio-rhythm and prefer to take the car. But if you change your job (with comparable salary), where you have to reach office an hour early than your earlier job, it may make sense for you to get up early and catch the public transport. That is say, depending upon the time period the adjustment mechanism could vary.

8.3 Major markets in the Demand Side of Macroeconomic Models

What constitutes the demand side of the macroeconomic models? Typically, as a consumer we demand various economic goods / services in life, such as, apples, oranges, rice, bread, television, car, house, money, education, recreation, Government bond, equity of a reputed company, gold, some bit of foreign exchange and what not - the list seems endless. It is impossible to arrive at demand for each of these goods / service. To do so is neither helpful nor practicable. So, we will group these. For the purpose of tractability (and our knowledge base) we will discuss three sets of demand, viz., (a) goods / commodities (Y); (b) money (M); and (c) bonds (B). Why are we neglecting share or equities? After all, in the newspapers of most of the countries we come across whether its stocks market is moving up or down. The unfortunate answer is: it is far too complicated to model equities in macroeconomics. There is of course another source of demand that we are neglecting in the present chapter, viz., demand for labour, which will be taken up in the next chapter. Hence for all practical purpose we will neglect equities in our basic models and confine our attention to three markets, where the equilibrium is determined by the equality of demand (denoted by superscript D), and supply (denoted by superscript S) (Box 2).

Box 2: Different Segments of demand in Macroeconomic Models



Different macroeconomic models differ in their forms of the demand and supply functions of these three markets.

Interestingly, if the universe comprises these three markets, then it may not be necessary to consider all these. After all, as the aggregate demand and supply of all commodities and services has to be equal to each other. In an n good / commodity (denoted

by i) world, this may be written as the identity between aggregate demand and supply, whereby[5],

$$(8.3) \qquad \sum_{i=1}^{n} P_i D_i \equiv \sum_{i=1}^{n} P_i S_i$$

Identity (8.3) can be written as, $\sum_{i=1}^{n-1} P_i D_i + P_n D_n \equiv \sum_{i=1}^{n-1} P_i S_i + P_n S_n$. Now, if all the n-1 markets are in equilibrium, then $\sum_{i=1}^{n-1} P_i D_i \equiv \sum_{i=1}^{n-1} P_i S_i$ and in that case, $D_n \equiv S_n$. Thus, out of the n markets if n-1 markets are in equilibrium, then nth market must be in equilibrium. This result, known as Walras Law, has profound implication for our discussion in macroeconomic models. Since we have three markets, we can effectively discuss two markets eliminating the third market. For all practical purpose we will discuss commodity and money market keeping the bond market in the background.

8.4 Commodity Market: Simple Keynesian Model

8.4.1 Description of the Model

Let us start with an analysis of the commodity market. Let there be a single commodity in the economy, denoted by Y. Of course, we can also think it a composite commodity but as already mentioned we assume away all problems of aggregation. This commodity Y may have two uses, viz., consumption (C) and investment (I). One can think of corn as an illustration which can be consumed as rice and can be invested as seed. A few features of this stylized economy deserve special mention.

First, in our model, there is just commodity like corn, which can be consumed as rice or can be invested as seed. Thus the notion of price is completely absent from the model. Hence the aggregate demand in the economy is given by the following relationship:

$$(8.4) \qquad Y^D = C + I$$

Second, the time period under consideration is very short, say, a day. Consequently, investment (I) in this model is given exogenously, and we get:

$$(8.5) \quad I = I_0$$

Third, consumption (C) in this model depends upon income / output (Y) *via* the psychology of the consumer. Thus, we have:

$$(8.6) \quad C = C(Y)$$

Note that we will follow the convention that any function relationship involving a variable will be written in the form of that variable itself, e.g., when we write y is a function of x, we will represent it as y = y(x) and not as y = f(x).

[5] Note that, the Greek letter sigma (Σ) denotes the summation.

Fourth, how does the relationship (8.6), formally called consumption function look like? By pure logic of psychology, when income increases consumption should increase but less than proportionately. For example if your income is RMB 10 thousand and corresponding consumption is RMB 7 thousand then when income is doubled (i.e., RMB 20 thousand representing an increase of RMB 10 thousand), your consumption is definitely going to increase but it will not increase by more than RMB 10 thousand. This means that change in consumption (dC; where d represents change) will definitely be positive (dC > 0) but will be less than change in income (dC<dY). Combining the two propositions, we have $0 < dC/dY < 1$. Note that in terms of basic differential calculus, dC/dY represents first order derivative of the consumption function (C=C(Y)). Geometrically, it represents the slope of the consumption function. Keynes termed dC/dY as "marginal propensity to consume" or MPC.

Fifth, savings in this model is simply non-consumption, or,

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

Note that the slope of the savings function is called "marginal propensity to save" (MPS) and since mps =1 – mpc, the value of mps should also lie between zero and one, i.e., $0 < dS/dY < 1$.

Seventh, combining (8.4) to (8.7) we, thus, arrive at the equation for the aggregate demand function, given by,

(8.8) $Y^D = C(Y) + I_0$

Eighth, since the time period is very short (say, a day) one cannot alter the supply in this model, so that supply function is just given by,

(8.9) $Y^S = Y$

Thus, combining (8.8) and (8.9) the equality of demand and supply ($Y^D = Y^S$) is attained when,

(8.10) $Y = C(Y) + I_0$, or equivalently,

(8.11) $Y - C(Y) = S(Y) = I_0$

8.4.2 An Algebraic Illustration

Let the model structure be illustrated by a linear model structure as follows: $C = a_0 + a_1 Y; and\ I = a_2$, then $Y = C(Y) + I_0$ would lead to, $Y = a_0 + a_1 Y + a_2$, yielding, $(1 - a_1)Y = a_0 + a_2$. Therefore, the equilibrium output / income (Y*) is given by:

(8.12) $Y^* = (a_0 + a_2)/(1 - a_1)$.

Let us look for economic interpretation of each of the coefficients.

- The slope of the consumption function or a_1 is simply the MPC which should be a positive fraction. Thus, MPC could be 4/5 or 1/5 but it would never be 1.5 or (-) 0.5. Also, note that since a_1 is MPC, the term in the denominator $(1 - a_1)$ is MPS.

- The intercept of the consumption function a_0 represents the autonomous consumption. Suppose you are a student and right now your income is zero, this does mean your consumption will be zero; e.g., your current consumption may come from your parents or funded by a bank loan or by your past savings. But whatever be the case, $a_0 > 0$.
- Moreover, Since S(Y) = $Y - C(Y)$, in this case, $S(Y) = Y - C = -a_0 + (1 - a_1)\, Y$, implying in this simplified model the intercept of the savings function is equal in magnitude but opposite in sign with the intercept of the consumption function.
- Coefficient a_2 is simply autonomous investment.

Interestingly, in this model, the income will be higher when (a) autonomous consumption is higher; (b) autonomous investment is higher (both a_0 & a_2 appears in the numerator of equation 8.12); and (b) mps is lower (since mps appears in denominator in equation 8.12) or equivalently mpc (1-mps) is higher. We will probe into the implications of these coefficients in determination of equilibrium income later. But before we do so, let us consider a graphical representation of the model.

8.4.3 A Graphical Representation of the Model

Figure 8.2 gives a graphical representation of the model. In the horizontal axis we have represented income (Y) and the vertical axis depicts various components of the aggregate demand and supply. The aggregate supply curve $Y^S = Y$ is represented by a 45° line (on which the vertical distance is equal to the horizontal distance from the two axes; remember tan(45°) = 1). The fixed investment part of aggregate demand is represented by a horizontal line with a distance of I_0 from the horizontal axis. The consumption function is represented by a straight line which has positive intercept (a_0) and slope equal to mpc (a_1), which is a positive fraction. Thus, the consumption function intersects the 45° line from above. In order to arrive at the aggregate demand we need to add investment to consumption, graphically, it amounts to shifting the consumption function in a parallel way by I_0. Thus, the line $C(Y) + I_0$ represents aggregate demand. Since the aggregate demand and aggregate supply curves intersects each other at E (where Y = C + I) corresponding level of income Y* is the equilibrium income.

Interestingly, the equilibrium income Y* can be arrived at from another way. From 45° we can vertically subtract consumption function to arrive at savings function. The savings function will have a negative intercept (which is equal to the intercept of the consumption function), will intersect the horizontal axis corresponding to a point when consumption function intersects the 45° line (implying Y = C, and hence S=0). Note that at Y*, the savings function intersects investment function (I_0). Thus, there are two equivalent ways to express the equilibrium condition either Y = C + I, or S = I, which is the same in equations (8.10) and (8.11).

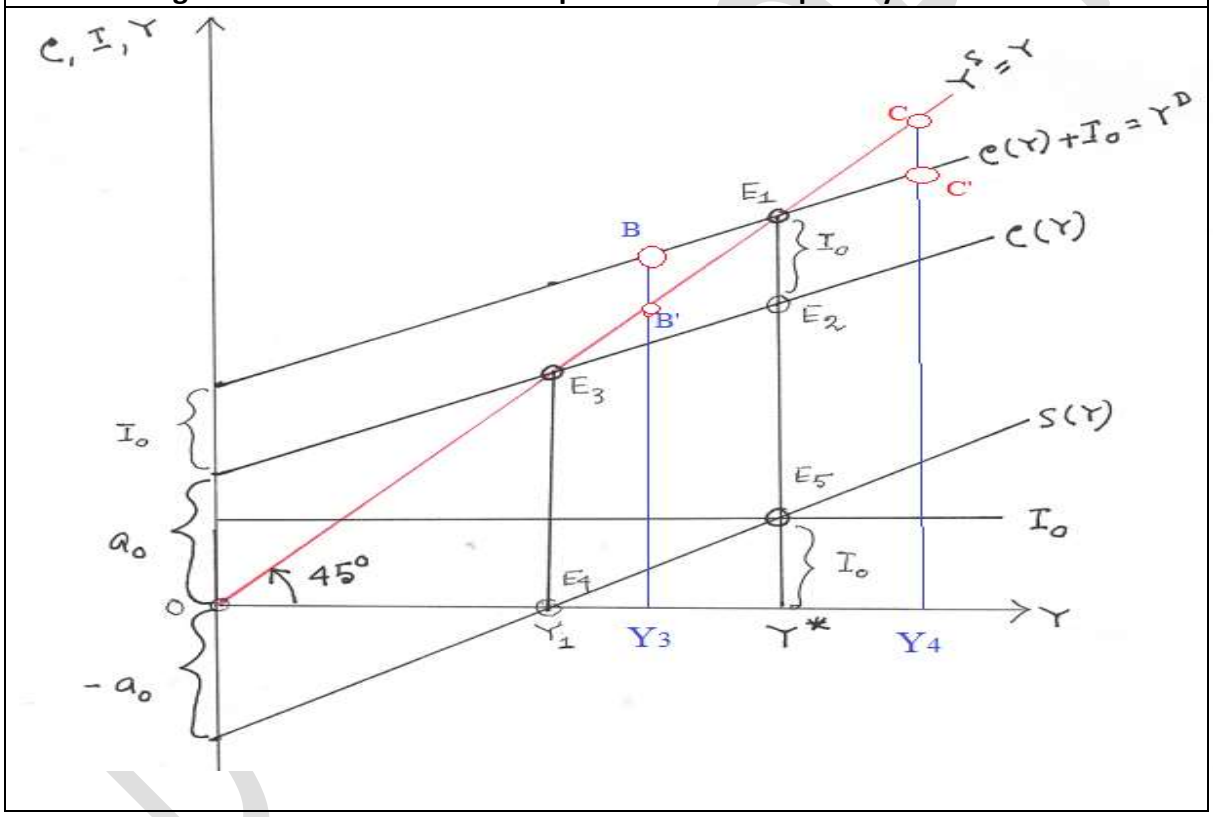
At this juncture an important feature of the equilibrium condition needs to be noted. We have learnt from national income accounting that GDP (or Y) is defined as the sum of consumption and investment. Does it then mean the economy is always in equilibrium? Clearly that cannot be the case. This apparent riddle can be solved if we interpret the all the variables in the equilibrium condition of Y = C + I, or S = I, in planned (or "*ex ante*") sense, as against actual (or, "ex post) sense in national income accounting. Thus, in particular, the equilibrium conditions should be explicitly written as follows,

$(8.10a)$ $Planned\ Y = Planned\ C(Y) + Planned\ I_0$, or equivalently,

$(8.11b)$ $Planned\ S(Y) = Planned\ I_0$

Also note that in Figure (8.2) the equilibrium Y (at Y*) is attained at E_1 (where Y = C+I, in a planned sense) or E_5 (where S = I in a planned sense)

Figure 8.2: Determination of Equilibrium in a Simple Keynesian Model



Having determined the equilibrium at Y*, the question comes whether it is stable.

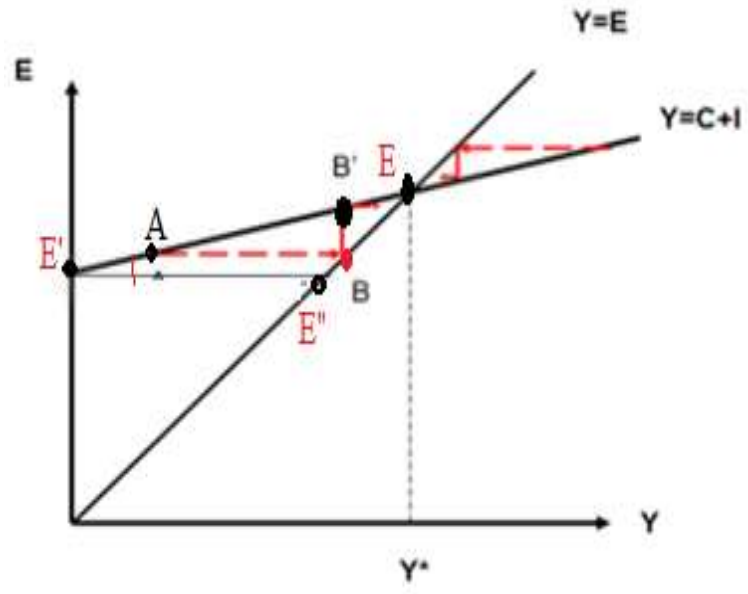
Consider a demand level of Y_3 < Y*, at this level, the aggregate demand is BY_3 while aggregate supply or production is $B'Y_3$. Thus, the extent of excess demand is BB'. In order to have stable equilibrium, something in the system needs to get adjusted so that the excess demand gets lower and lower over time. Look back at the first section on microeconomic stability analysis in terms of price and quantity adjustment, and asks yourself the question what would get adjusted here in an off-equilibrium situation? As there is no price in this

model, it has to be output. But being a very short period model, there is no way one can increase production? What then gets adjusted?

It is here "**unintended changes in inventory holding**" play a crucial role in this model. After all, in a situation like Y_3, when aggregate demand is more than aggregate supply, additional supply is brought and aggregate demand is met by only by drawing down inventory of the commodity. This will give a signal to the producer who in the next day could increase its production and thereby moving Y_3 to right till it goes to Y*. If the aggregate demand is at Y_4 then there is excess supply leading to unintended inventory accumulation causing reduction of supply next day and the equilibrium will shift leftward till it goes to Y*. Thus, the stability of the equilibrium is attained through unintended changes (drawdown or accumulation) in inventory. The general rule for stability is as follows:

- If planned expenditure (or demand) is *less* than output (or supply) then producers find that they are experiencing an unplanned accumulation of inventories, thus they will cut back production and output.
- If planned expenditure (or demand) is *more* than output (or supply) producers will find that they are experiencing an unplanned drawdown of inventories, hence will increase current production.
- This will go on till plans are fulfilled, and equilibrium is attained (Figure 8.3)

Figure 8.3: Stability of Equilibrium and the Adjustment Rule



Adjustment Rules:

- If Y < Y* then there will be inventory drawdown and in next period production will go up.
- If Y > Y* then there will be inventory accumulation and in next period production will down.
- If Y = Y* then there will not be any change

What is the stability condition then? Note that the adjustment mechanism described in Figure 8.3 will be valid if the aggregate demand curve (i.e., C+I curve) intersects the aggregate demand curve from above, which means if the angle ∠EE'E" = θ in Figure 8.3, then

θ < 45°. But remember tan(θ) is the slope of the C+I function, which means tan (θ) is mpc. Since tan(45°) = 1, the stability condition is satisfied when mpc < 1.

8.4.4 A Comparative Static Analysis: Keynesian Multiplier

Having determined the equilibrium demand Y*, let us change some of the parameters in the system and do the relevant comparative static analysis of the relevant parameters. A key parameter in the model is the exogenous level of investment I_0. What happens to the equilibrium demand Y* if investment changes from I_0 to $I_0 + \Delta I$ (where the Greek letter Δ denotes some discrete change; i.e., ΔI denotes change in I)? Graphically, in Figure 8.3, as a result of investment increasing from I_0 to $I_0 + A'E_7$ (=A E_6), aggregate demand goes from Y* to Y**.

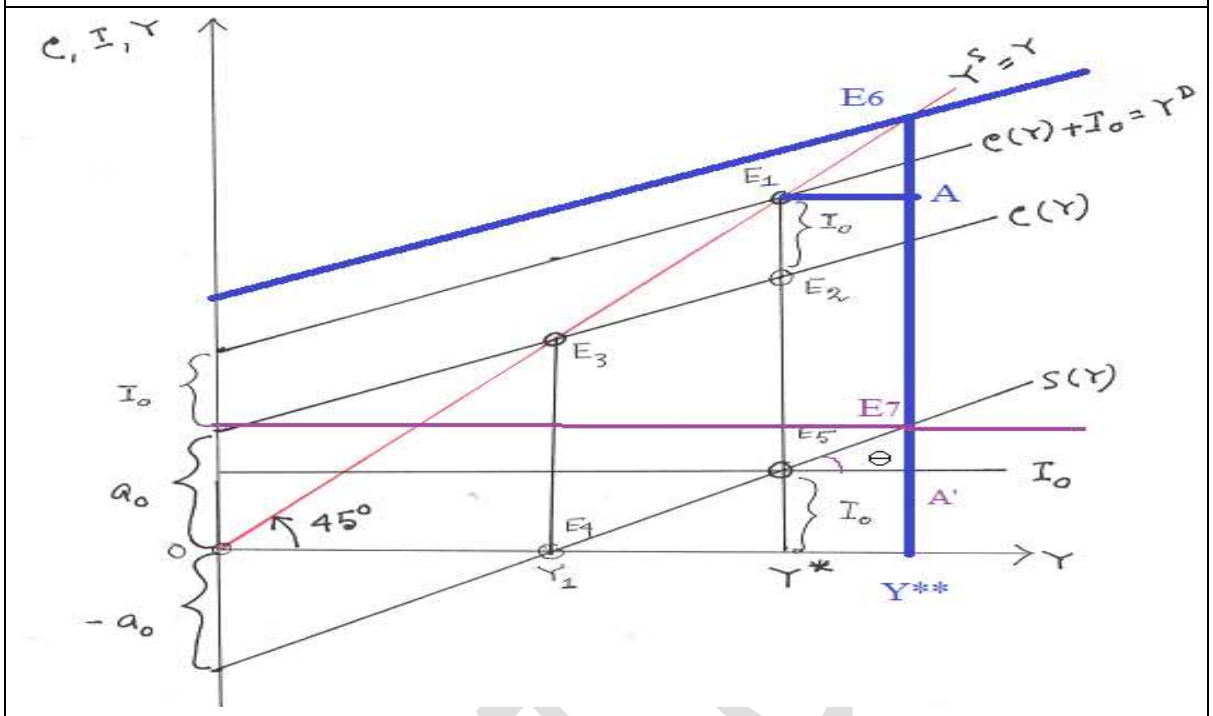
The question is what is the relation between the perpendicular $A'E_7$ and base E_5A' in the right angled triangle $E_5A'E_7$?

If we represent the angle $\angle E_7E_5A'$ by θ then by basic definition of trigonometry, tanθ = E_7A' / E_5A', or tanθ = ΔI / ΔY, yielding ΔY = (1/ tanθ) ΔI. But what is tanθ? It is merely the slope of the savings function S(Y), or the marginal propensity to save (mps or 1-mpc). Hence we arrive at the following basic relationship:

$$(8.13) \quad \Delta Y = \frac{1}{mps}\,\Delta I = \frac{1}{1-mpc}\,\Delta I$$

The question is whether ΔY > ΔI, or ΔY = ΔI, or ΔY < ΔI. Clearly the relative magnitude of ΔY and ΔI will depend on the value of $\frac{1}{mps} = \frac{1}{1-mpc}$. Now by economic logic, mps is a positive fraction (e.g., 0.5 = 1/2) , and the value of its reciprocal (1/0.5 = 2) has to be greater than one. Thus, the value of quantity $\frac{1}{mps}$ or $\frac{1}{1-mpc}$, is greater than one. Hence, ΔY is greater than ΔI. Thus, if investment (a parameter in our model) changes, in order to arrive at the resultant change of equilibrium demand (Y), the change in investment is to be multiplied by $\frac{1}{mps}$ or $\frac{1}{1-mpc}$, these quantity is known as multiplier, whose value is greater than one.

Figure 8.3: Investment Multiplier in a Simple Keynesian Model



In continuous time, if we treat the equilibrium condition, Y = C(Y) + I to be differentiable, then by totally differentiating it with respect to I, one gets the same multiplier formula (with C' as the mpc):

$$(8.13a)\quad \frac{dY}{dI} = \frac{dC}{dY}\frac{dY}{dI} + 1, \; or \; \frac{dY}{dI}\left(1 - \frac{dC}{dY}\right) + 1. \quad \therefore \quad \frac{dY}{dI} = \frac{1}{1 - \frac{dC}{dY}} = \frac{1}{1 - C'}$$

Equation (8.13) or (8.13a) is a great result. It shows if investment goes up by Rs. 100, then aggregate demand goes up not by Rs. 100, but if mpc= ½, then aggregate demand goes by Rs. [1/(½)]* 100 = Rs. 200. But how?

Consider the following illustration. Let the consumption function of the economy be $C = a_0 + a_1\, Y$ so that the mpc = a_1= ½. In this economy let there be an exogenous investment increases by RMB 100 million. Then to begin with the demand will go up by RMB 100 million in the first period, say t_1. Noting that Y = C + I, this increase in demand or equilibrium output will go up by ½*(RMB 100 million) = RMB 50 million in the second period, say t_2. This process will go on and on so that ultimately the economy will experience the following chain of changes in equilibrium output:

Time period	Change in Income (ΔY)
t_1	RMB 100 Million = ΔI
t_2	RMB 100 Million*½ = RMB 50 million = ½*ΔI (since mpc = ½)
t_3	RMB 50 Million*½ = RMB 25 million = ½*(½*ΔI) = $(½)^2$ΔI
t_4	RMB 25 Million*½ = RMB 12.5 million = $(½)^3$ΔI
....	.....

The process goes on and on.

Thus, the final change (denoted by Δ) in output / income is given by the following infinite series in geometric progression and yields a value of multiplier as two:[6]

$$(8.13b)\ \Delta Y = \Delta I + \frac{1}{2}\Delta I + \left(\frac{1}{2}\right)^2 \Delta I + \left(\frac{1}{2}\right)^3 \Delta I + \cdots \ldots \ldots up\ to\ \infty = \left(\frac{1}{1-1/2}\right)\Delta I = 2\Delta I$$

A few comments on (8.13b) are in order. First, since each number is getting multiplied by the value of mpc, which is a positive fraction, the series in (8.13b) is convergent (i.e., each successive term is less than each preceding term).[7] Second, since mpc is a positive fraction (e.g., ½ in our illustration), $\Delta Y > \Delta I$. Third, it is consumption that really acts as generator of demand in this model.

But wherefrom will this increase in investment come? It is here that we introduce government as another economic actor (apart from household and firm) in the model.

8.4.5 Introducing Government in the Simple Keynesian Model

Note that in the theoretical construct of "invisible hand" in a *laissez-faire* economy there is hardly any role economic role of government in an otherwise capitalist economy. [8] On the contrary, in a typical communist country (say USSR after the Bolshevik Revolution of 1917) government is the predominant economic agent. Keynes was thinking of a mixed economy where can have some meaningful role. For the time being, in our simple Keynesian model, let the economic role of the government be limited to taxation and spending. How would the Simple Keynesian model presented above change after the introduction of government? One can think of the following two changes:

---

[6] Remember the sum of infinite GP series of the form, $a+ar+ar^2+ar^3+ar^4+\ldots\ldots = a/(1-r)$, the common ratio, r is a positive fraction, i.e., r<1.

[7] We have already seen that in terms of the property of the equilibrium the stability is ensured via mpc being less than unity. After all, if mpc is greater than unity, the system will be divergent.

[8] Laissez-faire is a French word, which according to the Cambridge English Dictionary means "unwillingness to get involved in or influence other people's activities" or "If a government is laissez-faire, it does not have many laws and rules that control the buying and selling of goods and services". The origin of the word has an interesting anecdote. It is reported that the term *laissez faire* is most likely originated in a meeting that took place around 1681 between French Controller-General of Finances Jean-Baptiste Colbert and a group of French businessmen headed by M. Le Gendre. When the minister asked how the French state could be of service to the merchants and help promote their commerce, Le Gendre reportedly replied, "*laissez-nous faire*" ("leave it to us" or "let us do it)"; see https://en.wikipedia.org/wiki/Laissez-faire for details.

- First, apart from consumption and investment, government expenditure (denoted by G) is another item of aggregate demand, which is treated as a parameter.
- Second, with the introduction of taxes (T, a parameter of the model), consumption no longer just depends on income (Y), but "disposable income" (Y_d = Y-T).

Consequently, the equilibrium condition (8.10) may be revised as:

$$(8.14) \quad Y = C(Y - T) + I + G, \text{ or}$$

$$(8.14a) \quad S(Y - T) = I + G$$

Note that an autonomous shift in government expenditure (G) generates the similar multiplier effect as in (8.13). After all, an increase in government expenditure will generate additional demand in a chain of events as described in (8.13b). This can be seen from differentiating (8.14) with respect to G, and noting that $Y_d = Y - T$, which yields:

$$(8.15) \frac{dY}{dG} = \left(\frac{dC}{dY_d}\right)\left(\frac{dY_d}{dG}\right) + 1 = C'\left(\frac{dY_d}{dG}\right) + 1 \;\therefore\; \frac{dY}{dG} = \frac{1}{1 - C'} > 1$$

Wherefrom does the government spend (or, get G)? In real world, there can be three sources of government revenue: (a) taxation; (b) borrowing (issuing government bonds); and (c) deficit financing (or printing notes). In this simple one commodity model, let us not consider borrowing as an option. To begin with, let us consider an autonomous change in lump-sum taxation (T). Note that, a tax cut will lead to a rise in disposable income; consequently, consumption rises, aggregate demand rises, and output rises till a new equilibrium is attained (at a higher Y). Note that if we differentiate (8.14) with respect to T, we get:

$$(8.16) \frac{dY}{dT} = \frac{dC}{dY_d}\frac{d(Y - T)}{dT} = C'\left(\frac{dY}{dT} - 1\right) \;\therefore\; \frac{dY}{dT} = \frac{-C'}{(1 - C')}$$

Thus, if mpc= ¾ (i.e. 75 per cent of income is consumed and 25 per cent is saved), then out of an increase in government expenditure (dG>0), the value of the fiscal expenditure multiplier, i.e., dY/dG = 1/(1- ¾) = 4. But the tax cut multiplier (dT<0) is given by: dY/dT = (-)(-¾) / (1-¾) = (¾) / (¼) = 3 (note that another minus sign appears to account for the fact that dT<0).

Note that the tax multiplier is smaller than the government expenditure multiplier. After all, in case of expenditure multiplier the entire government spending increase goes towards increasing aggregate demand, but only a portion (75 per cent in this case) of the increased disposable income (i.e., Y-T) is consumed.

What happens if the budget is balanced? i.e., when dT/dG=1. Again consider equation (8.14) differentiate with respect to G to arrive at the value of balanced-budget (BB) multiplier $(dY/dG)_{BB}$ and then compare it with the unbalanced (UB) government expenditure multiplier as given by (8.15):

$$(8.17)\left(\frac{dY}{dG}\right)_{BB} = C'\left(1-\frac{dT}{dG}\right)+1;\ \therefore\ \left(\frac{dY}{dG}\right)_{BB} = 1 < \left(\frac{dY}{dG}\right)_{UB} = \frac{1}{(1-C')};\ as\ \frac{dT}{dG}=1$$

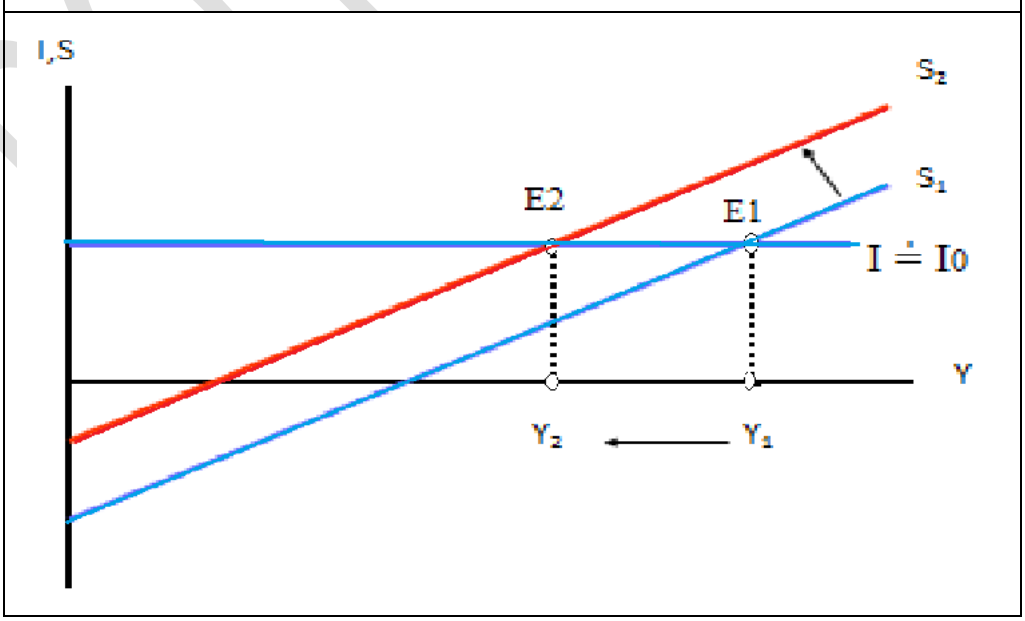
Note that in this case of balance budget, government spends on the one hand and taxes on the other. Thus, impact of the balance budget is limited to the initial expenditure as all the later positive multiplier effects of government expenditure are nullified by the negative effects of tax rise (note the minus sign in equation 8.16). Thus, if the government does not tax to finance its expenditure, what would be its source? In this simple model, the only source could be deficit financing, a euphemism for printing money.

Combination of (8.15), (8.16) and (8.17) present the basic tenets of Keynesian fiscal policy, demonstrating the effectiveness of government expenditure and limitation of a balanced budget.

8.4.6 Paradox of Thrift

Note that in the simple Keynesian model, from the expenditure or demand side, savings, taxes, imports are essentially leakages while investment by firms, government spending and export (expenditure on our goods by foreigners) are injections. In such a setup, one finds that thriftiness while a virtue for the individual, is disastrous for an economy. Why so? if consumers seek to save a larger amount out of any given level of income, that attempt to save more may lead to a fall in income leaving the amount of savings unchanged or even decreased. The basic concept is that if people save more in a recession, it will reduce consumption and thus aggregate demand will fall, impeding economic growth and, in fact, lowering the general level of savings. It rather resembles the notion of prisoner's dilemma in basic non-cooperative game theory in the sense that saving is advantageous to the individual but detrimental to the general population. This result is known as Paradox of Thrift and can be seen as from Figure 8.4.

Figure 8.4: Paradox of Thrift



In Figure 8.4, savings function shifts upwards from S_1 to S_2. With all other relationships remaining unaltered, this moves the equilibrium from E_1 to E_2, and the associated equilibrium level of income goes down so that $Y_1 < Y_2$.

How can we derive this relationship of paradox of thrift algebraically? In order to capture the functional form of savings function let us introduce a parameter α so that an increase in α shifts the savings function upwards. Thus, the earlier savings function given by equation (8.7) is reformulated as,

$$(8.7a)\ S = S(Y, \alpha)\ with\ mps = S_Y = \delta S/\delta Y > 0\ \&\ S_\alpha = \delta S/\delta \alpha > 0$$

where δ represents the partial derivatives of the relevant functions and is denoted by the subscipted variables (i.e., $S_Y = \delta S/\delta Y$ and so on).

Paradox of thrift can then be derived by totally differentiating the equilibrium savings investment equality, $S(Y, \alpha) = I$, so that:

$$(8.7b)\ dI = 0 = S_Y dY + S_\alpha d\alpha \ \ \therefore \frac{dY}{d\alpha} = -\frac{S_\alpha}{S_Y} < 0\ since\ S_Y > 0\ \&\ S_\alpha > 0$$

8.4.7 Some Preliminary Remarks

As these results has been heavily used and abused since the 1940s a few comments are in order.

First, it may be appropriate to treat these results, in the context of the simple Keynesian model (with one commodity in the time span of very short run, say a day), as indicative and not necessarily true in all situations.

Second, these results in their simplest forms neglect any implicit cost of deficit financing or the costs under bond financing.

Third, and most importantly this model assumes away supply constraints or postulates presence of unemployment resources. More formally, in the equilibrium income, Y* is given by, $Y^* = \min(Y^D, Y^S)$ and if $Y^D << Y^S$ then there will be unemployed resources and any fiscal policy would work in terms of generating aggregate demand. But in any situation when $Y^D >> Y^S$ such a policy would not work. But why would such a situation when $Y^D \neq Y^S$ arise? Does it go against our basic tenet of stable equilibrium? Is there any deficiency of the price system so that capitalist system fails to generate a stable equilibrium? In order to answer such question we will consider an extension version of the simple Keynesian model below where we will incorporate the money market in general and interest sensitivity of investment demand and money demand in particular.

8.5 Putting the Commodity and Money Market Together: The IS-LM Model

Camouflaged in English prose without much notation and figures, *the General Theory* is a difficult book to read. Perhaps Keynes' background in the philosophical basis of probability theory, mathematics and logic, made the text all the more abstruse. Writing exactly after ten years of publication of the General Theory, noted American economist Paul Samuelson, the Nobel Laureate in 1970, commented:[9]

> "I must confess that my own first reaction to the General Theory was not at all like that of -Keats on first looking into Chapman's Homer.[10] No silent watcher, I, upon a peak in Darien. My rebellion against its pretensions would have been complete except for an uneasy realization that I did not at all understand what it was about. And I think I am giving away no secrets when I solemnly aver-upon the basis of vivid personal recollection-that no one else in Cambridge, Massachusetts, really knew what it was about for some 12 to 18 months after its publication. *Indeed, until the appearance of the mathematical models of Meade, Lange, Hicks, and Harrod there is reason to believe that Keynes himself did not truly understand his own analysis*" (Samuelson, 1946; emphasis added).[11]

In fact, one of the most influential articles that sort of translated the General Theory in modern language was a young British economist John Hicks (later Knighted and a Nobel Laureate in Economics in 1972). Hicks in 1937 published an article "Mr Keynes and the "Classics": A Suggested Interpretation", that gave rise to what is now known as IS-LM model (which can be expanded as, "**I**nvestment **S**aving – **L**iquidity Preference **M**oney Supply"). It was popularized in the US by Alvin Hansen and often is often called called the Hicks-Hansen model and became the most standard paradigm of macroeconomic theory and policy.

Before we proceed further it may be useful to note that there are two major critiques against the IS-LM model. First, modern macroeconomics writings often note that the IS-LM analysis is devoid of an underlying microeconomic foundation and hence its validity can be questioned. Second, there is another non-mainstream view that IS-LM interpretation of Keynes is perhaps not an accurate representation of what Keynes wanted to mean - so much so that Axel Leijonhufvud, a Swedish economist who teaches at University of California Los Angeles, wrote a book titled, *On Keynesian Economics and the Economics of Keynes*.[12] While the second strand of criticism is beyond the scope of the present book, we will briefly discuss some of the models that address the first critique in a latter chapter.

---

[9] Note that the "Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel" (popularly called the Nobel Prize in Economics) has started in 1969 and has never been awarded posthumously. Thus, Keynes was never a contender of Nobel Prize in Economics.

[10] Added footnote: It may be noted that the reference is to a sonnet "On First Looking into Chapman's Homer" written by the English poet John Keats (1795–1821) in October 1816 describing his wonder while reading the works of the ancient Greek poet Homer as freely translated by the Elizabethan playwright George Chapman.

[11] Samuelson, Paul (1946): ""Lord Keynes and the General Theory", *Econometrica*, Vol. 14, No. 3 (Jul., 1946), pp. 187-200.

[12] Axel Leijonhufvud (1968): *On Keynesian Economics and the Economics of Keynes: A Study in Monetary Theory*, New York: Oxford University Press.

At his juncture, it may be useful to get to the skeleton of the model. Its main features are the following:

- The model examines the combined equilibrium of two markets: goods and money.
- Price level (P) is exogenously given.
- The goods market is at equilibrium when investments equal savings, (hence IS).
- While the goods market equilibrium can be described as Y = C (·) + I(·) + G, investment is no longer exogenously given, but is determined by real interest rate (r). Consumption continues to remain a function of Y.
- The money market is at equilibrium when the demand for liquidity equals money supply (hence LM).
- While money supply (M) is exogenously given, it has two sources of demand, viz., (a) transaction demand, that depends on Y; and (b) asset demand / speculative demand, which depends on nominal interest rate (i), which is defined as the real interest rate plus rate of inflation. Note that via constant P, the difference between real interest rate and nominal interest rate is assumed away from the model.
- Examining the joint equilibrium in these two markets allows us to determine two variables: output Y and the nominal interest rate i.

  We will now flesh out the skeleton of this basic model.

8.5.1 The Goods Market (the IS Curve)

The goods markets equilibrium is as earlier, viz., Y = C(Y-T) +I(·) + G. But the time period of the model is no longer is very short run, say a day but gets extended to medium term, say a year. In that case, investment is no longer fixed but depends on real rate on interest (r). How?

Note that investment in any project will crucially depend upon the stream of income / returns that it generates. Let us assume that an investment project lasts for two periods 0 and 1 and generates streams of income, given by R_0 and R_1. Now we cannot add R_0 and R_1 as these are accrued at different time periods. Since interest rate (r) is opportunity cost of the investment the present discounted value of the stream of incomes from the project is given by $R = R_0 + R_1/(1+r)$. If we relax the assumption of a two period project and take an N period project then the present discounted value (PDV) from the project is given by:

$$(8.18)\ R = R_0 + \frac{R_1}{(1+r)} + \frac{R_2}{(1+r)^2} + \cdots \ldots + \frac{R_N}{(1+r)^N} = \sum_{t=0}^{N} \frac{R_t}{(1+r)^t}$$

Note that higher is r the lower is the PDV from the project R, which will depress investment. Hence investment function is given as follows (where a dash / prime denotes first order derivative of the relevant function):

$$(8.19)\ I = I(r)\ with\ I' < 0$$

The equilibrium condition in the goods market is given by the equality of aggregate income and expenditure:

$$(8.20)\ Y = C(Y - T) + I(r) + G\ \ with\ 0 < C' < 1, \& I' < 0\ ;\ or\ equivalently,$$

$$(8.21)\ S(Y - T) = I(r) + G$$

Equations (8.20) or (8.21) describing the commodity market equilibrium is some sort of an equilibrium condition that we have not seen so far. It is an equilibrium condition in the commodity market with two variables, viz., Y and r. So it is not an equilibrium point but a curve. The combination of all Y and r for all which the commodity market is in equilibrium or I=S, is called the IS curve. What is its slope?

To understand the intuition for the slope of the IS curve consider equation (8.21), and do the following the thought experiment:

- Step 1: Let Y goes up
- Step 2: This will increase S, as S=S(Y-T) with S' > 0
- Step 3: In order to maintain the savings-investment equality I needs to go up in that case.
- Step 4: But I can go up if r goes down as I = I(r) with I'<0

To sum up:

$(8.21a)\ \boldsymbol{IS}:\ S[(Y \uparrow -\bar{T})] \uparrow = I(r \downarrow) \uparrow + \bar{G}$, where $\bar{T}$ & $\bar{G}$ are parameters of the model.

Hence any change in $\bar{T}\ or\ \bar{G}$ will shift the IS-curve.

Relating step 1 and step 4 we arrive at a result that an *increase in Y* needs to be accompanied by *fall in r* for maintenance of savings-investment equality. Thus, the IS curve is negatively sloped. This can be derived by totally differentiating equation (8.21),

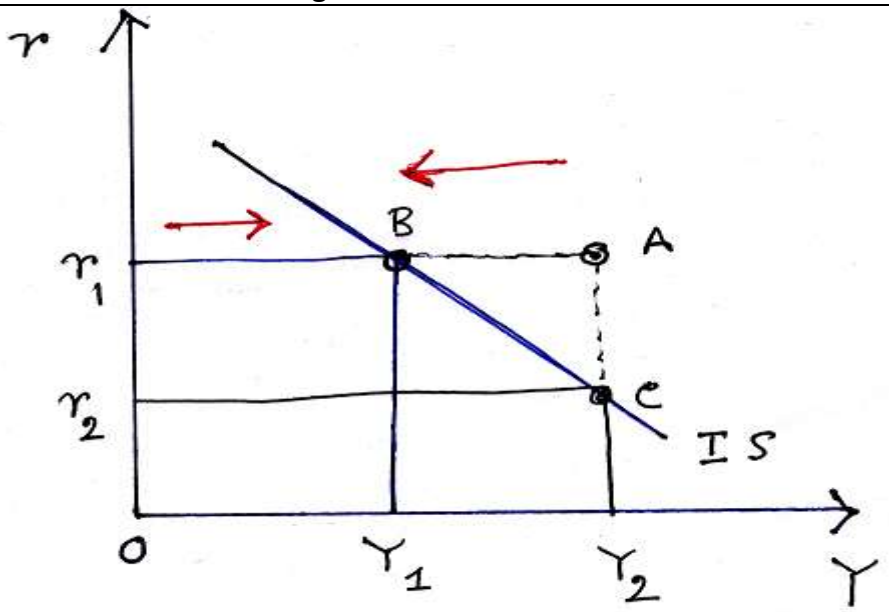
$$(8.21)\ S'dY = I'dr\ so\ that\ \left(\frac{dr}{dY}\right)_{IS} = \frac{S'(>0)}{I'(<0)} < 0$$

The IS curve is the locus or r and Y for all of which the commodity market is in equilibrium (Figure 8.5).

What is the adjustment process in the commodity market? It is postulated that despite the presence of both interest rate (r) and income (Y), the commodity market is more responsive to Y. Hence consider a point like A, corresponding to level of output $Y_2 > Y_1$ which is at the IS curve. Then, $S(Y=Y_2) > S(Y=Y_1) = I(r_1)$ then S > I. The adjustment rule in terms of discrepancy between savings and investment is given by:

- (8.22a) if S > I then Y decreases
- (8.22b) if S < I then Y decreases.

Figure 8.5: The IS Curve



8.5.2 Equilibrium in the Money Market: The LM Curve

Note that introduction of money (M) and bonds (a catch-all for all financial assets, called B) introduces price (P) in the model. While nominal money balance is denoted by M, real money balances is denoted by (M/P). Money or paper money to be precise does not yield any utility to an individual, why do people demand money then? Suppose a computer professional working in a hardware computer firm proposes to receive her income in the form of a laptop the both her as well as her firm's life will be miserable. After all, depending upon her productivity, the firm may find it difficult to pay her 1.357 laptops. She also may find it difficult to pay for a *Masala Dosa* (a popular breakfast / snack item in Southern part of India) as 0.015 laptops. To solve all such problems human civilization innovated the notion of money that we have already discussed in chapter 4.

At the outset a few features of money need to be noted. First, while we receive our income in form of money, money and income is not the same thing. Second, the return from holding money (in this case, cash) is negative of inflation. That is to say, if you hold INR 100 and if the inflation rate for India is 10 per cent per annum then INR 100 is worth of INR 90 after a year. Why then hold cash? It is better to hold bond (in this stylized two asset world) and earn rate of interest.

People hold cash because it is the most liquidity asset. Thus, Keynes viewed demand for money as a liquidity preference theory. In Keynes, people demand for money for two distinct purpose. First, *transaction demand for money,* i.e., the demand for money for the purpose of transaction and hence higher is someone's income higher will be her demand for money. Second, *speculative / asset demand for money*, refers to the demand for money for the purpose of easy liquidity forgoing the option to hold bonds

We will discuss these two sources of demand for money in a bit detail.

Transaction demand for money

As far as transaction demand of money is concerned, it can be best captured through what us known as "quantity theory of money". The earliest exposition of quantity theory can be traced in the writings of the Fifteenth century astronomer Nicolaus Copernicus, who was reported to have expressed the view that an excess quantity of money should be avoided. In the late 17th and 18th centuries expositions of quantity theory can be found in John Locke, Richard Cantillon, and David Hume and the quantity theory of money was integrated into the classical economics. In its basic form, the quantity theory of money looks like an identity, derived from the definition of velocity of circulation (V) defined as "number of times a unit of money changes hands for making aggregate transactions". In order to appreciate the concept of velocity of circulation suppose there are three people (A, B and C) each with an initial endowment of three commodities, viz., rice, vegetables and fish. Suppose to begin with A has rice and one unit of INR, B has vegetables but no money, and C has fish but no money. Consider the following series of transactions:

- A buys vegetable from B by spending one INR, so that at the end of transaction A has both rice and vegetable and B has one INR.
- In the next stage B buys fish from C so that at the end of transaction B has fish and C has one INR.
- In the third stage C buys vegetable from A so that at the end of the transaction C has vegetable and A has rice and one INR.

In this series of transactions, the total value of transaction is 3 INR which has occurred with one unit of money. This has occurred because one unit of INR has changed hand thrice. Put formally, the velocity of circulation is three in this case.

In general terms, if P be the price level and Y be the real income, then P·Y is the value of aggregate nominal income (assumed to be equal to transaction for simplicity), if M be the money supply then velocity of circulation is defined as:

$$(8.23)\ V = PY/M$$

The quantity theory of money is then given by:

$$(8.24)\ MV = PY$$

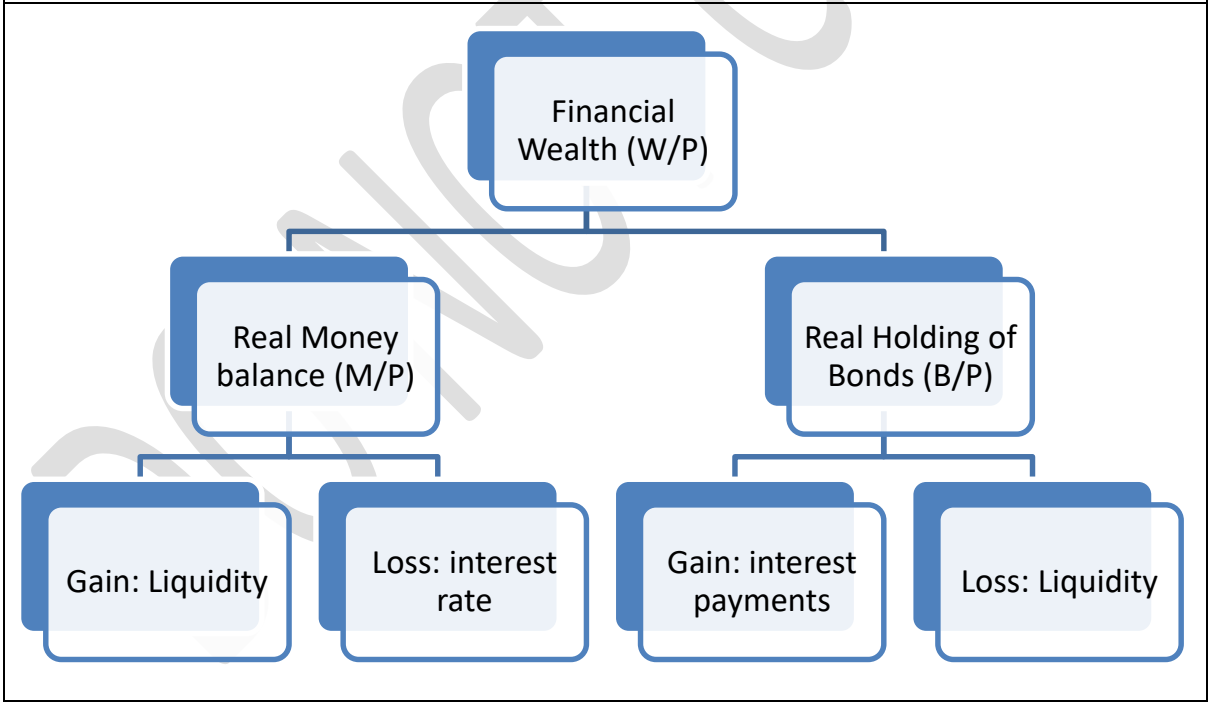
There are number of implications of the quantity theory of money. First, if V is taken to be a constant determined by institutional factors like payment system, degree of development in an economy, then as can effectively take it to be a constant. In the classical traditional Y is determined by the supply side of the economy (given by labour demand and supply and the level of technology yielding an aggregate production function), the equation (8.24) can be written as: $M\bar{V} = P\bar{Y}$, where symbol with an upper bar represents a parameter; in this case, a doubling of money supply M to 2M, makes the price level from P to 2P. This proportional relationship between money and prices is a corner stone of the quantity theory and we will turn to this issue in a later chapter.

Getting back to IS-LM model, one may note that price level is postulated to be constant in this model and accordingly inflation is assumed to be absent. But suffice to say, that in IS-LM one of the key component of money demand is transaction demand for money which is dependent on real income.

Speculative / Asset demand for Money

Within the context of the IS-LM model what is the composition of the investor's wealth? People like to hold their wealth in a way so as to maximize returns. This could be done by holding all of it as earning assets, but the assets are often not liquid enough to finance everyday transactions. So economic agents hold both money and other earning assets (like bonds, equities, etc). For simplicity let us assume there is only one kind of earning asset, say a government bond, and there is money. People hold both to optimize even though money is a barren asset. Society's total financial wealth is real money balance (M/P) and real bond holding (B/P). There gains and losses of holding each of these assets - while real money balance (assuming it is only currency) gives the holder no interest, it gives liquidity; on the contrary, real bond holding gives the holder interest payments at the cost of some loss of liquidity (Figure 8.6).

Figure 8.6: The Budget Set of the Financial Investor



Thus, collectively people will be facing the following finance wealth (FW) constraint:

$$(8.25)\ \left(\frac{M}{P}\right)^{d} + \left(\frac{B}{P}\right)^{d} \equiv \left(\frac{M}{P}\right)^{d} + \left(\frac{B}{P}\right)^{d} \equiv FW, or$$

$$(8.25a)\ \left(\frac{M}{P}\right)^{d} - \left(\frac{M}{P}\right)^{s} \equiv \left(\frac{B}{P}\right)^{s} - \left(\frac{B}{P}\right)^{d}$$

In some sense, we are back to our earlier discussion of Walras law as given in (8.3).

Equation (8.25a) suggests that if the money market is in equilibrium then the bond market has to be in equilibrium in the sense that in this two asset world, excess demand for money is equal to the excess supply of bonds. In other words, the money market and the bond market are mirror images of one another and we need to consider only one of the two markets and analyze its equilibrium, as equilibrium in the other market is automatically ensured.

Clearly the opportunity cost of holding money as an asset is foregoing the nominal interest payments (i). As we have taken price level (P) to be given for the time being we can assume that rate of inflation is zero, so that we can forget any distinction between nominal rate of interest (i) and real rate of interest (r).[13]

Relationship between Bond prices and interest Rates

The investor's choice problem is how much to hold bond and how much to hold money is essentially via bond price. But what is a bond? A bond is a promise to pay, in the future, fixed amounts that are stated on the bond. The interest rate that a bond actually pays therefore depends on how these payments compare to the market-determined price that is paid for the bond. But how is that price is determined in a market, so as to equate the implicit rate of interest paid on the bond to the rate of interest that buyers could get on other bonds of comparable risk and maturity.

Let us consider an example of a bond with current price equal to INR1000 and INR 1070 after a year, then the interest rate on the bond is given by:

$$(8.26)\ i = \frac{INR(1070 - 1000)}{INR\ 1000} \times 100\ \% = 7\ \%$$

Now suppose the current price of the bond is lower at INR 1050 then the interest rate on this bond is given by:

$$(8.26)\ i = \frac{INR(1070 - 1050)}{INR\ 1050} \times 100\ \% = 1.9\ \%$$

Thus when the current bond price goes up interest rate goes down. Going forward this relationship is extremely important.

[13] Remember real interest rate (r) is nominal interest rate (i) minus rate of inflation (π), r = i - π.

Back to Asset Demand for Money

Now suppose interest rate goes down then this means bond prices have gone up which will cause a fall in bond demand and hence a rise in asset demand for money. Hence asset demand / speculative demand for money is negatively related to interest rate.

Equilibrium in Money Market - the LM Curve

Combining these two sources of demand for money, viz., transaction demand and speculative / asset demand for money we now have the following equilibrium condition for the money market:

$$(8.27)\ \left(\frac{M}{P}\right)^{S} = \left(\frac{M}{P}\right)^{D} \text{ or } \overline{(M/P)} = L\,(Y,r) \text{ with } {}^{\delta L}/_{\delta Y} = L_Y > 0;\ {}^{\delta L}/_{\delta r} = L_r < 0$$

As earlier equation (8.27) describes combination of Y and r for all of which money demand is equal to money supply (or the money market is in equilibrium) is called the LM curve.

What is the slope of the LM curve? Refer to (8.27), and consider the following steps:

- Step 1: Let Y goes up
- Step 2: This will increase transaction demand for money as $L_Y > 0$
- Step 3: Since money supply has not changed, i.e., with $M/P = \overline{(M/P)}$ In order to maintain the balance between demand for and supply of money, asset demand for money has to do down.
- Step 4: But asset demand for money can go down if r goes up as $L_r < 0$

Combining the steps we arrive at the result that the LM curve is positively sloped and is given by (8.27a),

$$(8.27a)\ \boldsymbol{LM}:\ \overline{(M/P)} = L\,(Y\uparrow, r\uparrow)$$

As earlier, the slope of the LM curve can be derived by totally differentiating (8.27a), so that we get

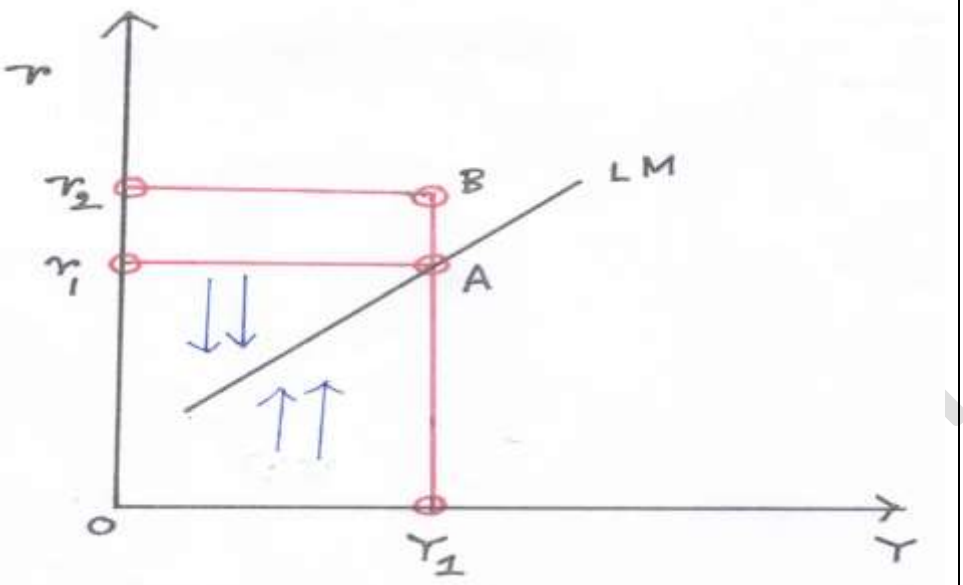
$$(8.27b)\ d\overline{(M/P)} = L_Y dY + L_r dr \ \ \therefore\ (dr/dY)_{LM} = -(L_Y/L_r) > 0\ as\ L_Y > 0\ \&\ L_r < 0$$

What is the adjustment process in the money market? Unlike the commodity market, the money market is more responsive to the interest rate r. Hence consider a point like B, corresponding to interest rate $r_2 > r_1$ which is at the LM curve. But speculative demand for money at r_2 is lower than speculative demand for money at r_1.Then money demand at B is lower than money supply which will trigger a downward movement in interest rate,. The adjustment rule in terms of discrepancy between money demand and money supply is given by

- (8.28a) If $\left(\frac{M}{P}\right)^{D} > \overline{(M/P)}$ then r rises
- (8.28b) If $\left(\frac{M}{P}\right)^{D} < \overline{(M/P)}$ then r falls

The LM curve and the adjustment rules are depicted in Figure 8.7.

Figure 8.7: The LM Curve



Note that M or effectively M/P is a parameter in the IS-LM model. Hence any change in M will lead to a shift of the LM curve. Such changes in M is termed as monetary policy.

8.5.3 Combining IS and LM

Having derived the IS and LM curve, we place them together to arrive at simultaneous determination of equilibrium in commodity and money market at E in Figure 8.8(a). Algebraically these may be arrived at by solving the system of equations given by:

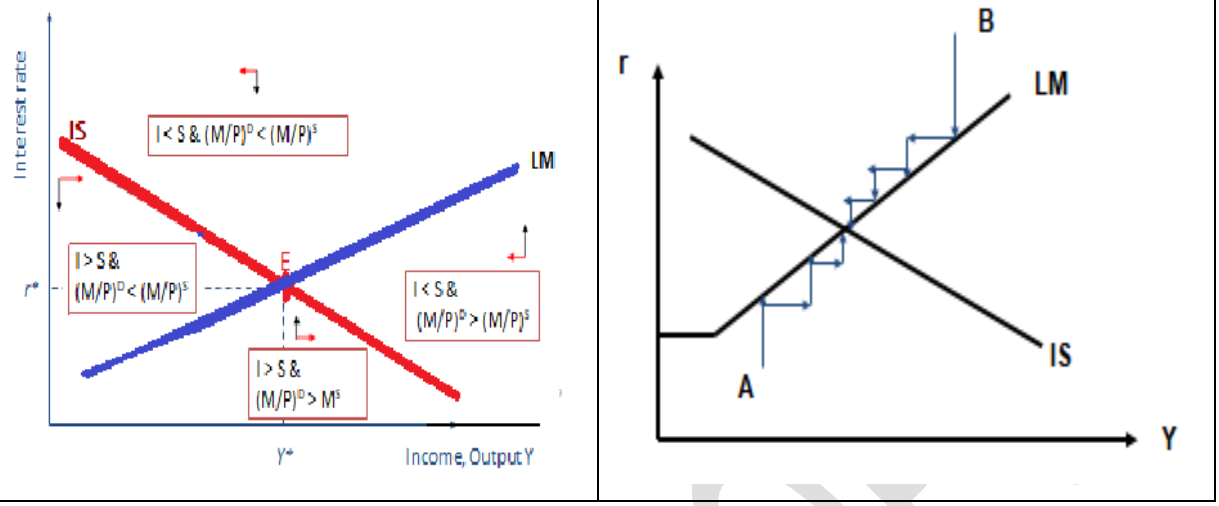
(8.21) $\boldsymbol{IS}$: $S(Y-\bar{T}) = I(r) + \bar{G}$

(8.27) $\boldsymbol{LM}$: $L\,(Y, r) = \overline{(M/P)}$

Note that if the IS curve has a negative slope throughout and the LM curve is non-declining, then they must intersect. Interestingly, if bond prices are finite, then interest rate must be strictly positive. Thus, LM has a positive intercept, IS have uniformly negative and LM have uniformly non negative slopes then the IS and LM curves can intersect only once. Moreover, the equilibrium at E is stable. The stability of equilibrium is ensured from the arrows indicating the adjustment in terms of income (in case of commodity market) and interest rate (in case of money market). In fact, if one starts with any off-equilibrium point then via the adjustment mechanism described in (8.22a) and (8.22b) for commodity market and (8.28a) and (8.28b) for the money market the stability of the equilibrium is ensured though an implicit assumption of that r adjusts faster than Y and through adjustment in r the asset markets clear to keep the economy on the LM curve (Figure 8.8(b)).

Figure 8.8: Equilibrium in the IS-LM model

(a) Determination of equilibrium | **(b) Ensuring stability of Equilibrium**



Having ensured the existence, uniqueness and stability of equilibrium let us now move to some comparative statics analysis by changing the parameters of the mode, viz., government expenditure / taxation and money supply. And that is the policy story, to which we now trun.

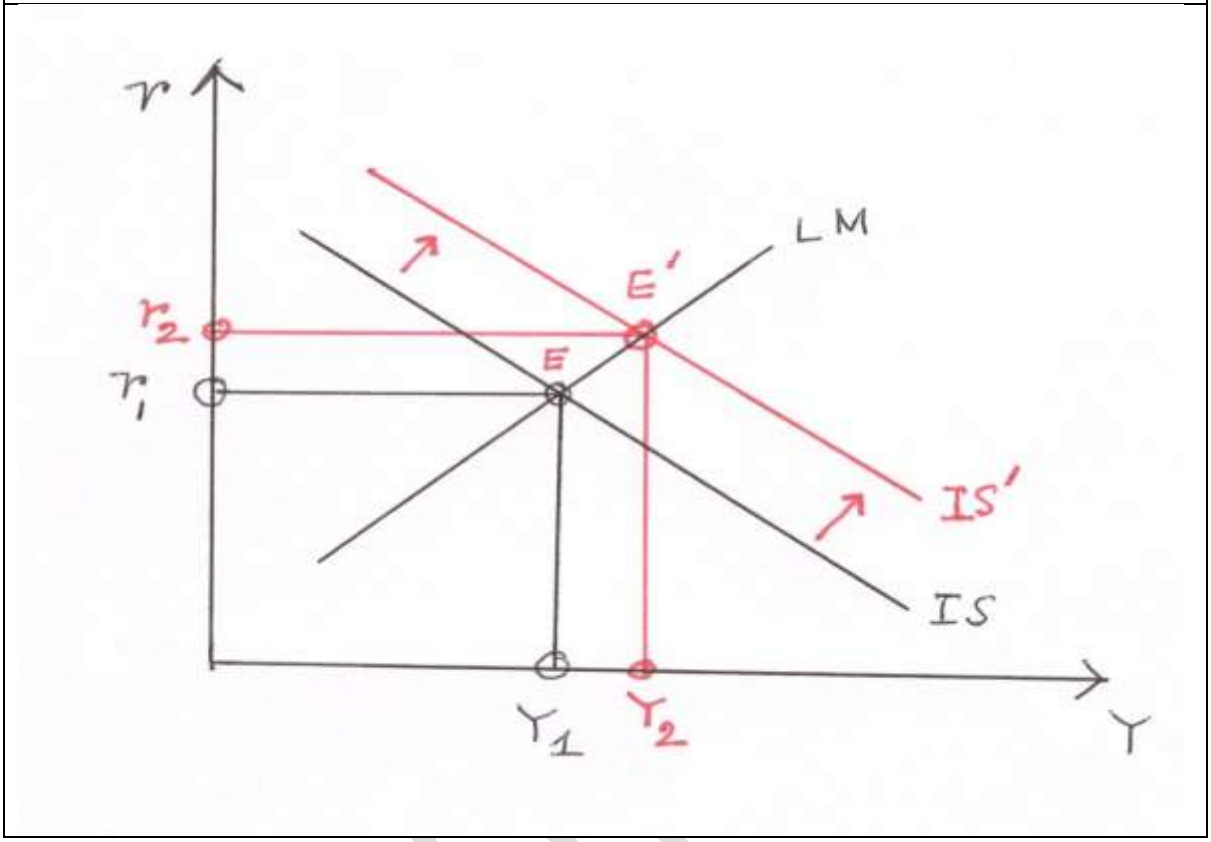
8.6 Role of Fiscal and Monetary Policies

8.6.1 Fiscal Policy

To begin with let us consider fiscal policy as an increase in government expenditure. But how does the government finance this additional expenditure; three routes may be thought of: (a) issuing public bonds; (b) increasing tax; and (c) printing money.

Consider first the situation where the expenditure is financed by issuing bonds. The increased government expenditure increases the aggregate consumption and demand *via* the Keynesian multiplier effect; it gives an impetus to aggregate demand and, thus, Y goes up. Now with higher Y there is more transaction demand for money; with money supply remaining unchanged asset demand for money has to go down, which can only be accompanied by a rise in interest rate. However, rise in interest rate will dampen private investment. Put in different way, this increased supply of government bond will lead to a fall in bond price and consequently there will be a rise in interest rate. This phenomenon of fall in private investment out of a rise of interest rate caused by an expansionary fiscal policy is called "crowding out" effect. It implies that an increase in government investment may crowd out private investment by increasing interest rate. This is easily seen from the IS-LM model. An increase in G will shift the IS curve rightwards – from IS to IS' in Figure 8.9. The earlier equilibrium is E and the new equilibrium is E'. Note that both Y and r have gone up at E'.

Figure 8.9: Impact of an increase in Government Expenditure in the IS-LM Model



Thus, while increase in government expenditure will lead to a rise in output it comes at a cost – the cost being crowding out of private expenditure arising out of the hike in interest rate. Hence, it will make sense when private investment is not forthcoming in any way like a recessionary situation.

What happens when the increase in government expenditure happens via an increase in taxes? In this case, G rises, T rises too but Y rises via the Keynesian process partially countered by fall in consumption arising out of a rise in T. However, the IS shifts to the right. As Y rises, demand for real balances rises and hence the market rate of interest rises. Thus, the impact will be similar to the bond-financed case.

What happens when increase in government expenditure is financed by printing of currency? In this case, since M changes the LM curve also gets shifted. We will look into this case after our discussion on monetary policy.

But notwithstanding these caveats, whenever there is any recession there is clamour of an expansionary fiscal policy. In the recent past when the US economy suffered from the onslaught of the global financial crisis, there has been rekindling of interest in fiscal multiplier in policy space (Box 2).

Box 2

Fiscal Multipliers

How do we measure fiscal multipliers? For the policy makers "Fiscal multipliers measure the short-term impact of discretionary fiscal policy on output …. are usually defined as the ratio of a change in output to an exogenous change in the fiscal deficit with respect to their respective baselines" (IMF, 2014). Two multipliers are commonly used (where Δ represents change):

- Impact multiplier = (ΔY(t))/(ΔG(t))
- Multiplier at horizon i = (ΔY(t+i))/(ΔG(t))

In March 2009, the International Monetary Fund prepared a note for the G-20 Ministerial Meeting, reporting a range of values for multipliers was used. While the low set of multipliers included: 0.3 on revenue; 0.5 on capital spending and 0.3 on other spending, the high set of multipliers included: 0.6 on revenue, 1.8 on capital spending, and around 1 for other spending.

What determines the size of the multipliers? The size of the multiplier is larger under the following three conditions: (a) "leakages" are few (i.e., only a small part of the stimulus is saved or spent on imports); (b) the monetary conditions are accommodative (i.e., the interest rate does not increase as a consequence of the fiscal expansion), and (c) the country's fiscal position after the stimulus is sustainable.

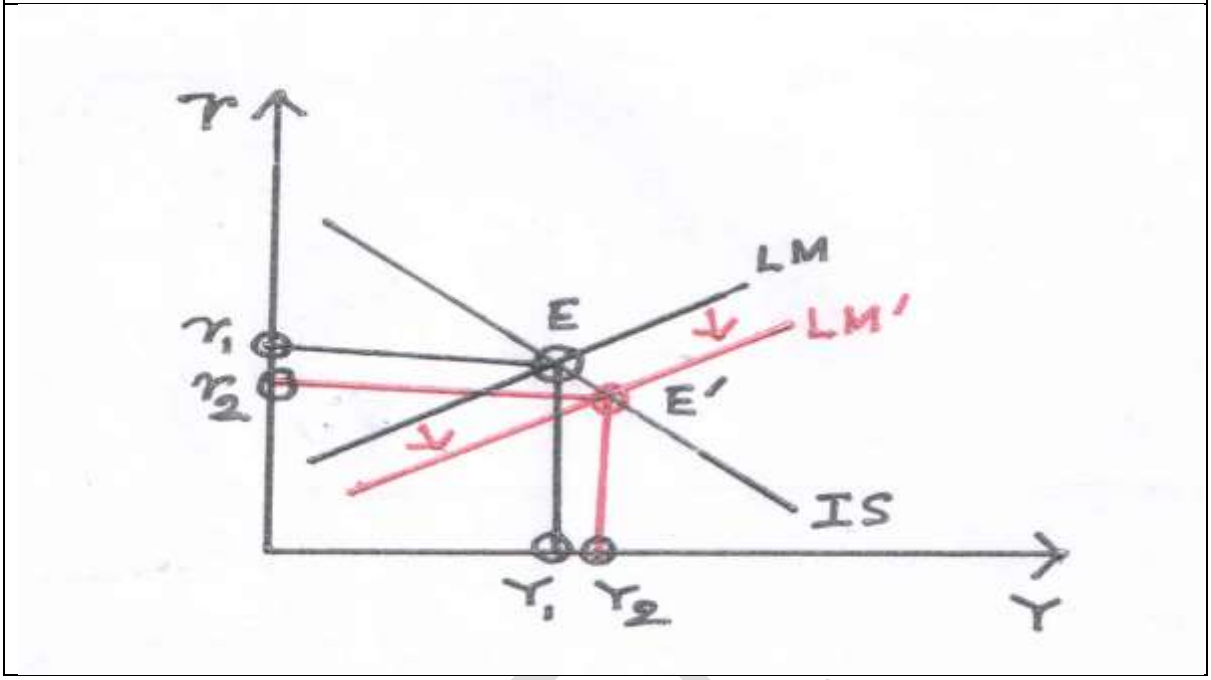
Reference:

Spilimbergo, Antonio., Steve Symansky, and Martin Schindler (2009): "Fiscal Multipliers", IMF Staff Position Note SPN/09/11.

8.6.2 Monetary Policy

Monetary policy refers to changes in quantity of money (M). Hence in terms of the IS-LM model it affects the LM curve. In particular, in M goes up, then with given P, there is increase in real money balance (M/P = m). Consequently the LM curve shifts to the right in Figure 8.10. If E and E' are two equilibria then please note that the new equilibrium E' is associated with a higher Y and lower r.

Figure 8.10: Impact of an increase in Money Supply in the IS-LM Model



But why is it so? Consider the following chain of events. The increase in M, creates an excess of real money balance (M/P) in the asset market. This will increase the demand for bonds, leading to a rise in bond price and ultimately lowering interest rate. But lower interest rate will boost private investment which through the Keynesian multiplier process will cause an increase in demand / income.

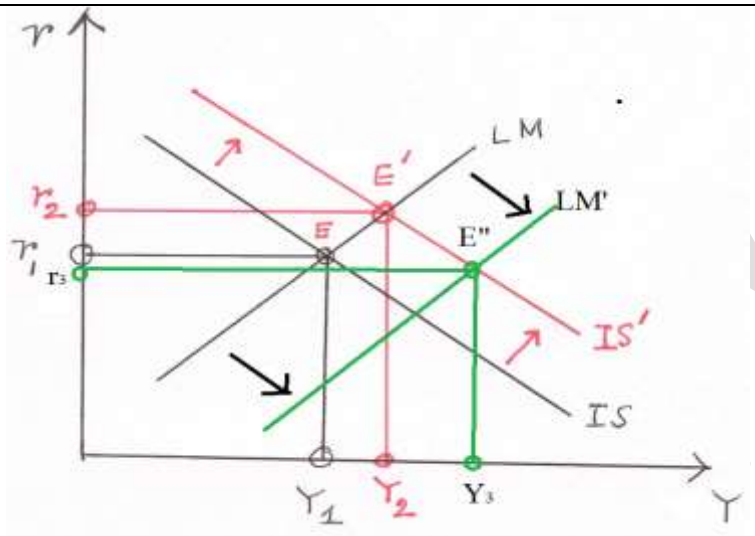
But what is difference between operation of expansionary monetary and fiscal policies? While both leads to higher level of income, fiscal policy operates directly but at the cost of crowding out. In case of monetary policy, the channel runs through boosting of private investment via reduced interest rate. Which one is preferable? The answer is that it depends on the context and the situation. In case of a deep recessionary situation when private investment is not forthcoming any way, a direct attack on lack of demand through fiscal policy (increase in G or reduced T) may work better. On the other hand, in less extraordinary circumstances, lack of demand may be handled via an interest rate induced boost in private investment. That is why in relatively normal circumstances the central bank monetary policy announcements dominate the space of economic news.

8.6.3 Joint Application of Fiscal and Monetary Policies

In a deep recessionary situation often monetary and fiscal policies are applied in union for enhanced operation of the multiplier process. Consider a combination of monetary policy and fiscal policy as given in Fig 8.11. As a result of a combined fiscal stimulus the increase in much

higher ($Y_3 > Y_2 > Y_1$) and also as interest rate has come down ($r_3 < r_1 < r_2$) the crowding our effect is ruled out. That was the reason that during the hey-day of the global financial crisis of 2008 - 2010 most of the advanced countries pursued monetary and fiscal stimuli together.

Figure 8.11: Impact of an increase in Money Supply in the IS-LM Model



8.7 Main Messages

John Maynard Keynes in a departure from the self-equilibrating classical tradition of macroeconomics brought fore the role played that demand could play in a business cycle fluctuation. At the risk oversimplifying the beasic tenets of Keynesian economics we can enumerate the following broad messages.

a) Demand side of the economy, viz., consumption and investment could play a great role in stabilizing economic fluctuations at least in the short run.
b) In this role, an increase in government investment could have a multiplier effects.
c) The idea of a balanced budget is not necessarily a good thing. Faced with a deep recession government could have a role of pump-priming.
d) In Keynesian demand-side macroeconomics, saving is seen as an withdrawal from income stream and an increase in saving could lead to a paradoxical result that income would go down.
e) Consideration of both commodity and money market together gives us inkling about the possible role played by monetary and fiscal policies.
f) While both monetary and fiscal policies would lead to higher income, in case of monetary policy interest rate goes down and in case of fiscal policy the interest rate goes up.
g) A modern formulation of the LM curve can be formulated in terms of a short term real interest rate being targeted by the central bank. The basic results of the IS-LM model, however, remain unaltered.

h) In the face of hitting zero lower bound, monetary policy in a number of advanced countries pursued quantitative easing or buying various assets from financial market players.

The story so far has been couched in terms of demand. It goes without saying that it a partial story. In order to decipher the whole chronicle next chapter will look into the tenets of supply and then combine it with demand.

Questions

1. In an IS-LM economy the following information is available:

- Consumption: $C= 260 – 10r + 0.8(Y – T)$
- Taxes: $T=200 + 0.2Y$
- Investment: $I= 1900 – 40r$
- Government spending: $G=1800$
- Net exports: $NX= 700 – 0.14Y$
- Money Demand: $M^D= 0.25Y – 25r$
- Money Supply: $M^S = 2000$

(i) Compute the equilibrium values of Y and r

(ii) The economic mood turns pessimistic in this economy, and consumption and investment fall by 60 units and 40 units for all possible levels of income. By how much should the budget deficit be changed to restore the economy to its original position? In which direction should the budget deficit change?

2. Consider the IS-LM model of an economy. Policy makers wish to stimulate private investment while keeping private consumption unchanged.

a. What mix of monetary and fiscal policy will achieve this outcome?
b. Draw a fully labelled diagram to support your answer.

3. Consider an economy described as follows:

- $C = 0.8(1 – t)Y$
- $t = 0.25$
- $I = 900 – 50r$
- $G = 800$
- $(M/P)^d= 0.25Y – 62.5r$
- $M = 1000$
- $P = 2$

(C=consumption, I = investment, G = government expenditure, t = proportional tax rate, $(M/P)^d$ = demand for real balances, M = supply of nominal balances, P = price level, r = rate of interest, Y = income, rate of inflation is 0)

(a) Compute the equilibrium values of Y and r

(b) Consider the original set of equations given above. The demand for real balances is now changed to $(M/P)^d = 0.25Y$. Everything else is unchanged. Calculate the equilibrium value of Y and r in this situation.

(c) Draw the IS and the LM curve in this case {described in part (b)} and label it fully.

(d) Suppose G is raised to 400. What happens to Y? {in part (b)}

4. **Suppose that the economy is characterized by the following structural Equations:**

- C = 160 + 0.6 (Y –T)
- I =150
- G = 150
- T = 100

Where C is consumption, I is investment, G is Government expenditure, T is income tax and Y is income or output.

a. Determine the equilibrium output level.
b. If G rises to 200, what is the equilibrium level of output?
c. What is the Value of the government expenditure multiplier?
d. If tax falls to 50, by how much will equilibrium output rise?
e. What is the value of tax multiplier?