UNIT 1 THE HARROD-DOMAR MODEL*

Structure

1.0 OBJECTIVES

After reading this unit, you will be able to

- state the necessity of sustained economic growth;
- outline the implications of the assumptions made in the Harrod Domar model;
- determine how steady state growth can be achieved in an economy with fixed saving rate and capital-output ratio;
- determine the conditions under which a steady growth rate can be maintained;
- distinguish between warranted growth rate and actual growth rate;
- discuss the instability problem of the Harrod-Domar Model; and
- identify the limitations of the Harrod-Domar Model.

1.1 INTRODUCTION

Of all the issues facing development economists, none is as compelling as the question of economic growth. A country's ability to provide improving standards of living for its people depends crucially on its long-run rate of economic growth. Over a long period of time, even an apparently small difference in the rate of economic growth can translate into a large difference in the income of the average person. Ever since the end of Second World War, interest in the problems of economic growth has led economists to formulate growth models of different types.

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A feature common to them all is that they are based on the Keynesian saving-investment analysis. The Harrod-Domar Model is the first and the simplest model of economic growth.

You may recall that the Keynesian analysis was for the short run. If we extend it to the long run, we find that capital stock of a country increases as investment is more than the replacement investment or the depreciation level. Increase in capital stock leads to increase in production capacity of an economy. As production capacity increases, there is economic growth of the country. Thus, the Harrod-Domar model is a direct outcome of the projection of the short-run Keynesian analysis into the long-run.

1.2 FEATURES OF MODERN ECONOMIC GROWTH

Throughout most of human history, appreciable growth in per capita gross domestic product (GDP) was the exception rather than the rule. Let us consider the growth rates of the world's leading economies over the past four centuries. During the period 1580-1820, the Netherlands was a leading industrial country; it experienced an average annual growth in real GDP per worker hour of roughly 0.2 per cent. Average annual growth rate of the United States of America during the period 1890-1989 was a relatively dramatic 2.2 per cent per year. Although an annual growth rate of 2 per cent in per capita GDP does not appear very impressive, a moment's reflection (and calculation) reveals its enormous potential if such growth rate is sustained. Simple calculations show that at the 2 per cent rate, a country's per capita GDP doubles in 35 years – a length of time considerably shorter than the life span of an individual.

Robert Lucas, in his Marshall Lectures at the University of Cambridge in 1984-85 (prior to the acceleration in economic growth rate of India, when per capita income was growing at less than 1.5 per cent per annum) stated:

"Rates of growth of real per-capita income are….diverse, even over sustained periods…..Indian incomes will double every 50 years; Korean every 10 years. An Indian will, on average, be twice as well off as his grandfather, a Korean 32 times…..".

A sustained economic growth in the last century was not experienced the world over. In the nineteenth and twentieth centuries, only a handful of countries, mostly in Western Europe and North America could manage to "take off into sustained growth", to use a well-known term coined by the economic historian W.W. Rostow. Throughout most of what is commonly known as the Third World, the growth experience only began well into the twentieth century; for many of them, probably not until the post-World War II era, when colonialism ended.

The now-developed countries (such as the US, Canada, Australia, etc.) grew in an environment uninhabited by countries of far greater economic strength. Today, the story is completely different.

The developing countries not only need to grow, they must grow at rates that far exceed historical experience. The developed world already exists, and their access to economic resources is far higher than that of the developing countries. Exponential growth at rates of 2 per cent per annum may well have significant long-run effects, but they cannot match the parallel growth of human aspirations, and the increased perception of global inequalities.

1.3 UNDERLYING IDEAS

The Harrod-Domar Model was developed independently by Roy F. Harrod in 1939 and Evsey Domar in 1946. Although Harrod and Domar models differ in details, they are bracketed together because of their similarity of approach. Both these models emphasise the essential conditions of achieving and maintaining steady growth (i.e., occurring in a smooth, gradual and regular manner). Harrod and Domar assign a crucial role to capital accumulation in the process of growth. In fact, they emphasised the dual role of investment, viz., (i) it generates income through the multiplier effect, and (ii) it leads to capital accumulation and increase in productive capacity.

Economic growth is the result of abstention from current consumption. An economy produces a variety of commodities. The act of production generates income. The very same income is used to buy these commodities. Commodity production creates income, which creates demand for those very same commodities. We broadly classify commodities into two groups, viz., (i) *consumption goods*, which are produced for the purpose of satisfying human wants and preferences, and (ii) *capital goods*, which are produced for the purpose of producing other commodities. Mangoes, fountain pen, clothes, etc. are examples of consumption goods. A blast furnace, a conveyor belt, equipment, etc. come under the category of capital goods.

As you know from the circular flows of income and expenditure, the income generated from the production of all goods is spent on both consumer goods and capital goods. Typically, households buy consumer goods, whereas firms buy capital goods to expand their production or to replace worn-out machinery. All income is not spent on current consumption. By abstaining from consumption, households make available a pool of funds that firms use to buy capital goods. This is the act of investment. Note, however, that without the initial availability of saving it would not be possible to invest and there would be no expansion. This is the simple starting point of the theory of economic growth.

Implicit in this story is the idea of macroeconomic balance. If you think of a circuit diagram with income flowing out of firms as they produce and income flowing back into firms as they sell, you can visualize saving as a leakage from the system. The demand for consumption goods alone falls short of the income that created this demand. Investors fill this gap by stepping in with their demand for capital goods.

Macroeconomic balance is achieved when this investment demand is at a level that exactly counter-balances the saving leakage. This concept is summarized in Fig. 1.1, which depicts the circuit diagram.

Fig. 1.1: The Circuit Diagram: Production, Consumption, Saving and Investment

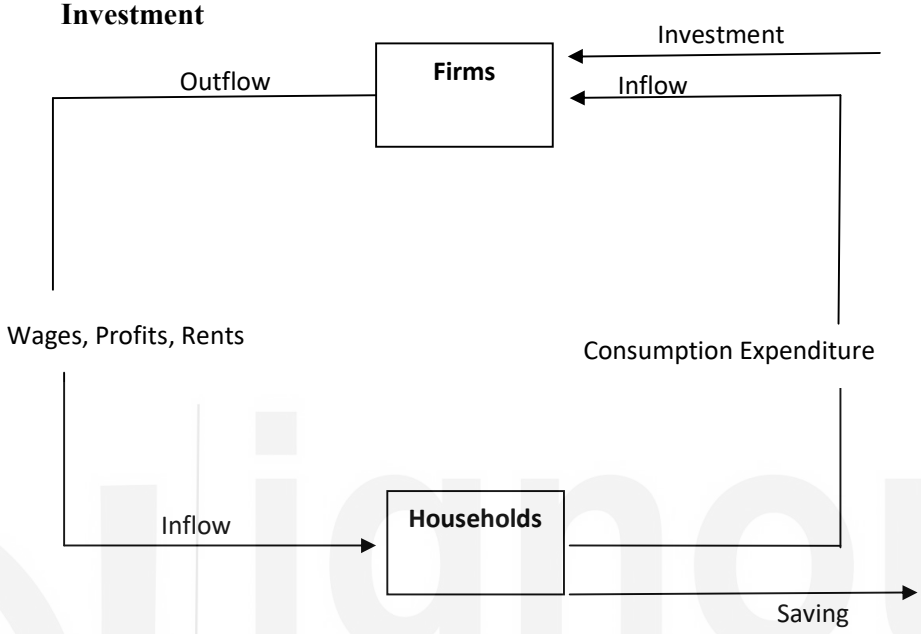

Fig. 1.1 shows income flowing out of the firms as they produce and income flowing back into the firms as they sell. Saving is the leakage from the system. Balance is reached when Investment exactly counterbalances the saving leakage.

Check Your Progress 1

1) Describe the importance of sustained economic growth.

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2) Explain the circuit diagram.

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1.4 ASSUMPTIONS OF THE MODEL

The main assumptions of the Harrod- Domar Model are as follows:

1) The economy is operating under full employment. It implies that there is no idle production capacity.
2) There is no government interference in the functioning of the economy.
3) The model is based on the assumption of "closed economy". In other words, government restrictions on trade and the complications caused by international trade are ruled out.
4) There are no lags in adjustment of variables, that is, economic variables such as saving, investment, income, expenditure, etc. adjust themselves completely within the same period.
5) The average propensity to save (APS) and marginal propensity to save (MPS) are equal to each other, i.e., APS = MPS. In symbols, $\boldsymbol{S/Y = \Delta S/\Delta Y = s.}$ Households save a fixed proportion of their income every year.
6) The Capital Output ratio, θ, which is defined as the units of capital required to increase output by one unit is constant. Thus, $\boldsymbol{K/Y = \Delta K/\Delta Y} = \theta$.

   This amounts to assuming that the law of constant returns to scale operates in the economy because of the fixity of the capital-output ratio.
7) Income, investment and saving are all defined in the net sense, that is, they are considered over and above the depreciation. Thus, depreciation rates are not included in these variables.
8) The general price level is assumed to be constant, i.e., money income and real income are the same.
9) There are no changes in the interest rate.
10) There is fixed proportion of capital (K) and labour (L) in the production process.

These assumptions are meant to simplify the task of growth analysis, these could be relaxed later.

1.5 HARROD-DOMAR EQUATION

Economic growth is positive when investment exceeds the amount necessary to replace depreciated capital, thereby allowing the next period's cycle to recur on a larger scale. We adopt the following notations: *Y* denotes total Output, *C* denotes total consumption, and *S* denotes total saving. Remember that these variables are *aggregates* over the population. Thus the following equation shall be true as a matter of accounting:

$Y_t = C_t + S_t,$ for all time periods t ... (1.1)

In other words, national income is divided between consumption and saving. The other side of the coin is that the value of produced output (also equal to *Y*) should be equal to the sum of consumption goods and capital goods. Thus,

$$Y_t = C_t + I_t \quad \text{...(1.2)}$$

where *I* denotes investment. If we equate equations (1.1) and (1.2), we obtain the famous macroeconomic balance equation, that is, saving equals investment. In notations,

$$S_t = I_t \quad \text{... (1.3)}$$

As we have mentioned earlier, investment augments the national capital stock, *K*. Thus,

$$K_t = K_{t-1} + I_t \quad \text{... (1.4)}$$

Equation (1.4) means that capital stock in period *t* equals the sum of capital stock in the previous period $(t-1)$ and the investment made in period *t*. We can write equation (1.4) as

$$I_t = K_t - K_{t-1} \quad \text{... (1.4a)}$$

By combining equations (1.3) and (1.4a) we obtain

$$S_t = K_t - K_{t-1} \quad \text{... (1.5)}$$

As defined earlier, saving rate $s_t = S_t/Y_t$. Therefore, $S_t = s_t Y_t$ or simply sY_t, if we assume saving ratio to be constant over time.

Similarly, $K_t = \theta Y_t$ and $K_{t-1} = \theta Y_{t-1}$ for all time periods *t* with θ as the capital output ratio.

Using these in (1.5), we get:

$$sY_t = \theta Y_t - \theta Y_{t-1} = \theta(Y_t - Y_{t-1}) \quad \text{... (1.6)}$$

By re-arranging terms in equation (1.6) we obtain

$$\frac{s}{\theta} = \frac{Y_t - Y_{t-1}}{Y_t} \quad \text{... (1.7)}$$

Or, $g_w = \frac{s}{\theta} = \frac{Y_t - Y_{t-1}}{Y_t}$ …(1.8)

where g_w is the required or warranted growth rate in National Income.

Equation (1.8) is the famous Harrod-Domar equation. According to this equation, for maintaining equilibrium in the economy, the ratio of 's' (saving-income ratio) to 'θ' (capital output ratio) should be equal to the growth rate ($g_w = \frac{Y_t - Y_{t-1}}{Y_t}$) in income or output of the economy.

The 'warranted growth rate' (g_w) refers to that growth rate of the economy when it is operating at full capacity. It can be interpreted as the growth rate required for full utilization of a growing stock of capital, so that entrepreneurs would be satisfied with the amount of investment actually made. The Harrod-Domar equation given at (1.8) links the growth rate of the economy to two fundamental

variables: the ability of the economy to save, and the capital-output ratio. By pushing up the rate of saving, it would be possible to accelerate the rate of growth. Likewise, by increasing the rate at which capital produces output (a lower value of θ), growth can be enhanced. You may note that central planning in countries such as India and erstwhile Soviet Union, during the pre-liberalisation period, was deeply influenced by the Harrod-Domar equation. If an economy has to grow steadily, without any disturbances, then the two ratios (namely, saving rate and capital-output ratio) have to be constant over time, that is,

$\frac{S_t}{Y_t} = \frac{S_{t-1}}{Y_{t-1}} = \frac{S_{t+1}}{Y_{t+1}} =$ ……. = s, and

$\frac{K_t}{Y_t} = \frac{K_{t-1}}{Y_{t-1}} = \frac{K_{t+1}}{Y_{t+1}} =$ ……. = θ .

If such constancy holds, then the economy will grow steadily at the required rate of growth, which is equal to $\frac{s}{\theta}$.

A small amendment to the Harrod-Domar model allows us to incorporate the effects of population growth. It should be clear that as the equation (1.8) currently stands, it is a statement regarding the rate of growth of gross national product (GNP), not GNP per capita. To talk about per capita growth, we should net out the effects of population growth. This is easy enough to do. If population (P) growth rate is *n*, we have

$$n = \frac{P_t - P_{t-1}}{P_t} = 1 - \frac{P_{t-1}}{P_t} \quad \text{... (1.9)}$$

From equation (1.9) we find that

$$\frac{P_{t-1}}{P_t} = (1 - n) \quad \text{... (1.10)}$$

Let $y_t = Y_t/P_t$ denote per capita income

From equation (1.6) we have $\theta Y_t = \theta Y_{t-1} + sY_t$. Let us divide both sides by P_t. Thus we have

$$\theta Y_t/P_t = \theta Y_{t-1}/P_t + sY_t/P_t \quad \text{... (1.11)}$$

$$\theta\, y_t = \frac{\theta Y_{t-1}}{P_t} * \frac{P_{t-1}}{P_{t-1}} + sy_t \quad \text{... (1.12)}$$

Recall that we denote y_t as per capita income while Y_t is total income of the country.

$$\theta\, y_t = \theta\, y_{t-1} * \frac{P_{t-1}}{P_t} + sy_t \quad \text{... (1.13)}$$

$$\theta\, y_t - \left(\theta\, y_{t-1} * \frac{P_{t-1}}{P_t}\right) = sy_t \quad \text{... (1.14)}$$

$$\theta\left[y_t - y_{t-1} * \frac{P_{t-1}}{P_t}\right] = sy_t \quad \text{... (1.15)}$$

Lest us divide both sides of equation (1.15) by y_t

$$1 - \frac{y_{t-1}}{y_t} * \frac{P_{t-1}}{P_t} = \frac{s}{\theta} \quad \text{... (1.16)}$$

$$\frac{y_{t-1}}{y_t} * \frac{P_{t-1}}{P_t} = 1 - \frac{s}{\theta} \quad \text{... (1.17)}$$

Let us define $\frac{y_t - y_{t-1}}{y_t} = g^*$ where g^* is the per capita growth rate. This can be rearranged to show that $1 - \frac{y_{t-1}}{y_t} = g^*$ or $\frac{y_{t-1}}{y_t} = (1 - g^*)$.

In equation (1.10) we have shown that $\frac{P_{t-1}}{P_t} = (1 - n)$ where n is the population growth rate. If we substitute these two expressions ($\frac{y_t - y_{t-1}}{y_t}$ and $\frac{P_{t-1}}{P_t}$) in equation (1.17), we obtain

$$(1 - g^*)(1 - n) = 1 - \frac{s}{\theta} \quad \text{... (1.18)}$$

We expand equation (1.18) and see that

$$1 - g^* - n + g^* n = 1 - \frac{s}{\theta}$$

$$g^* + n - g^* n = \frac{s}{\theta}$$

Since both g^* and n are small numbers, such as 0.05 or 0.02, their product is very small relative to the other terms and can be ignored as an approximation. This gives us the approximate equation

$$\frac{s}{\theta} = g^* + n \quad \text{... (1.19)}$$

This is an expression that combines some of the fundamental features underlying growth, viz., the ability to save and invest (captured by *s*), the ability to convert capital into output (which depends inversely on θ), and the rate of population growth (n).

Check Your Progress 2

1) State the equation for the warranted growth rate.

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2) Under what conditions can an economy grow steadily, without any disturbances?

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3) How does the Harrod-Domar equation change when the effect of population growth rate is incorporated?

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1.6 KNIFE-EDGE PROBLEM

Let us now discuss the issue: how to achieve steady growth? According to Harrod, the economy can achieve steady growth if and only if the expected growth rate (let us denote it by g_t^e) equals the warranted growth rate, g_w. What if the expectation is for some rate of growth other than g_w?

As you know from equation (1.8), $g_w = \frac{s}{\theta}$. We assume that capital output ratio is constant and is equal to θ for every period.

$\frac{K_t}{Y_t} = \frac{K_{t-1}}{Y_{t-1}} = \frac{K_{t+1}}{Y_{t+1}} = \ldots\ldots\ldots\ldots\ldots\ldots = \theta$

Or $K_t = \theta Y_t$ or $K_{t+1} = \theta Y_{t+1}$ … (1.20)

We know that

$I_t = K_t - K_{t-1}$

Substituting the value of K_t from equation (1.20) in the above gives us

$I_t = \theta(Y_t - Y_{t-1})$ ... (1.21)

Since Y_t (output in current time period is known only after the period is over; before that it is just an estimate or expected value) is not known, the economic agents make an expectation about it, Y_t^e. Investment in period *t* will therefore depend upon Y_t^e (see Units 4 and 5 of BECC-106)

$I_t = \theta(Y_t^e - Y_{t-1})$ ... (1.22)

Investment in period *t* depends on difference between expected demand in period *t* and actual demand in period $(t-1)$.

If $Y_t^e > Y_{t-1}$, *then* $I_t > 0$ *and* $Y_t^e < Y_{t-1}$, *then* $I_t < 0$

From the Keynesian model we know that

$Y_t = C_t + I_t$ ... (1.23)

In (1.23), aggregate demand is the sum of consumption and investment demand as there is no government sector and foreign trade by assumption.

A fixed fraction of income is consumed (since we assume *s* to be constant in the model).

$$C_t = cY_t \quad \text{... (1.24)}$$

Substituting C_t from equation (1.24) in equation (1.23), we get

$$Y_t = cY_t + I_t \quad \text{... (1.25)}$$

$$Y_t = \frac{1}{1-c} I_t \quad \text{... (1.26)}$$

$$Y_t = \frac{1}{s} I_t \quad \text{... (1.27)}$$

where $\frac{1}{s}$ is the investment multiplier with which income Y will go up when investment demand, *I,* increases by one unit.

If we divide both sides of equation (1.27) by Y_t^e, we get

$$\frac{Y_t}{Y_t^e} = \frac{1}{s}\frac{I_t}{Y_t^e} \quad \text{... (1.28)}$$

Substituting for I_t from equation (1.22) in equation (1.28), we obtain

$$\frac{Y_t}{Y_t^e} = \frac{\theta}{s}\frac{[Y_t^e - Y_{t-1}]}{Y_t^e} \quad \text{... (1.29)}$$

Since $\frac{Y_t^e - Y_{t-1}}{Y_t^e} = g_t^e$, the expected growth rate, we have

$$\frac{Y_t}{Y_t^e} = \frac{\theta}{s} g_t^e \quad \text{... (1.30)}$$

Since $\frac{s}{\theta}$ is the warranted growth rate, g_w, we have:

$$\frac{Y_t}{Y_t^e} = \frac{g_t^e}{g_w} \quad \text{... (1.31)}$$

An implication of (1.31) is that the expected growth rate will be equal to the warranted growth rate, *if and only if* the expected output Y_t^e is equal to the actual output Y_t. It means that steady growth is possible only if the expected output Y_t^e is equal to the actual output Y_t. In symbols,

$g_t^e = g_w = \frac{s}{\theta}$ *if and only if* $Y_t^e = Y_t$

Since expectations to be correct is a matter of pure chance, according to Harrod-Domar model, realisation of steady growth is uncertain.

Let us look again into the actual growth rate, g_t^a.

$$g_t^a = \frac{Y_t - Y_{t-1}}{Y_t} = 1 - \frac{Y_{t-1}}{Y_t} \quad \text{... (1.32)}$$

Our objective is to find a relationship between g_t^a and g_t^e, so that both the rates can be compared.

$$g_t^e = \frac{Y_t^e - Y_{t-1}}{Y_t^e} = 1 - \frac{Y_{t-1}}{Y_t^e}$$

Or, $\frac{Y_{t-1}}{Y_t^e} = (1 - g_t^e)$ ... (1.33)

By re-arranging terms in (1.33) we find that

$$Y_{t-1} = (1 - g_t^e)Y_t^e \quad \text{... (1.34)}$$

Let us look back at equation (1.31).

We have $\frac{Y_t}{Y_t^e} = \frac{g_t^e}{g_w}$, which we can re-arrange as

$Y_t = \frac{g_t^e}{g_w} Y_t^e$ or, $Y_t = \frac{g_t^e}{s/\theta} Y_t^e$. This gives us

$$Y_t = \frac{\theta}{s} g_t^e Y_t^e \quad \text{... (1.35)}$$

Now we have values of Y_{t-1} from equation (1.34) and value of Y_t from equation (1.35). Let us substitute these values in equation (1.32). We find that

$$g_t^a = 1 - \frac{(1-g_t^e)Y_t^e}{\frac{\theta}{s} g_t^e Y_t^e} \quad \text{... (1.36)}$$

Thus,

$$g_t^a = 1 - \frac{(1-g_t^e)}{g_t^e} * \frac{s}{\theta} \quad \text{... (1.37)}$$

When the actual growth rate is equal to expected growth rate (i.e., $g_t^e = g_t^a$), we have from equation (1.37)

$$g_t^a = 1 - \frac{(1-g_t^a)}{g_t^a} * \frac{s}{\theta}$$

Or, $(1 - g_t^a) = \frac{(1-g_t^a)}{g_t^a} * \frac{s}{\theta}$

Or, $(1 - g_t^a) g_t^a = (1 - g_t^a) * \frac{s}{\theta}$

Hence, $g_t^a = \frac{s}{\theta}$ ...(1.38)

It is clear that g_t^a (actual growth rate) equals $\frac{s}{\theta}$, the warranted growth rate (required for steady growth of the economy) *if and only if* the actual growth rate is equal to the expected growth rate, g_t^e. That is

$$g_t^a = g_t^e = g_w = \frac{s}{\theta}$$

Actual growth rate = Expected growth rate = warranted growth rate = $\frac{s}{\theta}$

We already know from previous discussion that expected growth rate will equal $\frac{s}{\theta}$ if and only if the expectations are correct, that is $Y_t^e = Y_t$.

According to the Harrod-Domar model, there will be instability in an economy if actual growth rate deviates from the expected growth rate. If $g_t^e > \frac{s}{\theta}$ actual growth rate will be higher than expected growth rate. On the other hand, if $g_t^e < \frac{s}{\theta}$ actual growth rate will be lower than expected growth rate.

This in fact is the beginning of the Harrod's instability problem. The steady state growth of the economy requires equality between $g_t^a = g_t^e = g_w = \frac{s}{\theta}$

In a free enterprise economy, these equilibrium conditions would be satisfied only rarely, if at all. Therefore Harrod analyzed the situations when these conditions are not satisfied. If investors anticipate more than the warranted rate of growth $\frac{s}{\theta}$, then actual growth rate will exceed even the high expected growth rate.

In other words, if g_t^e exceeds $g_w = \frac{s}{\theta}$, then the actual growth rate will turn out to be even greater than the already high expected growth rate. Investors would then get a wrong signal. Instead of feeling that they expected too much, and slowing down their investment, investors will feel that they expected too little since $g_t^a > g_t^e$. So in the next period, they will invest more. Thus the gap between the actual growth rate and the warranted growth rate will keep widening in each period (see Fig. 1.2). The economy will experience inflation. There will be insufficient goods in the pipeline or insufficient equipment. Such a situation will lead to secular inflation because actual income grows at a faster rate than the one allowed by the growth in the productive capacity of the economy. In other words, the following inequality holds $g_t^a > g_t^e > g_w = \frac{s}{\theta}$.

Fig. 1.2: Interaction between Actual, Expected and Warranted Growth Rates

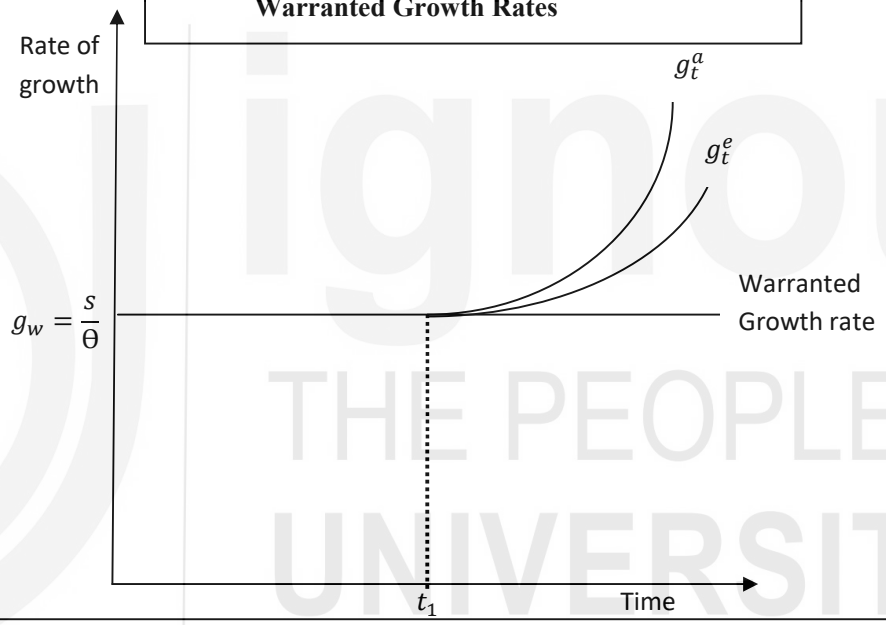

Fig. 1.2 shows that when g_t^e exceeds $g_w = \frac{s}{\theta}$ then actual growth rate will turn out to be even greater than the already high expected growth rate. Investors would then get a wrong signal. Such a situation will lead to secular inflation because actual income grows at a faster rate than allowed by the growth in the productive capacity of the economy. The following inequality holds $g_t^a > g_t^e > g_w = \frac{s}{\theta}$.

On the other hand, if investors anticipate a growth rate lower than the warranted growth (i.e., $g_t^e < g_w$) then actual growth rate will be even lower than the expected growth rate. In other words, $g_t^a < g_t^e < g_w$. The investors will now feel that they expected too much as the actual growth rate turns out to be lower than the expected growth rate. So in the next period, they will invest even lesser thereby further widening the gap between actual and warranted growth rates (see Fig. 1.3). Such a situation will lead to secular depression because actual income

grows much slower than what is required for full utilization of the productive capacity of the economy.

This is the crux of Harrod's problem. A slight deviation of actual growth rate from warranted growth rate leads the economy drift farther away from the steady state growth path. It is hence called "knife-edge equilibrium". Fig. 1.2 and Fig. 1.3 show the interaction between actual, expected and warranted growth rates.

Fig. 1.3: Interaction between Actual, Expected and Warranted Growth Rates

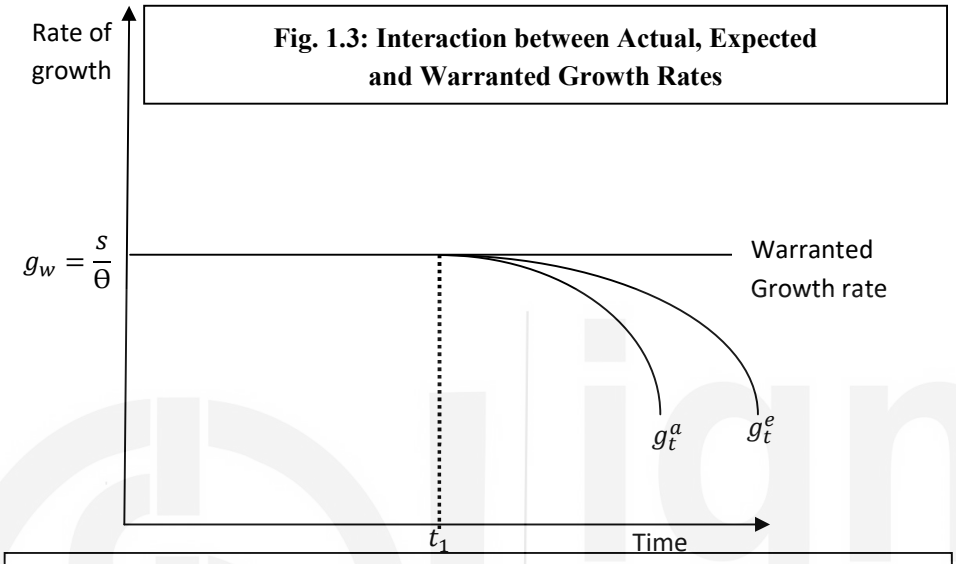

Fig. 1.3 shows that when $g_t^e < g_w$, then actual growth rate will be even lower than the expected growth rate. In other words, $g_t^a < g_t^e < g_w$. Such a situation will lead to secular depression because actual income grows slowly than what is required for full utilization of the productive capacity of the economy.

An Illustration:

Let us understand the Harrod's instability problem through an example. For an economy, let the saving rate be 20 per cent (s=0.2); the capital-output ratio $\Theta = \frac{\Delta K}{\Delta Y} = 2$. Hence the warranted growth rate will be

$$g_w = \frac{s}{\theta} = 10\% = 0.1$$

Suppose, the previous period's output is given as $Y_{t-1} = 90$. The economy can attain steady state equilibrium when the actual output growth rate equals expected output growth rate which in turn equals the warranted growth rate of 10 per cent. Thus for steady state growth, the expected output should be equal to the actual output of 100 units, $Y_t^e = Y_t = 100$.

If the above holds then, $g_t^a = \frac{Y_t - Y_{t-1}}{Y_t} = \frac{100-9}{100} = 10\%$.

In this case $g_t^a = g_w = 10\%$.

Here investment will equal, $I = \Theta\Delta Y = 2 * 10 = 20$ units

Now this investment will create aggregate demand through the multiplier effect, which equals $Y = \frac{1}{s} I$

$Y = \frac{1}{0.2} * 20$

$Y_t = 100$

Thus if investors expect an output of 100 units, they will invest 20 units in trying to create capacity for an additional 10 units of demand, $(Y_t - Y_{t-1})$. This investment of 20 units will generate through the multiplier of 5 yielding an aggregate demand of 100 units. In this way, expectations are realized, that is, $g_t^e = g_t^a = g_w = \frac{s}{\theta} = 10\%$.

If, however, the investors anticipate a little too much, i.e.,$Y_t^e = 101$. The additional units which are expected to be produced, $Y_t^e - Y_{t-1} = 101 - 90 = 11$ units.

The investors will then invest, $I = \theta \Delta Y = 2 * 11 = 22$ units.

Now, these 22 units of investment will create an aggregate demand of

$Y = \frac{1}{0.2} * 22$

$Y_t = 110$

As can be seen from above, $Y_t > Y_t^e$, that is, 110 >101.

Let us now calculate the actual and expected growth rates.

$g_t^a = \frac{Y_t - Y_{t-1}}{Y_t} = \frac{110-90}{110} = 18.18\%$

$g_t^e = \frac{Y_t^e - Y_{t-1}}{Y_t^e} = \frac{101-90}{101} = 10.8\%$

As can be seen now,

$g_t^a > g_t^e > g_w$

$18.18\% > 10.8\% > 10\%$

Investors in the next period will feel that they invested too little and will further increase their investments which in turn will further widen the gap.

Let us now look into the opposite situation. Suppose, the investors expect too little, $Y_t^e = 99$. The additional units which are expected to be produced, $Y_t^e - Y_{t-1} = 9$ units.

The investors will then invest, $I = \theta \Delta Y = 2 \times 9 = 18$ units.

Now, these 18 units of investment will create an aggregate demand of

$Y = \frac{1}{0.2} \times 18$

$Y_t = 90$

As can be seen from above, $Y_t < Y_t^e$, that is, 90 < 99.

Let us now calculate the actual and expected growth rates.

$g_t^a = \frac{Y_t - Y_{t-1}}{Y_t} = \frac{90-9}{90} = 0\%$

$g_t^e = \frac{Y_t^e - Y_{t-1}}{Y_t^e} = \frac{99-9}{99} = 9\%$

As can be seen now,

$g_t^a < g_t^e < g_w$

$0\% < 9\% < 10\%$

Thus investors will feel that they expected too much and hence they will reduce investment further in the next period thereby widening the gap between actual and warranted growth.

Check Your Progress 3

1) Why is the equilibrium condition in the Harrod-Domar model called the 'knife-edge equilibrium'?

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2) What happens to an economy when expected growth rate is higher than the warranted growth rate?

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3) Specify the effect of an expected growth rate lower than the warranted growth rate.

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1.7 LIMITATIONS OF HARROD-DOMAR MODEL

Some of the conclusions of the Harrod-Domar model depend on the crucial assumptions made by Harrod and Domar which make this model unrealistic. These are

1) The propensity to save (s) and the capital-output ratio (Θ) are assumed to be constant. In reality, they are likely to change in the long run and thus modify the requirements for steady growth.
2) The assumption that labour and capital are used in fixed proportions (due to the assumption of constant returns to scale) is untenable. Generally, labour can be substituted for capital and the economy can move smoothly towards a path of steady growth. In fact, unlike Harrod's model, this path is not so unstable that the economy should experience chronic inflation or unemployment if g_t^a does not coincide with g_w.
3) The Harrod-Domar model fails to consider changes in the general price level. Price changes always occur over time and may stabilize otherwise unstable situations. In fact, if allowance is made for price changes and variable proportions in production, then the system may have much stronger stability than what the Harrod's model suggests.
4) The assumption that there are no changes in interest rates is irrelevant to the analysis. In fact, interest rates do change and affect investment. A reduction in interest rates during periods of overproduction can make capital-intensive processes more profitable by increasing the demand for capital, thereby making excess supplies of goods.
5) The Harrod-Domar model ignores the effect of government programmes on economic growth. If, for instance, the government undertakes programmes of development, the Harrod-Domar analysis does not provide us with causal (functional) relationship.

1.8 LET US SUM UP

In this Unit, we discussed the Harrod-Domar Model which is the direct outcome of projection of the short-run Keynesian analysis into the long-run. The Harrod-Domar model shows the importance of saving and investing in an economy. The model was developed independently by Roy F. Harrod and Evsey Domar. According to this model, the growth of an economy is positively related to its saving ratio and negatively related to its capital-output ratio.

The model implies that a higher saving rate allows for more investment in physical capital. This investment can increase the production of goods and services in a country, thereby increasing growth. The capital-output ratio shows how much capital is needed to produce a dollar's worth of output. It reflects the efficiency of using machines. This efficiency means that a lower capital-output ratio leads to higher economic growth since fewer inputs generate higher outputs. The model held a great appeal to the developing world. It is argued that in

developing countries, low rates of economic growth and development are linked to low saving rates. This creates a vicious cycle of low investment, low output and low saving. To boost economic growth rate, it is necessary to increase saving either domestically or from abroad. Higher saving creates a virtuous circle of self-sustaining economic growth.

The model suggests that there is no natural reason for an economy to have balanced economic growth. The sustained economic growth requires equality between expected growth rate, actual growth rate and warranted growth rate. This however can only be a coincidence. A slight deviation of actual growth rate from the warranted growth rate will lead the economy drift farther away from the steady state growth path.

The instability in the Harrod-Domar model is due to its rigid assumptions such as the assumptions of a fixed production function, a fixed saving rate, and a fixed capital-output ratio. Despite these limitations, the Harrod-Domar model is important as it makes Keynes' static short-run saving and investment theory a dynamic one.

1.9 ANSWERS/HINTS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) Sustained growth has enormous potential. A sustained growth of even 2%, will double GDP per capita in 35 years.
2) If you think of a circuit diagram with income flowing out of firms as they produce and income flowing back into firms as they sell, you can visualize saving as a leakage from the system.

Check Your Progress 2

1) It is given by the ratio of s to θ. Refer to Section 1.5.
2) If the economy has to grow steadily, without any disturbances, then the two ratios namely saving rate and capital-output ratio have to be the same over time. If the above holds, then the economy will grow steadily at a given rate of growth $\frac{s}{\theta}$, which is the ratio of saving rate to capital-output ratio.
3) The equation changes to $\frac{\boldsymbol{s}}{\theta} = \boldsymbol{g^* + n.}$

Check Your Progress 3

1) A slight deviation of actual growth rate from warranted growth rate leads the economy drift farther away from the steady state growth path.
2) If g_t^e exceeds $g_w = \frac{s}{\theta}$ than actual growth rate will turn out to be even greater than the already high expected growth rate. Investors would then get a wrong signal. Such a situation will lead to secular inflation because

actual income grows at a faster rate than allowed by the growth in the productive capacity of the economy. The following inequality holds: $g_t^a > g_t^e > g_w = \frac{s}{\theta}$.

3) If $g_t^e < g_w$, than actual growth rate will be even lower than the expected growth rate. In other words, $g_t^a < g_t^e < g_w$. Such a situation will lead to secular depression because actual income grows slowly than what is required for full utilization of the productive capacity of the economy.

UNIT 2 THE SOLOW MODEL*

Structure

2.0 OBJECTIVES

After going through this unit, you will be in a position to

- explain economic growth with the help of neoclassical growth model;
- outline the implications of the assumptions made in the Solow model;
- determine how steady state growth can be achieved in an economy with an exogenous population growth rate and technological progress;
- determine the growth of key variables such as output per worker (means per unit of labour) and capital per worker on the balanced growth path;
- examine the impact of saving rate and population growth on the long run living standards; and
- comment on the golden rule level of capital.

2.1 INTRODUCTION

The limitations of the Harrod-Domar model prompted many economists to think further. Recall from the previous Unit that the warranted growth rate in the

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Harrod-Domar model was given by the ratio of 's' (saving rate) and capital-output ratio 'v'. The razor edge problem came up because s and v are constants, so that their ratio is a constant, and there is no scope for altering this ratio. In real life, however, economies do not face such razor edge problems and policy makers do have certain flexibility. In order to make the Harrod-Domar model more realistic, economists proceeded on two lines. In a major contribution to economic growth theory, Robert M. Solow developed the neoclassical model of economic growth in 1957, for which he was awarded Noble Prize in economic sciences in 1987. Solow has made a huge contribution to our understanding of the factors that determine the rate of economic growth for different countries. Solow extended the Harrod-Domar model by adding labour as a factor of production, and assuming that capital-output ratio is not constant.

The Solow growth model shows how saving, population growth, and technological progress affect the level of an economy's output and its growth over time. It also explains why national income grows, and why some economies grow faster than others.

In this Unit, we begin with the assumptions of the model. Subsequently we derive the steady state growth path. We then introduce the golden rule capital-labour ratio. We also understand how the changes in the savings rate, population and technological progress affect the output per person and capital per person in the steady state. We conclude by discussing implications of the Solow Model for the economies of the world.

2.2 SOURCES OF ECONOMIC GROWTH

Solow considers an aggregate production function which defines the relationship between output (Y) and two inputs, viz., capital (K) and labour (L). In symbols, it is given by

$$Y = EF(K, L) \quad \text{... (2.1)}$$

where E denotes the level of technology.

In equation (2.1), if the levels of inputs (K and L) are constant and the level of technology is the same, output will be constant – there will be no economic growth. For the level of output to grow, either the levels of inputs grow or the level of technology must improve (that means, there should be 'technological progress' or 'productivity growth'), or both. Thus growth of output has two sources, viz., (i) growth in inputs, and (ii) productivity growth. According to Solow, relationship between the rate of output growth, the rates of input growth, and productivity growth is

$$\frac{\Delta Y}{Y} = \frac{\Delta E}{E} + a_K \frac{\Delta K}{K} + a_L \frac{\Delta L}{L} \quad \text{... (2.2)}$$

where

$\frac{\Delta Y}{Y}$ = rate of output growth

$\frac{\Delta E}{E}$ = rate of productivity growth

$\frac{\Delta K}{K}$ = rate of capital input growth

$\frac{\Delta L}{L}$ = rate of labour input growth

a_K = elasticity of output with respect to capital

a_L = elasticity of output with respect to labour

Equation (2.2) is called the 'growth accounting equation'. Growth accounting provides useful information about the sources of growth. It however does not completely explain a country's growth performance. Because growth accounting takes the economy's rates of input growth as given, it cannot explain why capital and labour grow at the rates they do. The growth of capital stock is the result of saving and investment decisions taken by the households and firms, while the growth of labour depends on population growth. By taking capital stock and labour as given, growth accounting presents a static picture. In the next section we take a closer look at the dynamics of economic growth, or how the growth process evolves over time.

2.3 ASSUMPTIONS OF THE SOLOW MODEL

The main assumptions of the Solow model are as follows:

i) The economy is operates under full employment of inputs.
ii) There is no government interference in the functioning of the economy (it is a free market economy).
iii) There is no external trade so that it is a "closed economy".
iv) The economy operates under a *neoclassical production function*. It exhibits constant returns to scale. For example, if all factors of production (K and L in this case) are doubled, output will be exactly doubled. In notations,

$$zY = F(zK, zL) \quad \text{... (2.3)}$$

for any positive number z.

Both capital and labour are essential for production. This production function allows us to analyze all quantities in the economy relative to the size of the labour. If we set $z = \frac{1}{L}$ in equation (2.3) we get,

$$\frac{Y}{L} = F\left(\frac{K}{L}, 1\right) \quad \text{... (2.4)}$$

The output per worker $\frac{Y}{L}$ is a function of capital per worker $\frac{K}{L}$

Let us define $y = \frac{Y}{L}$, output per worker, and $= \frac{K}{L}$, capital per worker.

Thus we can write the production function given at (2.4) as $y = F(k, 1)$, which can be re-formulated as

$$y = f(k) \quad \text{… (2.5)}$$

The production function given as equation (2.5) is assumed to satisfy three conditions, viz., $f(0) = 0,\ f'(k) > 0\ and\ f''(k) < 0$. We interpret these conditions as follows: First, output is zero when capital per worker is zero. Second, marginal product of capital per unit of labour is positive. Third, marginal product of capital per unit of labour increases at a decreasing rate (In other words, marginal product of capital is positive but it declines as capital per unit of labour increases). The production function given at (2.5) above is shown in Fig. 2.1. You can observe that the production function has a positive slope but it becomes flatter as the amount of capital per worker increases, indicating that it exhibits diminishing returns. When k is low, the average worker has very little capital to work with, so an extra unit of capital is very useful and produces a lot of additional output. When k is high, the average worker has a lot of capital already, so an extra unit of capital increases production only slightly.

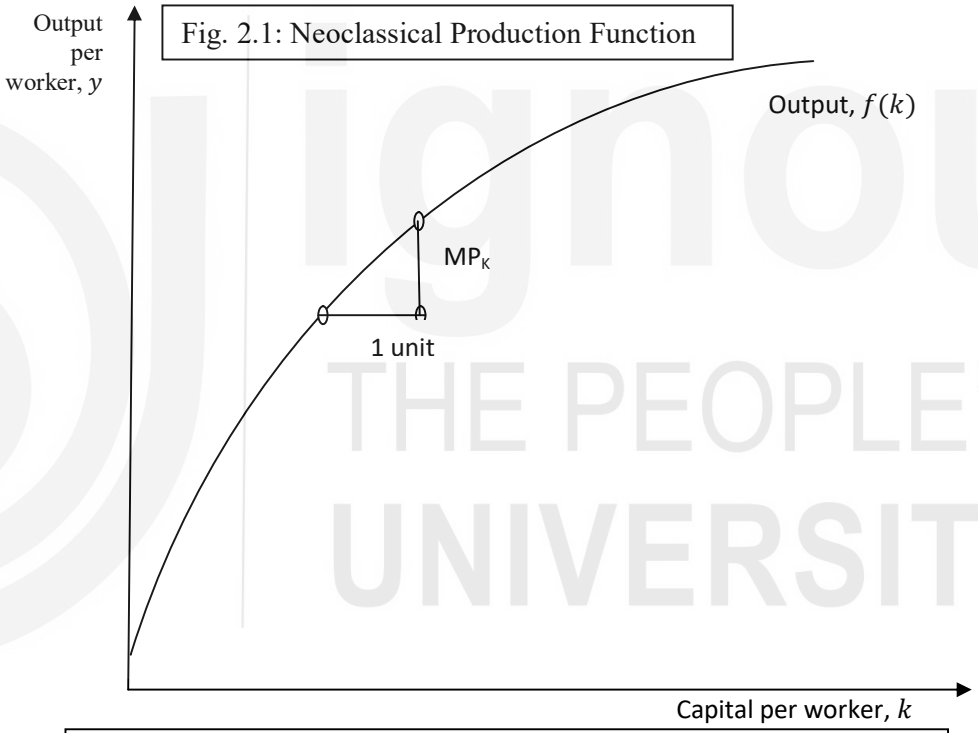

Fig. 2.1: Neoclassical Production Function

Fig. 2.1 shows that the output per worker depends on capital per worker. The slope of the production function, marginal product of capital – is positive but becomes flatter as k increases, exhibiting diminishing returns to capital per worker.

v) Growth of labour input is exogenously determined (given from outside the model) at a constant rate of *n.* In notations,

$$n = \frac{1}{L}\frac{dL}{dt}\ , \qquad \frac{dL}{dt} = L(\dot{t}) \qquad \text{... (2.6)}$$

vi) and Technology, E (which we will introduce later) and g respectively. , and $g = \frac{1}{E}\frac{dE}{dt}$ and $\frac{dE}{dt} = E(\dot{t})$

vii) The Solow model assumes that each year people save – a fraction s of their income and consume a fraction (1–s). The saving rate is fixed. The consumption function can be expressed as

$$c = (1 - s)y \quad \text{....(2.7)}$$

viii) The capital stock depreciates at a constant rate δ every period. Change in capital stock between one period and the next depends on Investment which raises the capital stock and depreciation, which wears out the capital stock.

Change in capital Stock = Investment – Depreciation

$$\dot{K(t)} = I - \delta K(t)\ ,\ \dot{K(t)} = \frac{dK}{dt} \quad \text{...(2.8)}$$

The higher the capital stock, the greater is the amount of depreciation.

Check Your Progress 1

1) State the properties of the production function used in the Solow model.

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2) Describe the growth accounting equation.

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2.4 STEADY STATE GROWTH PATH

The demand for goods comes from consumption and investment.

$$y = c + i \quad \text{...(2.9)}$$

This is the national income identity for a closed economy with no government purchases. The goal is to determine the saving rate which is desirable. Substitute for c from equation (2.7) in equation (2.9)

$$y = (1 - s)y + i \quad \text{...(2.10)}$$

We get, $i = sy$ ...(2.11)

This equation shows that investment equals saving. Thus the rate of saving *s* is also the fraction o output devoted to investment. Let us substitute $y = f(k)$ in equation (2.11). This gives us

$$i = sf(k) \quad \text{...(2.12)}$$

Equation (2.12) expresses investment per worker, i, as a function of the capital stock per worker, k. Fig. 2.2 shows for any given capital stock, , the production function $y = f(k)$ determines how much output the economy produces, and the saving rate s determines the allocation of that output between consumption per worker c and investment per worker i .

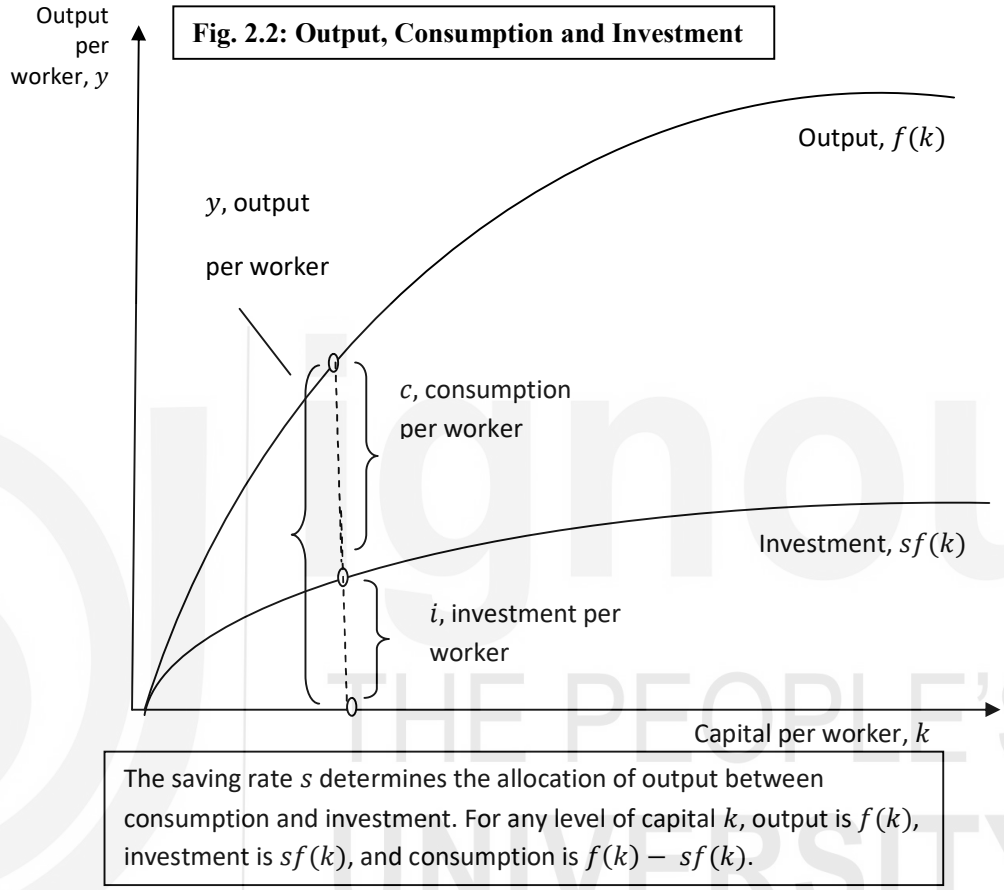


Fig. 2.2: Output, Consumption and Investment

The saving rate s determines the allocation of output between consumption and investment. For any level of capital k, output is $f(k)$, investment is $sf(k)$, and consumption is $f(k) - sf(k)$.

2.4.1 Dynamics of the Model

We want to determine the behaviour of the economy we have just described. Labour is exogenous and not determined within the model. Thus to characterize the behaviour of the economy we must analyze the behaviour of the other input, capital.

$k = \frac{K}{L}$, we can use the chain rule to find

$$\dot{k(t)} = \frac{\dot{K(t)}}{L(t)} - \frac{K(t)}{L(t)^2} * \dot{L(t)} \quad \text{...(2.13)}$$

$$\dot{k(t)} = \frac{\dot{K(t)}}{L(t)} - \frac{K(t)}{L(t)} * \frac{\dot{L(t)}}{L(t)} \quad \text{...(2.14)}$$

Substitute for $\dot{K(t)}$ from equation 2.8 and $\frac{\dot{L(t)}}{L(t)} = n$ from equation (2.6) in equation (2.14)

$$\dot{k(t)} = \frac{I - \delta K(t)}{L(t)} - \frac{K(t)}{L(t)} * n \quad \text{...(2.15)}$$

Substitute $\frac{I}{L} = i \; and \; \frac{K}{L} = k$ in equation (2.15)

$$\dot{k(t)} = i - \delta k - nk \quad \text{...(2.16)}$$

Substitute i from (2.12) into equation (2.16)

$$\dot{k(t)} = sf(k) - (\delta + n)k \quad \text{...(2.17)}$$

Equation (2.17) is the key equation of the Solow model. It states that the rate of change of the capital stock per unit of labour is the difference between two terms. The first, $sf(k)$, is the actual investment per unit of labour: output per unit of labour $f(k)$ and the fraction of that output that is invested is s. The second term, $(\delta + n)k$, is break-even investment, the amount of investment that must be done to keep k at its existing level. There are two reasons that some investment is needed to prevent k from falling. First, existing capital is depreciating; this capital must be replaced to keep the capital stock from falling. This is the δk term in equation (2.17). Second the quantity of labour is growing. Since the quantity of labour is growing at rate n, the capital stock must grow at rate n to hold k steady. This is the nk term in equation (2.17). This is the amount of investment necessary to provide new workers, n with capital. The equation shows that population growth reduces the accumulation of capital per worker much the way depreciation does. When actual investment per unit of labour exceeds the investment needed to break-even, k is rising. When actual investment falls short of the break-even investment, k is falling. And when the two are equal, k is constant.

2.4.2 Steady State Level of Capital

A steady state is a situation in which the economy's output per worker, y, consumption per worker c and capital stock per worker k are constant. To explain how the Solow model works, we first examine the characteristics of a steady state and then discuss how economy might attain it. In Fig. 2.3, there is a single capital stock k^* at which the amount of investment equals the amount of depreciation and the amount of investment necessary to provide new workers, n with capital. If the economy finds itself at this level of the capital stock, the capital stock will not change because the two opposing forces acting on it –investment and (depreciation and population growth) – just balance. That is, at k^*, $\dot{k} = 0$, so the capital stock per worker k and output per worker $f(k)$ are steady over time (rather than growing or shrinking). We therefore call k^* the **steady state** level of capital.

The definition of an equilibrium is a positive value of k, denoted by k^* such that $\dot{k} = 0$. This is called the steady state. There is a corresponding value of output per worker , denoted by y^* such that $\dot{y} = 0$. The steady state value of k^* is solved from equation (2.17).

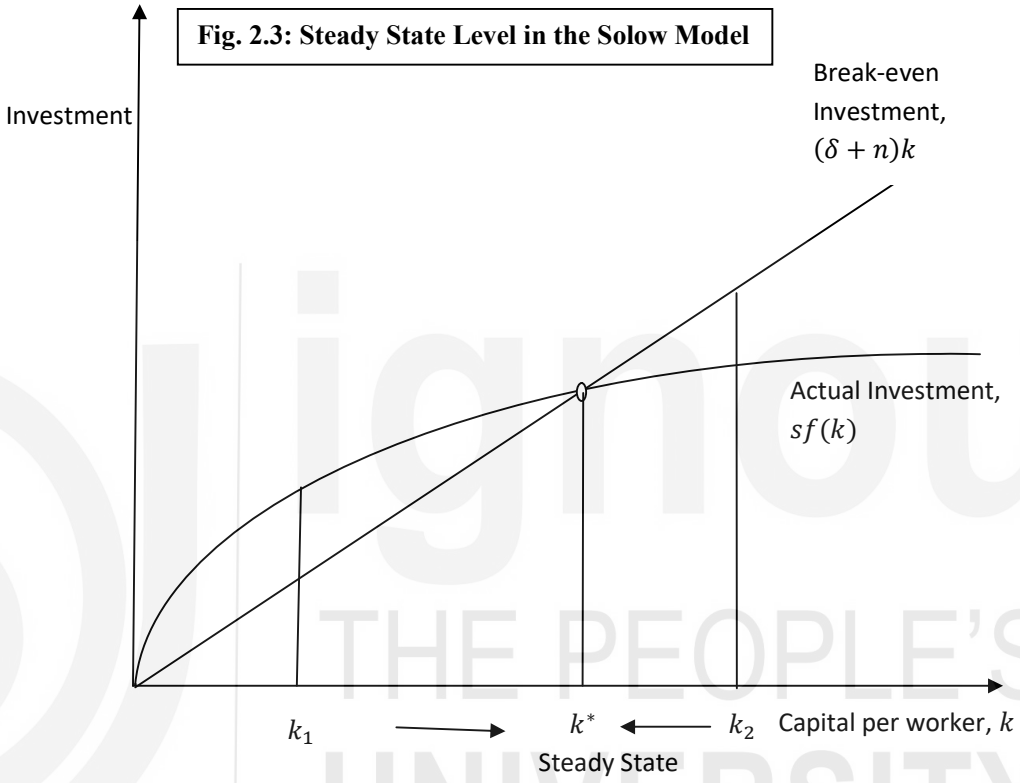
$$0 = sf(k^*) - (\delta + n)k^* \quad \text{…(2.18)}$$

Then y^* is solved from

$y^* = f(k^*)$

The steady state is significant for two reasons. As we have just seen, an economy at the steady state will stay there. In addition, and just as important, an economy *not* at the steady state will go there. That is, regardless of the level of capital with which the economy begins, it ends up with the steady-state level of capital. In this sense, *the steady state represents the long-run equilibrium of the economy.*

Fig. 2.3: Steady State Level in the Solow Model

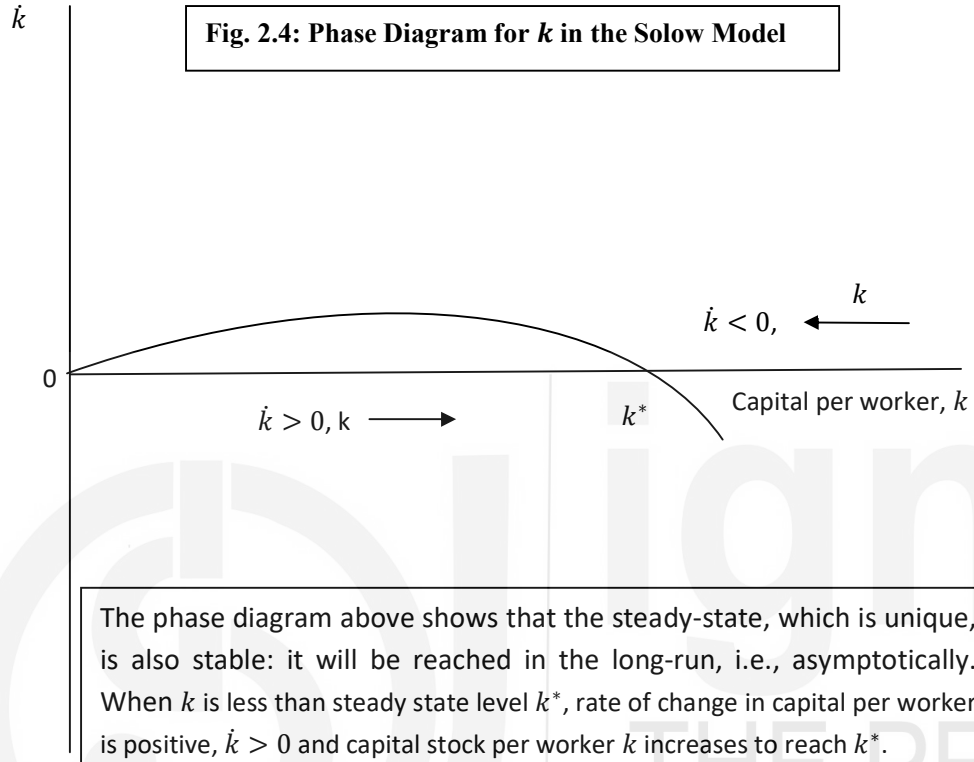


The steady state level of capital k^* is the level at which investment equals break-even investment $(\delta + n)k$. Below k^*, i.e., at k_1 capital stock increases because investment exceeds depreciation and population growth. At k_2, capital stock shrinks. An economy always ends up at the steady state level, k^*.

To see why an economy always ends up at the steady state, suppose that the economy starts with less than the steady-state level of capital, such as level k_1 in Fig. 2.3. In this case, the level of investment exceeds the break-even investment (depreciation and population growth). Over time, the capital stock will rise and will continue to rise, along with output $f(k)$ until it approaches the steady state k^*. Similarly, suppose that the economy starts with more than the steady-state level of capital, such as level k_2. In this case, investment is less than break-even investment; capital is reducing faster than it is being replaced. The capital stock will fall, again approaching the steady-state level. Once the capital stock reaches the steady state, investment equals depreciation and population growth, and there is no pressure for the capital stock to either increase or decrease.

Fig. 2.4 summarizes this information in the form of a phase diagram, which shows $\dot{k}$ as a function of k. If k is initially less than k^*, actual investment exceeds break-even investment and so $\dot{k}$ is positive- that is k is rising. If k exceeds k^*, $\dot{k}$ is negative- that is k is falling. Finally if k equals k^*, $\dot{k}$ is zero. Thus regardless of where k starts, it converges to k^*.

Fig. 2.4: Phase Diagram for k in the Solow Model



The phase diagram above shows that the steady-state, which is unique, is also stable: it will be reached in the long-run, i.e., asymptotically. When k is less than steady state level k^*, rate of change in capital per worker is positive, $\dot{k} > 0$ and capital stock per worker k increases to reach k^*.

2.4.3 Balanced Growth Path

In the steady state with population growth, capital per worker and output per worker are constant. Because the number of workers is growing at the rate n, total output and total capital must also be growing at the rate n.

$$y = \frac{Y}{L}, \qquad k = \frac{K}{L}$$

Additionally, in the steady state

$\dot{y} = 0$ and $\dot{k} = 0$

Differentiating k with respect to time

$$\frac{dk}{dt} = \frac{1}{L}\frac{dK}{dt} - \frac{K}{L^2}\frac{dL}{dt} \qquad ...(2.19)$$

$$\frac{dk}{dt} = \frac{K}{L}\left(\frac{1}{K}\frac{dK}{dt} - \frac{1}{L}\frac{dL}{dt}\right) \qquad ...(2.20)$$

$$\frac{1}{k}\frac{dk}{dt} = \frac{1}{K}\frac{dK}{dt} - \frac{1}{L}\frac{dL}{dt} \qquad ...(2.21)$$

In the steady state $\frac{dk}{dt} = 0$, and $\frac{1}{L}\frac{dL}{dt} = n$. Putting this in equation 2.21

$$\frac{1}{K}\frac{dK}{dt} = n \qquad ...(2.22)$$

Similarly differentiating y with respect to time

$$\frac{dy}{dt} = \frac{1}{L}\frac{dY}{dt} - \frac{Y}{L^2}\frac{dL}{dt} \quad ...(2.23)$$

$$\frac{dy}{dt} = \frac{Y}{L}\left(\frac{1}{Y}\frac{dY}{dt} - \frac{1}{L}\frac{dL}{dt}\right) \quad ...(2.24)$$

$$\frac{1}{y}\frac{dy}{dt} = \frac{1}{Y}\frac{dY}{dt} - \frac{1}{L}\frac{dL}{dt} \quad ...(2.25)$$

In the steady state $\frac{dy}{dt} = 0$, and $\frac{1}{L}\frac{dL}{dt} = n$. By substituting these values in equation (2.25), we obtain

$$\frac{1}{Y}\frac{dY}{dt} = n \quad ...(2.26)$$

In the steady state output and capital stock grows at the rate of population growth, while output per worker and capital per worker remain constant. Thus the Solow model implies that, regardless of its starting point, the economy converges to a balanced growth path- a situation where each variable of the model grows at the rate exogenously given by the population growth.

2.5 THE GOLDEN RULE LEVEL OF CAPITAL ACCUMULATION

If we were to introduce households into the model, their welfare would depend not on output but on consumption: investment is simply an input into production in the future. Thus for many purposes we are likely to be more interested in the behavior of consumption than in the behavior of output. A benevolent policymaker would thus want to choose the steady state with the highest level of consumption. The steady-state value of k that maximizes consumption is called the **Golden Rule level of capital** and is denoted k^*_{Gold}. National income accounts identity

$$y = c + i \quad \ldots(2.19)$$

Consumption per worker is

$$c = y - i \quad \ldots(2.20)$$

Because steady state output is $f(k^*)$ and steady state investment is $(\delta + n)k^*$ at the break-even investment k^*; we can express the steady state consumption as

$$c = f(k^*) - (\delta + n)k^* \quad ...(2.21)$$

This equation shows that an increase in steady-state capital has two opposing effects on steady-state consumption. On the one hand, more capital means more output. On the other hand, more capital also means that more output must be used to replace capital that is wearing out and equip new workers with high level of capital. Fig. 2.5 graphs steady-state output and steady-state break-even investment as a function of the steady-state capital stock.

Steady-state consumption is the gap between output and break-even investment. This figure shows that there is one level of the capital stock—the Golden Rule level k^*_{Gold} that maximizes consumption. If the capital stock is below the Golden Rule level, an increase in the capital stock raises output more than break-even investment, so consumption rises. In this case, the production function is steeper

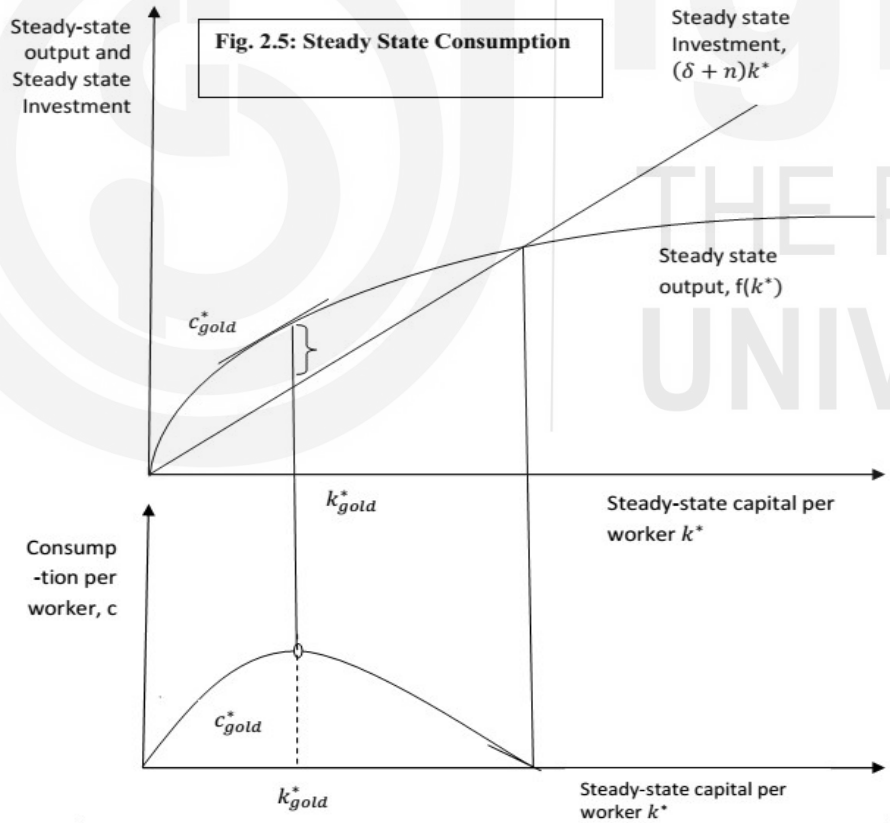
than the $(\delta + n)k^*$ line, so the gap between these two curves—which equals consumption—grows as k^*rises. By contrast, if the capital stock is above the Golden Rule level, an increase in the capital stock reduces consumption, because the increase in output is smaller than the increase in break-even investment. In this case, the production function is flatter than the $(\delta + n)k^*$ line, so the gap between the curves—consumption—shrinks as k^*rises. At the Golden Rule level of capital, the production function and the $(\delta + n)k^*$ line have the same slope, and consumption is at its greatest level. Panel b shows consumption per worker depends on the capital per worker. An increase in capital per worker till the Golden rule level raises consumption per worker. A further increase in capital per worker shrinks consumption per worker. The fundamental reason for this outcome is the dimishing marginal productivity of capital-that is, the larger the capital stock already is, the smaller the benefit from expanding the capital stock further. The golden rule level of capital per worker ratio k^*_{Gold} is given by the condition

$$f'(k^*) = \delta + n \quad ...(2.22)$$

$$f'(k^*) - \delta = n \quad ...(2.23)$$

Equation (2.23) implies that marginal productivity of capital, net of depreciation, equals population growth rate at the golden rule level.

Fig. 2.5: Steady State Consumption



Steady state is the difference between output f(k^*) and steady state investment, $(\delta + n)k^*$. Steady state consumption is maximized at the Golden rule steady state. The Golden rule capital stock is denoted k^*_{gold} and the Golden rule consumption is denoted c^*_{gold}.

Check Your Progress 2

1) Explain the dynamics of the Solow Model?

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2) Explain how does an economy always ends up at the steady state?

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3) Explain the condition required to attain Golden rule level of capital.

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2.6 THE FUNDAMENTAL DETERMINANTS OF LONG-RUN LIVING STANDARDS

What determines how well off the average person in an economy will be in the long run? We can use the Solow model to answer this question. Here, we discuss three factors that affect long-run living standards: the saving rate, population growth and productivity growth.

2.6.1 The Impact of Growth in the Saving Rate

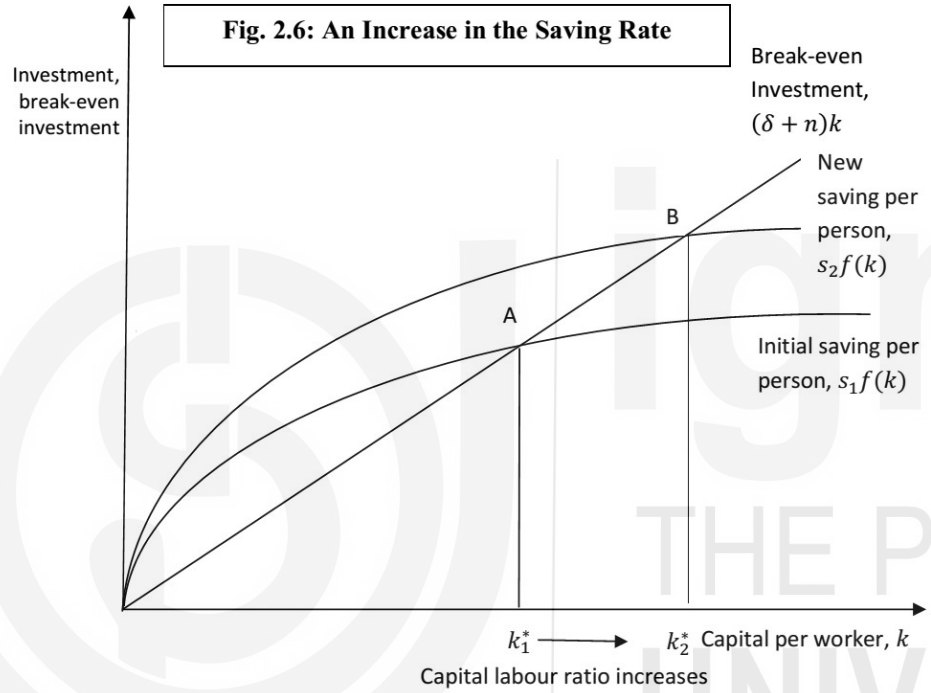
According to the Solow model, a higher saving rate implies higher living standards in the long run, as illustrated in Fig. 2.6. Suppose that the initial saving rate is s_1 so that saving per worker is $s_1 f(k)$. The saving curve when saving curve when the saving rate is s_1 is labelled "Initial saving per worker". The initial steady state capital-labour ratio, k_1^* , is the capital labour ratio at which initial saving curve and the break-even investment line cross (point A). Suppose now that the government introduces policies that strengthen the incentives for saving, causing the country's saving rate to rise from s_1 to s_2 . The increased saving rate raises saving at every level of the capital-labour ratio. Graphically, the saving curve shifts upwards fom $s_1 f(k)$ to $s_2 f(k)$. The new steady-state capital-labour ratio, k_2^* , corresponds to the intersection of the new saving curve and the break-even investment line (point B). Because k_2^* is larger than k_1^*, the higher saving rate has increased the steady-state capital-labour ratio. Gradually, this economy will move to the higher steady state capital-labour ratio, as indicated by the

arrows on the horizontal axis. In the new steady state, output per worker y, and consumption per worker c will be higher than in the original steady state.

Higher saving rate leads to faster growth in the Solow model, but only temporarily. An increase in the rate of saving raises growth only until the economy reaches the new steady state.

If the economy maintains a high saving rate, it will maintain a large capital stock and a high level of output, but it will not maintain a high growth rate forever. A higher saving rate is said to have a level effect because only the level of output per person- and not its growth rate- is influenced by the saving rate in the steady state.

Fig. 2.6: An Increase in the Saving Rate



An increase in the saving rate s, shifts the saving function upward. At the initial steady state k_1^*, investment now exceeds break-even investment. The capital stock rises until the economy reaches a new steady state k_2^* with more capital and output.

2.6.2 The Impact of Growth in the Population Rate

What is the relationship between population growth and a country's level of development as measured by output, consumption and capital per worker? The Solow model's answer to this question is shown in Fig. 2.7. An initial steady state capital-labour ratio, k_1^* corresponds to the intersection of the break-even investment line and the saving curve at point A. Now suppose that the rate of population growth which is same as the rate of labour force growth increases from an initial level n_1 to n_2 . What will happen to living standards?

An increase in population growth rate means that workers are entering the labour force more rapidly than before. These new workers must be equipped with capital. Thus, to maintain the same steady-state capital-labour ratio, the amount

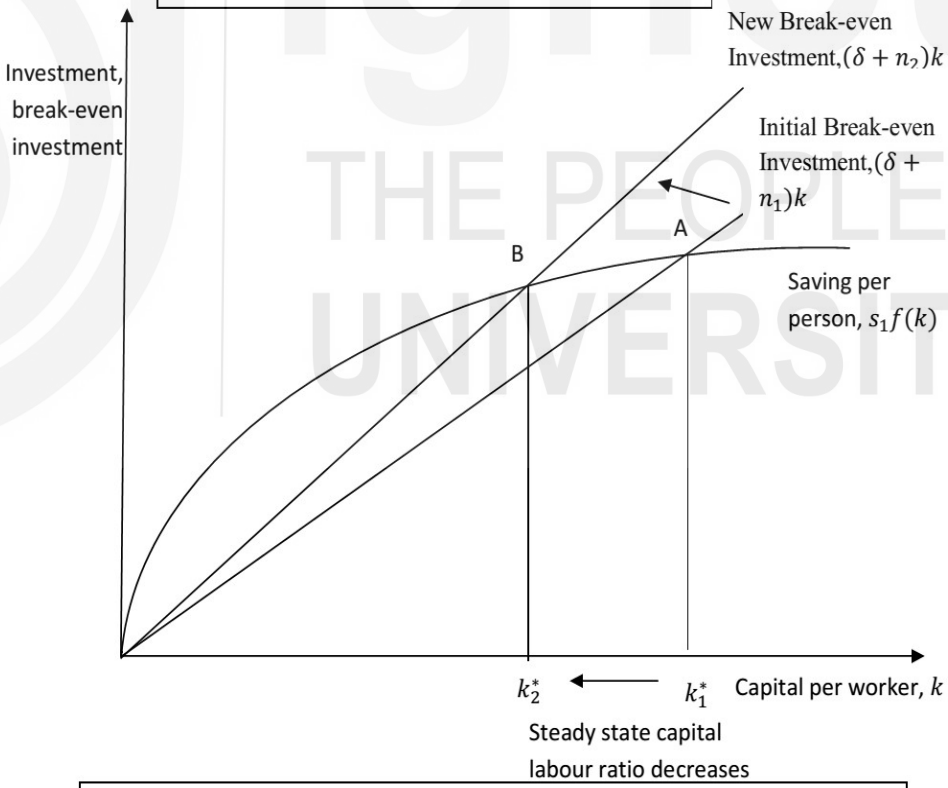
of investment per current member of workers must rise. Algebraically, the rise in n increases investment per worker from $(\delta + n_1)k$ to $(\delta + n_2)k$.

This increase in the population growth rate causes the break-even investment line to pivot up and to the left (i.e., be steeper), as its slope rises from $(\delta + n_1)$ to $(\delta + n_2)$.

After the pivot of the break-even investment line, the new the steady state is at point B. The new steady-state capital-labour ratio is k_2^*, which is lower than the original capital-labour ratio, k_1^*. Because the new steady state capital-labour ratio is lower, the new steady state output per worker and consumption per worker will be lower as well.

Thus the Solow model implies that increased population growth will lower living standards. The basic problem is that when the work-force is growing rapidly, a large part of current output must be diverted just to providing capital for the new workers to use. This result suggests that policies to control population growth will indeed improve living standards. Notice that a change in the population growth rate, like a change in the saving rate, has a level effect on output per person, but does not affect the steady-state growth rate of output per person.

Fig. 2.7: Impact of Population Growth



Population growth from n_1 *to* n_2 ,shifts the break-even investment line representing population growth and depreciation upward. The new steady state k_2^* has a lower level of capital per worker than the initial steady state k_1^* .

2.7 TECHNOLOGICAL PROGRESS IN SOLOW MODEL

In the model so far, when the economy reaches its steady state. Output per worker stops growing. To explain persistent growth, we need to introduce technological progress into the model. The model can be modified to include exogenous technological progress, which over time expands society's production capabilities. We now write the production function as

$$\boldsymbol{Y = F(K, L \times E)} \quad ...(2.24)$$

Where E is a new (somewhat abstract) variable called the **efficiency of labour**. The term $(\boldsymbol{L \times E})$ can be interpreted as measuring the *effective number of workers*. It takes into account the number of actual workers L and the efficiency of each worker E. This new production function states that total output Y depends on the inputs of capital K and effective workers, $\boldsymbol{L \times E}$. We assume that technological progress causes the efficiency of labour $\boldsymbol{E}$ to grow at some constant rate $\boldsymbol{g}$, which is exogenously given.

$$\frac{1}{E}\frac{dE}{dt} = g \quad ...(2.25)$$

This form of technological progress is called *labour augmenting*, and g is called the rate of **labour-augmenting technological progress**. Because the labour force L is growing at rate n, and the efficiency of each unit of labour E is growing at rate g, the effective number of workers $\boldsymbol{L \times E}$ is growing at rate $n + g$. We now analyze the economy in terms of quantities per effective worker. We now let $= \frac{K}{(L \times E)}$, stand for capital per effective worker and $y = \frac{Y}{(L \times E)}$ stand for output per effective worker.. With these definitions, we can again write $y = f(k)$.

k $= \frac{\mathrm{K}}{\mathrm{L} \times E}$, we can use the chain rule to find

$$\dot{k(t)} = \frac{\dot{K(t)}}{E(t)L(t)} - \frac{K(t)}{E(t)L(t)^2} * \dot{L(t)} - \frac{K(t)}{E(t)^2L(t)} * \dot{E(t)} \quad ...(2.26)$$

$$\dot{k(t)} = \frac{\dot{K(t)}}{E(t)L(t)} - \frac{K(t)}{E(t)L(t)} * \frac{\dot{L(t)}}{L(t)} - \frac{K(t)}{E(t)L(t)} * \frac{\dot{E(t)}}{E(t)} \quad ...(2.27)$$

Let us substitute for $\dot{K(t)}$ from equation 2.8 and $\frac{\dot{L(t)}}{L(t)} = n$ from equation 2.6 and $\frac{\dot{E(t)}}{E(t)} = g$ from equation (2.25) in equation (2.27). This gives us

$$\dot{k(t)} = \frac{I - \delta K(t)}{E(t)L(t)} - \frac{K(t)}{E(t)L(t)} * n - \frac{K(t)}{E(t)L(t)} * g \quad ...(2.28)$$

Substitute $\frac{I}{E \times L} = i$ and $\frac{K}{E \times L} = k$ in equation (2.28)

$$\dot{k(t)} = i - \delta k - nk - gk \quad ...(2.29)$$

By substituting $i = sf(k)$ into equation (2.29), we obtain

$$\dot{k(t)} = sf(k) - (\delta + n + g)k \quad ...(2.30)$$

Equation (2.30) shows the evolution of capital per unit of effective worker, k . The change in capital stock, $k(\dot{t})$ equals investment $sf(k)$ minus the break-even investment $(\delta + n + g)k$. Break-even investment includes three terms: to keep k constant, δk is needed to replace depreciating capital, nk is needed to provide capital for new workers, and gk is needed to provide capital for the new "effective workers" created by technological progress.

The steady state value of k^* is solved from equation 2.30 by putting $k(\dot{t}) = 0$. We drop the time-subscripts, *t* as output per effective worker and capital per unit of effective labour are constant in the steady state.

Thus, we obtain

$$0 = sf(k^*) - (\delta + n + g)k^* \qquad \ldots(2.31)$$

Then y^* is solved from

$$y^* = f(k^*)$$

In the steady state, capital per unit of effective labour k^* is given by

$$sf(k^*) = (\delta + n + g)k^* \qquad \ldots(2.32)$$

As before, in the steady state, investment equals the break-even investment. As shown in Fig. 2.8 there is one level of *k*, denoted by k^*, at which capital per effective worker and output per effective worker are constant. As before, this steady state represents the long-run equilibrium of the economy.

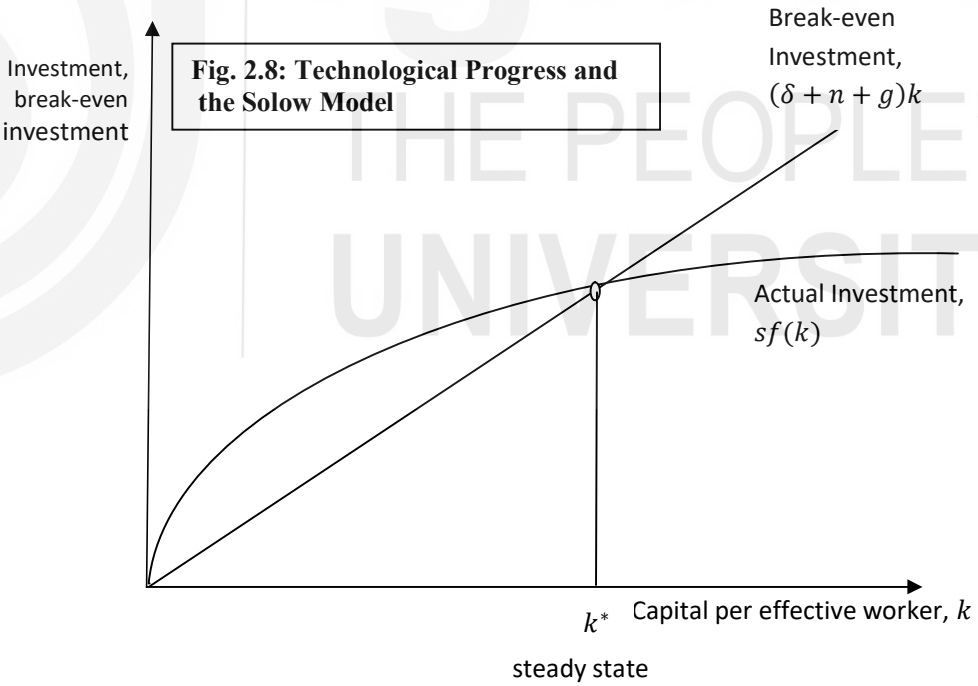


Fig. 2.8: Technological Progress and the Solow Model

The break-even investment now equals $(\delta + n + g)k$. In the steady state investment $sf(k)$exactly offsets the reductions in k attributable to depreciation, population growth and technological progress.

2.7.1 Balanced Growth Path

By assumption, we have

$$y = \frac{Y}{E \times L}, k = \frac{K}{E \times L}$$

Additionally, in the steady state, $\dot{y} = 0$ and $\dot{k} = 0$.

Differentiating k with respect to time, we obtain

$$\frac{dk}{dt} = \frac{1}{E \times L}\frac{dK}{dt} - \frac{K}{E \times L^2}\frac{dL}{dt} - \frac{K}{E^2 \times L}\frac{dL}{dt} \quad ...(2.33)$$

$$\frac{dk}{dt} = \frac{K}{E \times L}\left(\frac{1}{K}\frac{dK}{dt} - \frac{1}{L}\frac{dL}{dt} - \frac{1}{E}\frac{dE}{dt}\right) \quad ...(2.34)$$

$$\frac{1}{k}\frac{dk}{dt} = \frac{1}{K}\frac{dK}{dt} - \frac{1}{L}\frac{dL}{dt} - \frac{1}{E}\frac{dE}{dt} \quad ...(2.35)$$

In the steady state $\frac{dk}{dt} = 0$, and $\frac{1}{L}\frac{dL}{dt} = n$, $\frac{1}{E}\frac{dE}{dt} = g$. By substituting this in equation (2.35), we obtain

$$\frac{1}{K}\frac{dK}{dt} = n + g \quad ...(2.36)$$

Similarly, by differentiating y with respect to time, we obtain

$$\frac{dy}{dt} = \frac{1}{E \times L}\frac{dY}{dt} - \frac{Y}{E \times L^2}\frac{dL}{dt} - \frac{Y}{E^2 \times L}\frac{dL}{dt} \quad ...(2.37)$$

$$\frac{dy}{dt} = \frac{Y}{L}\left(\frac{1}{Y}\frac{dY}{dt} - \frac{1}{L}\frac{dL}{dt} - \frac{1}{E}\frac{dE}{dt}\right) \quad ...(2.38)$$

$$\frac{1}{y}\frac{dy}{dt} = \frac{1}{Y}\frac{dY}{dt} - \frac{1}{L}\frac{dL}{dt} - \frac{1}{E}\frac{dE}{dt} \quad ...(2.39)$$

In the steady state, $\frac{dy}{dt} = 0$, and $\frac{1}{L}\frac{dL}{dt} = n$, $\frac{1}{E}\frac{dE}{dt} = g$. Putting this in equation (2.39)

$$\frac{1}{Y}\frac{dY}{dt} = n + g \quad ...(2.40)$$

From equations (2.36) and (2.40), we now know that in the steady-state, the growth rates of the aggregate capital stock K and aggregate output Y are each in equality with the sum of the technology growth rate and population growth rates.

$$\frac{1}{K}\frac{dK}{dt} = \frac{1}{Y}\frac{dY}{dt} = n + g$$

Alternatively,

$$\frac{1}{K}\frac{dK}{dt} - n = g \text{ , and } \frac{1}{Y}\frac{dY}{dt} - n = g \quad ...(2.41)$$

The growth rates of the capital stock per labour $\frac{K}{L}$ and of output per labour $\frac{Y}{L}$ are each equal to the technology growth rate. The economy in the long run converges to the balanced growth path. On the balanced growth path, the growth rate of output per worker is solely determined by the growth rate of technological progress.

With the addition of technological progress, our model can finally explain the sustained increases in standards of living that we observe. That is, we have

shown that technological progress can lead to sustained growth in output per worker. By contrast, a high rate of saving leads to a high rate of growth only until the steady state is reached. Once the economy is in steady state, the rate of growth of output per worker depends only on the rate of technological progress. *According to the Solow model, only technological progress can explain sustained growth and persistently rising living standards*.

2.7.2 The Golden Rule Level of Capital

The Golden Rule level of capital is now defined as the steady state that maximizes consumption per effective worker. Following the same arguments that we have used before, we can show that steady-state consumption per effective worker is

$$c = f(k^*) - (\delta + n + g)k^* \quad ...(2.42)$$

Steady state consumption is maximized, if

$$f'(k^*) = \delta + n + g \quad ...(2.43)$$

$$f'(k^*) - \delta = n + g \quad ...(2.44)$$

Equation (2.44) implies that, at the Golden Rule level of capital, the net marginal product of capital, $(MPK - \delta)$, equals the rate of growth of total output $(n + g)$.

Table 2.1 The Fundamental Determinants of Long-Run Living Standards

An increase in	**Causes long run output, capital and consumption per worker to**	**Reason**
The saving rate, *s*	Rise	Higher saving allows for more investment and a larger capital stock
The rate of population growth, n	Fall	With higher population growth, more output must be used to equip new workers with capital, leaving less output available for consumption or to increase capital per worker
The rate of technological progress, g	Rise	Higher productivity directly increases output. It also raises savings and the capital stock.

1) Why an increase in saving rate has only level effect on output per worker?

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2) Explain how an increase in population growth from n_1 to n_2 affect the long-run level of capital and output per worker.

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3) Explain how an increase in the rate of technological progress results in a sustained increase in the standards of living.

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2.8 LET US SUM UP

The Solow model of economic growth is a unique and splendid contribution to economic growth theory. It establishes the stability of the steady-state growth through a very simple and elementary adjustment mechanism. In this unit we have learned that in the Solow growth model saving, population growth and technological progress interact in determining the level and growth of a country's standard of living. In the steady state of the Solow growth model, the growth rate of output per person is equal to the growth rate of capital per worker. Both these growth rates are solely determined by the exogenous rate of technological progress g. The Golden rule (consumption maximizing) steady state is characterized by equality between the net marginal product of capital ($MPK - \delta$) and the steady state growth rate of total income ($n + g$). There are two determinants of long run growth in the Solow model- a increase in the saving rate and a fall in the population growth rate. An economy's rate of saving determines the size of its capital stock and thus its level of production. The higher the rate of saving, the higher the stock of capital and the higher the level of output. An economy's rate of population growth is another long-run determinant of the standard of living. According to the Solow model, the higher the rate of population growth, the lower the steady-state levels of capital per worker and

output per worker. However, both the changes in saving rate and population rate have level affect output per person but do not affect the steady state growth rate of output per person. It is only the technological progress which can lead to sustained growth in output per worker.

2.9 ANSWERS/HINTS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) The production function has a positive slope but it becomes flatter as the amount of capital increases, indicating that it exhibits diminishing returns.
2) The relationship between the rate of output growth and the rates of input growth and productivity growth is called the growth accounting equation.

Check Your Progress 2

1) $k(\dot{t}) = sf(k) - (\delta + n)k$,

   The above equation is the key equation of the Solow model. It states that the rate of change of the capital stock per unit of labour is the difference between two terms. The first, $sf(k)$, is the actual investment per unit of labour and the second term, $(\delta + n)k$, is break-even investment.
2) Refer to Fig. 2.3. Suppose that the economy starts with less than the steady-state level of capital, such as level k_1. In this case, the level of investment exceeds the break-even investment (depreciation and population growth). Over time, the capital stock will rise and will continue to rise, along with output $f(k)$ until it approaches the steady state k^*.
3) The golden rule level of capital per worker ratio k^*_{Gold} is given by the condition
   $f'(k^*) = \delta + n$

Check Your Progress 3

1) A higher saving rate is said to have a level effect because only the level of output per person- and not its growth rate- is influenced by the saving rate in the steady state.
2) According to the Solow model, the higher the rate of population growth, the lower the steady-state levels of capital per worker and output per worker. Refer to Fig. 2.7
3) The economy in the long run converges to the balanced growth path. On the balanced growth path, the growth rate of output per worker is solely determined by the growth rate of technological progress.

UNIT 3 ENDOGENOUS GROWTH MODELS*

Structure

3.0 OBJECTIVES

After reading this unit, you will be able to

- explain how increasing returns to scale leads to expansion of output and economic growth;
- identify the reasons behind economic growth of advanced economies in the long run;
- outline the assumptions of the endogenous growth models;
- explain the important features of the AK model;
- determine how saving and investment can lead to persistent growth in the AK model;
- explain the aggregate production function in the Romer model;
- derive the steady state growth rate of output, capital and technology;
- calculate the steady state levels of the key variables such as output-technology ratio and capital-technology ratio on the balanced growth path; and
- examine the impact of a permanent increase in the R&D share in total inputs.

3.1 INTRODUCTION

The Solow model of economic growth (see Unit 2) has proved to be quite useful in our understanding of economic growth. An implication of the Solow model is that there should be convergence in growth across countries in the long run. When capital per labour is low, the returns to capital are very high as a result of which growth rate of the economy is high. When capital per labour increases,

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there is diminishing returns to capital and growth rate slows down. Thus growth rate of poor countries (low capital per labour) should be higher while that of rich countries (high capital per labour) should be lower. In the process there would be convergence in growth rates across countries. Empirically, however, it is observed that rich countries grow richer and poor countries become poorer over time. Even in India, we observe that advanced states have grown faster than backward states over time indicating divergence in economic growth. This type of growth scenario is contrary to the conclusions of the Solow model.

Another limitation of the Solow model, a theoretical one, is its assumption regarding technological progress. According to the Solow model, productivity growth or technological progress is the only source of long run growth of output per capita. Thus an explanation of long run economic growth should include an explanation of productivity growth. The model, however, simply takes the rate of productivity growth as given (exogenous or determined outside the model), instead of explaining how productivity growth is determined. In other words, in the Solow model the determinant of long run growth rate of output per capita is technological progress, which is exogenous to the model.

The Solow model also implied that an increase in rate of savings only has a short run impact on rate of growth and is neutral in its effect on the long run rate of growth. Hence, treating technological change as exogenous, neoclassical theory could not focus on the fundamental forces which determine long run growth of nations.

Endogenous growth theory overcomes these limitations of the Solow model. In this unit we discuss two models, viz., the AK model and the Romer model. We seek an understanding of why the advanced economies of the world, such as the U.S.A. have grown at around 2 per cent per year for the past century. From where does the technological progress that underlines such growth come? Instead of assuming that growth occurs because of unpredictable and exogenous improvements in technology, the endogenous growth theory focuses on understanding the forces underlying technological progress. Hence, main concern of the endogenous growth models is to explain the differences in growth rates among countries and the contributions of different factors to economic growth in these countries. These models go more deeply into the ultimate sources of growth by treating the rate of technological progress or the rate of population growth, or both, as endogenous factors.

3.2 OVERVIEW OF ENDOGENOUS GROWTH MODELS

The endogenous growth theory came into being as a response to the limitations of the Solow model. It tried to explain productivity growth, and hence the growth rate of output, endogenously or within the model. The endogenous growth models reject the Solow model's assumption of exogenous technological progress.

Recall that the neoclassical growth models assumed diminishing returns to inputs so that expansion of output and economic growth cannot take place beyond a level. In order to overcome this restriction to economic growth, endogenous growth models assume that increasing returns to scale is possible.

There are quite a few endogenous growth models in economic literature. We begin by stating the general assumptions of such models model. Subsequently we come to the specifics. The simplest endogenous model is the AK model. We then introduce the aggregate production function in the Romer model. The conditions for balanced growth and steady state levels of key variables, viz., (i) output-technology ratio, and (ii) capital-technology ratio are developed subsequently. We also discuss how the changes in technological progress affect the levels of 'output per person' and 'capital per person' in the steady state. We conclude by discussing implications of the endogenous growth models for the economies of the world.

The main assumptions of endogenous growth models are as follows:

a) There are many firms in a market.

b) Knowledge or technological advance is a non-rival good.

c) There are increasing returns to scale to all factors taken together and constant returns to a single factor (at least for one of the factors).

d) Technological advance comes from things people do. It means that technological advance is based on the creation of new ideas.

e) Many individuals and firms have market power and earn profits from their discoveries. This assumption arises from the fact that there could be increasing returns to scale in production. Increasing returns to scale leads to imperfect competition in the market.

3.3 THE AK MODEL

As pointed out above, the AK model is the simplest endogenous model. It assumes a constant, exogenous, saving rate. It models technological progress with a single parameter (usually denoted by A). It rejects the assumption that the production function exhibit diminishing returns to scale. Our simple endogenous growth model is based on the aggregate production function

$$\mathbf{Y = AK} \qquad \text{... (3.1)}$$

where Y is aggregate output, K is aggregate capital stock and A is a positive constant measuring the amount of output produced for each unit of K. Thus in (3.1) we assume that Y is a constant proportion of K.

According to the production function in equation (3.1), each additional unit of capital increases output by A units, regardless of how many units of capital are used in production. Because the marginal product of capital, equal to A, does not depend on the size of the capital stock K, the production function in equation (3.1) does not imply diminishing marginal productivity of capital. The

assumption that the marginal productivity is constant, rather than diminishing, is a key departure from the Solow model.

Endogenous growth theorists have provided a number of reasons to explain why, for the economy as a whole, the marginal productivity of capital may not be diminishing. One explanation emphasizes the role of human capital. In economics, the term human capital means knowledge, skills, and training of individuals. As economies accumulate capital and become richer, they devote more resources towards "investment in people", through improved nutrition, schooling, health care, and on the job training. This investment in people increases the countries' human capital, which in turn raises productivity. If the physical capital stock increases while the stock of human capital stock remains fixed, there will be diminishing marginal productivity of physical capital, as each unit of physical capital effectively works with a smaller amount of human capital. Endogenous growth theory argues that, as an economy's physical capital stock increases, its human capital stock tends to increase in the same proportion. Thus, when the physical capital stock increases, each unit of physical capital effectively works with the same amount of human capital, so the marginal productivity of capital need not decrease.

A second rationale for constant marginal productivity of capital is based on the observation that, in a growing economy, firms have incentives to undertake research and development (R&D) activities. This R&D increases the technical know-how and results in productivity gains. Such gains offset any tendency for the marginal productivity of capital to decline.

In the above, we examined why a production function like equation (3.1) might be a reasonable description of the economy as a whole. We took into account factors such as increased human capital and R&D. Let us now find out the implications of equation (3.1). As in the Solow model, let us assume that national saving, S, is a constant fraction 's' of aggregate output, AK (since Y=AK).

Thus, $S = sY = sAK$. As you from introductory macroeconomics, investment must equal saving in a closed economy. Recall that gross investment equals net investment (the net increase in the capital stock) plus depreciation (*dK*), that is,

$$\boldsymbol{I = \Delta K + dK} \qquad \textbf{... (3.2)}$$

Therefore, setting investment equal to saving, we have

$$\boldsymbol{\Delta K + dK = sAK} \qquad \textbf{...(3.3)}$$

The growth rate of capital stock thus is

$$\boldsymbol{\frac{\Delta K}{K} = (sA - d)} \qquad \textbf{...(3.4)}$$

Because output is proportional to the capital stock (see equation (3.1)), the growth rate of output $\frac{\Delta Y}{Y}$ equals the growth rate of the capital stock $\frac{\Delta K}{K}$. Therefore equation (3.4) implies that

$$\frac{\Delta Y}{Y} = sA - d \qquad \text{...(3.5)}$$

From equation (3.5) we can find out the factors determine the growth rate of output $\frac{\Delta Y}{Y}$. Notice that, as long as $sA > d$, the economy's income grows forever, even without the assumption of exogenous technological progress. The growth rate of output in equation (3.5) depends on the saving rate (s). This is in sharp contrast to the Solow model. Recall that in Solow model the saving rate does not affect the long-run growth rate of the economy. In the AK model, however, the saving rate affects long-run growth of the economy. This result is more realistic because higher rates of saving and capital formation encourages human capital formation and provides incentives for R&D. The resulting increases in productivity help to spur long run growth. In summary, in comparison to the Solow model, places greater emphasis on the saving, human capital formation and R&D as sources of long run growth.

Thus a simple change in the production function can alter dramatically the predictions about economic growth. In the Solow model, saving leads to growth temporarily, but diminishing returns to capital eventually force the economy to approach a steady state in which growth depends only on exogenous technological progress. By, contrast, in this endogenous growth model, saving and investment can lead to persistent growth.

Although endogenous growth theory remains in a developmental stage, the approach appears promising in at least two dimensions. First, this theory attempts to explain, rather than assumes, the economy's rate of productivity growth. Second it shows how the long run growth rate of output may depend on factors, such as the country's saving rate that can be affected by government policies.

Check Your Progress 1

1) State the unique assumption of the AK model?

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2) What determines the growth rate of output in the AK model?

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3.4 THE ROMER GROWTH MODEL

Romer's model of Endogenous Technological Change of 1990 identifies a research sector specializing in the production of ideas. This sector invokes human capital along with the existing stock of knowledge to produce ideas or new knowledge. To Romer, ideas are more important than natural resources. He cites the example of Japan which has very few natural resources but it was open to new western ideas and technology.

Romer describes the aggregate production function as

$$\boldsymbol{Y = L_Y^{1-\propto}\,(x_1^{\propto} + x_2^{\propto} + \cdots . + x_A^{\propto})} \quad \ldots(3.6)$$

$$\boldsymbol{Y = L_Y^{1-\propto} \sum_{i=1}^{A} x_i^{\propto}} \quad \ldots(3.7)$$

Where L_Y is the number of workers producing output and the $x_{i\,s}^{'}$ are different types of capital goods. A large number of perfectly competitive firms combine labor and capital to produce a homogenous output good, Y. Output Y is produced using labor L_Y and a number of different capital goods, x_i which we call intermediate goods. At any point in time, A measures the number of capital goods that are available to be used in the final goods sector. Inventions or ideas in the model correspond to the creation of new capital goods that can be used by the final goods sector to produce output.

If A was fixed, the pattern of diminishing returns to each of the separate capital goods would mean that growth would eventually taper off to zero. However, in the Romer model, A is not fixed. Instead there are L_A workers engaged in R&D and this leads to invention of new capital goods. When we recognize that ideas (A) are also an input into the production function, then there are increasing returns.

We can define the aggregate capital stock as

$$\boldsymbol{K = \sum_{i=1}^{A} x_i} \quad \ldots(3.8)$$

Again we will treat the savings rate as exogenous and assume

$$\boldsymbol{\dot{K} = s_K Y - dK} \quad \ldots(3.9)$$

Capital accumulates as people in the economy forgo consumption at some given rate, s_K and depreciates at the exogenous rate, d. One observation that simplifies the analysis is the fact that all of the capital goods play an identical role in the production process. For, this reason, we can assume that the demand from producers for each of these capital goods is the same, implying that

$$\boldsymbol{x_i = \bar{x}\,, i = 1, 2 \ldots \ldots \ldots, A} \quad \ldots(3.10)$$

This means that the production function can be written as

$$\boldsymbol{Y = A L_Y^{1-\propto} \bar{x}^{\propto}} \quad \ldots(3.11)$$

Note now that $\boldsymbol{K = A\bar{x}}$ from equation 3.8 and equation 3.10

$$\boldsymbol{\bar{x} = \frac{K}{A}} \quad \ldots(3.12)$$

So output can be expressed as

$$\boldsymbol{Y = AL_Y^{1-\propto}\left(\frac{K}{A}\right)^{\propto} = (AL_Y)^{1-\propto}K^{\propto}} \quad \ldots(3.13)$$

The aggregate production function in the Romer model describes how the capital stock, K, and labor L_Y , combine to produce output, Y, using the stock of ideas, A. $\propto$ is a parameter between 0 and 1. For a given level of technology, the production function in equation 3.13 exhibits constant returns to scale in K and L_Y . However when we recognize that ideas (A) are also an input into the production function, then there are increasing returns.

The total labor supply in the economy is used in two activities. L_Y workers are used to produce output and L_A workers are engaged in R&D and this leads to the invention of new capital goods.

$$\boldsymbol{L_Y + L_A = L} \quad \ldots(3.14)$$

We assume a constant fraction of labor force is engaged in R&D to produce new ideas

$$\boldsymbol{\frac{L_A}{L} = s_A} \quad \ldots(3.15)$$

The remaining fraction of workers is used to produce output

$$\boldsymbol{\frac{L_Y}{L} = 1 - s_A = s_Y} \quad \ldots(3.16)$$

Labor which is equivalent to the population, grows exponentially at some constant and exogenous rate n.

$$\boldsymbol{\frac{\dot{L}}{L} = n} \quad \ldots(3.17)$$

$A(t)$ is the stock of knowledge or the number of ideas that have been invented over the course of history until time t. $\dot{A}$ is the number of new ideas produced at any given point in time. $\dot{A}$ is described using a production function for the change in the number of capital goods, ideas:

$$\boldsymbol{\dot{A} = \bar{\gamma} L_A^{\lambda}} \quad \ldots(3.18)$$

$\dot{A}$ depends positively on the number of researchers attempting to discover new ideas, L_A. λ is an index of how slowly diminishing marginal productivity sets in for researchers. For example duplication of effort is more likely when there are more persons engaged in research. λ is some parameter between 0 and 1. $\bar{\gamma}$ is the rate at which they discover new ideas. This rate of discovery $\bar{\gamma}$ would depend on the stock of ideas that have already been invented, A.

$$\boldsymbol{\bar{\gamma} = \gamma A^{\theta}} \quad \ldots(3.19)$$

If $\theta > 0$, this rate of discovery would be an increasing function of A that is the invention of ideas in the past raises the productivity of researchers in the present. If $\theta < 0$, this rate of discovery would be a decreasing function of A, and corresponds to the fishing out case in which the fish become harder to catch over time. Finally, $\theta = 0$ implies that the productivity of research is independent of the stock of knowledge.

Rewrite the general production function for ideas from equations (3.18) and (3.19)

$$\dot{A} = \gamma L_A^{\lambda} A^{\theta} \quad \ldots(3.20)$$

We assume that $\theta < 1$. This effect stems from the "giant shoulders" effect. For instance, invention of new software must have relied upon previous invention of relevant computer hardware. We also assume $\lambda < 1$ may reflect an externality associated with duplication: some of the ideas created by an individual researcher may not be new to the economy

Check Your Progress 2

1) Explain the aggregate production function of the Romer Model?

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2) Explain what do θ *and* λ represent in the production function of ideas?

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3) Explain the condition required to attain Golden rule level of capital.

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3.5 THE STEADY STATE GROWTH IN THE ROMER MODEL

This economy converges to a steady state growth path in which capital and output grow at the same rate. So, we can derive the steady state growth rate as follows. Re-write the production function after substituting for L_Y from equation (3.16) as

$$Y = (As_Y L)^{1-\alpha} K^{\alpha} \quad \ldots(3.21)$$

Taking logs and derivatives of both sides of equation (3.21)

$$\frac{\dot{Y}}{Y} = (1-\alpha)\left(\frac{\dot{A}}{A} + \frac{\dot{s_Y}}{s_Y} + \frac{\dot{L}}{L}\right) + \alpha\left(\frac{\dot{K}}{K}\right) \quad \ldots(3.22)$$

Now use the fact that the steady state growth rates of capital and output are the same to derive that this steady state growth rate is given by

$$\left(\frac{\dot{Y}}{Y}\right)^* = (1-\alpha)\left(\frac{\dot{A}}{A} + \frac{\dot{s_Y}}{s_Y} + \frac{\dot{L}}{L}\right) + \alpha\left(\frac{\dot{Y}}{Y}\right) \quad \ldots(3.23)$$

Now $\frac{\dot{s_Y}}{s_Y} = 0$ …(3.24)

That is the share of labor allocated to the non-research sector cannot be changing along the steady state path otherwise the fraction of researchers would eventually go to zero or become greater than 1, which would be infeasible. So we have,

$$\left(\frac{\dot{Y}}{Y} - \frac{\dot{L}}{L}\right)^* = \frac{\dot{A}}{A} \quad \ldots(3.25)$$

The steady state growth rate of output per worker equals the steady state growth rate of A. Let lower case letters denote per capita variables and let g_X denote the growth rate of variable X. Then

$$g_Y = g_K = g_A \quad \ldots(3.26)$$

That is per capita output, capital labor ratio and stock of ideas must all grow at the same rate along a balanced growth path. If there is no technological progress in the model, then there is no growth. Therefore we must work out this rate of technological growth along a balanced growth path.

3.6 DERIVING THE STEADY STAE GROWTH RATE IN THE ROMER MODEL

The big difference relative to the Solow model is that the A term is determined within the model as opposed to evolving at some fixed rate unrelated to the actions of the agents in the model economy. To derive the steady-state growth rate in this model, note that the growth rate of the number of capital goods is

$$\frac{\dot{A}}{A} = \frac{\gamma(s_A L)^\lambda}{A^{1-\theta}} \quad \ldots(3.27)$$

The steady state of this economy implies that the parameter is A growing at a constant rate. This can only be the case if the growth rate of the right hand side of equation (3.27) is zero.

Taking log and derivatives of both sides of equation (3.27), we get

$$0 = \lambda\left(\frac{\dot{s_A}}{s_A} + \frac{\dot{L}}{L}\right) - (1-\theta)\frac{\dot{A}}{A} \quad \ldots(3.28)$$

Again in the steady state, the growth rate of the fraction of researchers $\frac{\dot{s_A}}{s_A}$ must be zero. So along the model's steady state growth path, the growth rate of the number of capital goods is

$$\left(\frac{\dot{A}}{A}\right)^* = \frac{\lambda}{1-\theta}\frac{\dot{L}}{L} \quad \ldots(3.29)$$

Substituting for $\frac{\dot{L}}{L} = n$ from equation (3.17), we get

$$\boldsymbol{g_Y = g_K = g_A = \left(\frac{\dot{A}}{A}\right)^* = \frac{\lambda}{1-\theta} n} \quad \ldots(3.30)$$

The long run growth rate of output per worker in this model depends positively on three factors.

a) The parameter λ, which describes the extent to which diminishing marginal productivity sets in as we add researchers. We may refer to the externality associated with λ as stepping on toes effect.

b) The strength of the "standing on shoulders" effect, θ. The more past inventions help to boost the rate of current inventions, the faster the growth rate will be. It reflects a positive knowledge spill-over in research. We may refer to the externality associated with θ as standing on shoulders effect.

c) The growth rate of the number of workers, n. The higher is n, the faster the economy adds researchers. This may seem like a somewhat unusual assumption but it holds well if one takes a very long view of world economic history. Prior to the industrial revolution, growth rates of population and GDP per capita were very low. The past 200 years have seen both population growth and economic growth rates increases.

3.7 THE STEADY STATE LEVEL OF OUTPUT TECHNOLOGY RATIO

Just as with our discussion of the Solow model, we can decompose output per worker into a capital-output ratio component and a Total factor productivity component. In other words one can re-arrange equation (3.13) by substituting $\boldsymbol{L_Y = (1 - s_A)L}$

$$\boldsymbol{Y = (A\,(1 - s_A)L)^{1-\alpha} K^{\alpha}} \quad \ldots(3.31)$$

From equation (3.9), $\dot{K} = s_K Y - dK$

$$\boldsymbol{\frac{\dot{K}}{K} = s_K \frac{Y}{K} - d} \quad \ldots(3.32)$$

WE find that equation (3.32) is the capital accumulation equation.

Let us divide both sides of equation (3.31) by L, so that we get output per capita

$$\boldsymbol{y = \frac{Y}{L} = A^{1-\alpha}(1 - s_A)^{1-\alpha}\left(\frac{K}{L}\right)^{\alpha}} \quad \ldots(3.33)$$

Let us substitute $\boldsymbol{k = \frac{K}{L}}$ in equation (3.33).

$$\boldsymbol{y = A^{1-\alpha}(1 - s_A)^{1-\alpha} k^{\alpha}} \quad \ldots(3.34)$$

Let us divide both sides of equation (3.34) by A.

This gives us

$$\boldsymbol{\frac{y}{A} = (1 - s_A)^{1-\alpha}\left(\frac{k}{A}\right)^{\alpha}} \quad \ldots(3.35)$$

If we substitute $\bar{y} = \frac{y}{A}$ and $\bar{k} = \frac{k}{A}$ in equation (3.35) we get

$$\bar{y} = (1 - s_A)^{1-\alpha}\bar{k}^{\alpha} \quad \ldots(3.36)$$

where $\bar{y} = \frac{y}{A} = \frac{Y}{AL}$ is output per worker to technology or output technology ratio and $\bar{k} = \frac{k}{A} = \frac{K}{AL}$ is capital per worker to technology or capital technology ratio.

If we rewrite the capital accumulation equation (3.32) in terms of $\bar{k}$, we obtain the capital technology ratio

$$\frac{\dot{\bar{k}}}{\bar{k}} = \frac{\dot{K}}{K} - \frac{\dot{A}}{A} - \frac{\dot{L}}{L} \quad \ldots(3.37)$$

Let us substitute for $\frac{\dot{K}}{K} = s_K\frac{Y}{K} - d$, $\frac{\dot{A}}{A} = g_A$, and $\frac{\dot{L}}{L} = n$ in equation (3.37). This gives us

$$\frac{\dot{\bar{k}}}{\bar{k}} = s_K\frac{Y}{K} - d - g_A - n \quad \ldots(3.38)$$

$$\frac{\dot{\bar{k}}}{\bar{k}} = s_K\left(\frac{Y/AL}{K/AL}\right) - d - g_A - n \quad \ldots(3.39)$$

$$\frac{\dot{\bar{k}}}{\bar{k}} = s_K\frac{\bar{y}}{\bar{k}} - d - g_A - n \quad \ldots(3.40)$$

$$\dot{\bar{k}} = s_K\bar{y} - (d + g_A + n)\bar{k} \quad \ldots(3.41)$$

Solving for steady state output technology ratio is determined by the production function and the condition that in the steady state $\dot{\bar{k}} = 0$. We solve for $\bar{k}^*$ by putting $\dot{\bar{k}} = 0$ in equation 3.41

$$0 = s_K\bar{y} - (d + g_A + n)\bar{k} \quad \ldots(3.42)$$

$$0 = s_K\left[(1 - s_A)^{1-\alpha}\bar{k}^{\alpha}\right] - (d + g_A + n)\bar{k} \quad \ldots(3.43)$$

$$\bar{k}^{1-\alpha} = (1 - s_A)^{1-\alpha}\frac{s_K}{d+g_A+n} \quad \ldots(3.44)$$

$$\bar{k}^* = (1 - s_A)\left(\frac{s_K}{d+g_A+n}\right)^{\frac{1}{1-\alpha}} \quad \ldots(3.45)$$

Substituting $\bar{k}^*$ from equation (3.45) into the production function in equation (3.36), we get

$$\bar{y}^* = (1 - s_A)^{1-\alpha}\left(\frac{s_K}{d+g_A+n}\right)^{\frac{\alpha}{1-\alpha}}(1 - s_A)^{\alpha} \quad \ldots(3.46)$$

Hence steady state output technology ratio is given by

$$\bar{y}^* = (1 - s_A)\left(\frac{s_K}{d+g_A+n}\right)^{\frac{\alpha}{1-\alpha}} \quad \ldots(3.47)$$

3.8 PERMANENT INCREASE IN THE SHARE OF R&D

In this section we try to answer what happens to the advanced economies of the world if the share of population searching for new ideas increases permanently? To simplify things slightly, let's assume that $\lambda = 1 \; and \; \Theta = 0$. We can re write equation (3.27) as

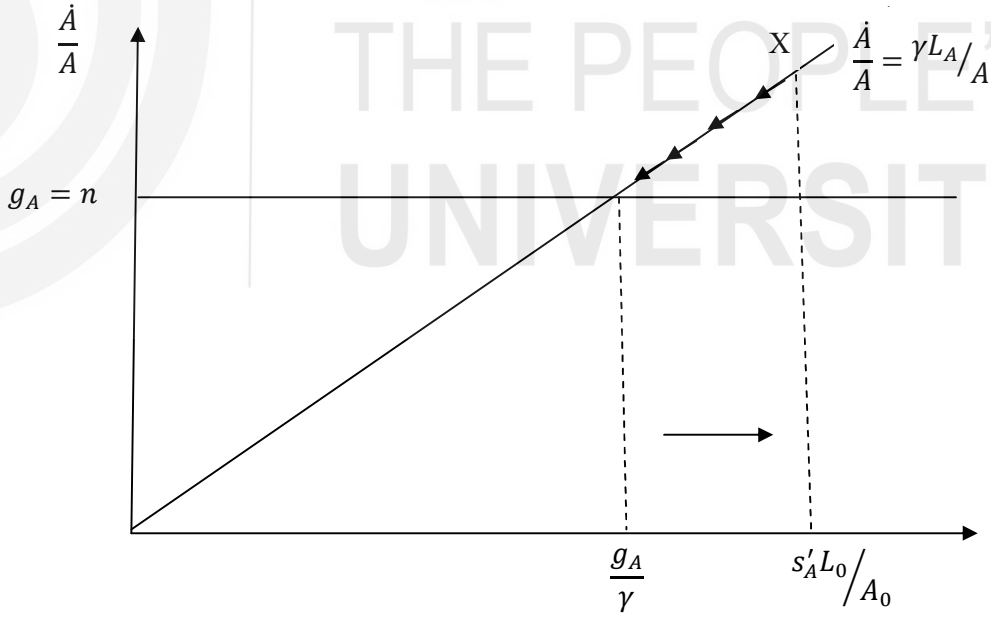
$$\frac{\dot{A}}{A} = \frac{\gamma(s_A L)}{A} \qquad ...(3.48)$$

Fig. 3.1 shows what happens to technological progress when s_A increases permanently to $s_A{}'$, assuming that economy begins in a steady state. In steady state, the economy grows along a balanced growth path at the rate of technological progress, g_A, which happens to equal the rate of population growth, n under our simplifying assumptions

$$g_A = \frac{\dot{A}}{A} = \frac{\gamma(s_A L)}{A} \qquad ...(3.49)$$

$$\frac{g_A}{\gamma} = \frac{\dot{A}}{A} = \frac{L_A}{A} \qquad ...(3.50)$$

Fig. 3.1: Technological Progress: An Increase in the R&D Share

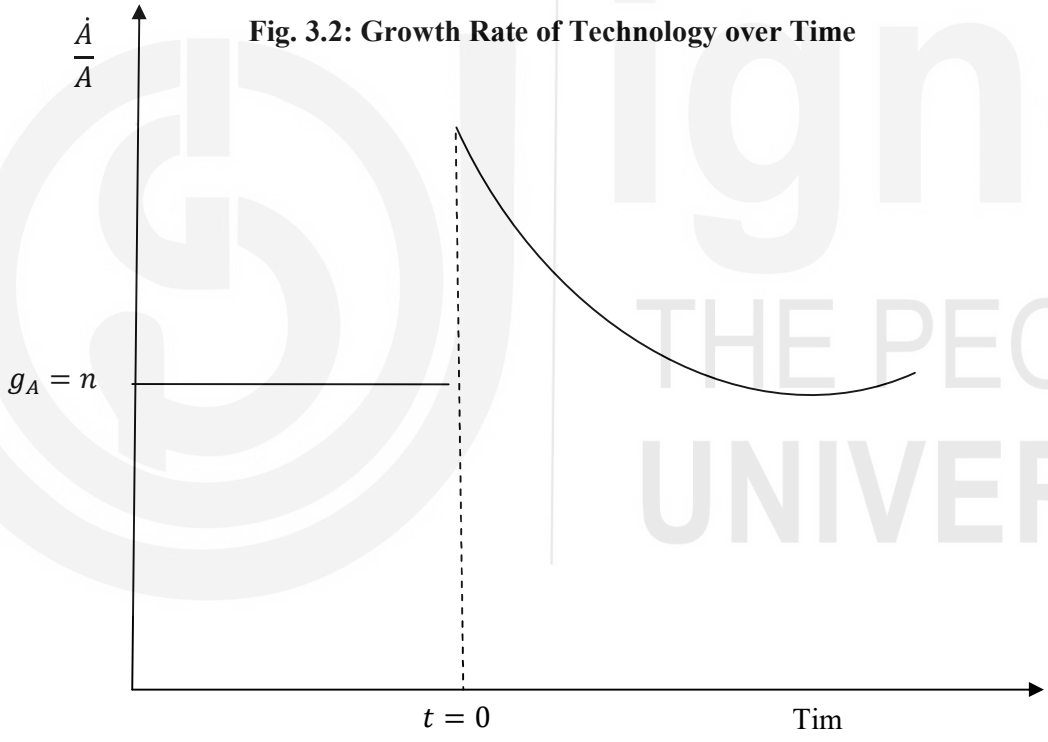


In steady state, the economy grows along a balanced growth path at $g_A = n$. With an increase in $s_A \; at \; t = 0$, the number of researchers increases and the ratio of $\frac{L_A}{A}$ jumps to a higher level X. At X, technological progress $\frac{\dot{A}}{A}$ exceeds population growth n, so the ratio $\frac{L_A}{A}$ declines over time, as indicated by the arrows.

From equation (3.50) the ratio of $\frac{L_A}{A}$ is therefore equal to $\frac{g_A}{\gamma}$. In Fig. 3.1, suppose the increase in s_A occurs at time $t = 0$. With a population of L_0, the number of researchers increases as L_A increases, so that the ratio $\frac{L_A}{A}$ jumps to a higher level. The additional researchers produce an increased number of new ideas, so the growth rate of technology is also higher at this point. This situation corresponds to the point labelled "X" in Fig. 3.1. At X, technological progress $\frac{\dot{A}}{A}$ exceeds population growth n, so the ratio $\frac{L_A}{A}$ declines over time, as indicated by the arrows.

As this ratio declines, the rate of technological change gradually falls also, until the economy returns to the balanced growth path where $g_A = n$. Therefore, a permanent increase in the share of the population devoted to research raises the rate of technological progress temporarily, but not in the long run. This behaviour is depicted in Fig. 3.2.

Fig. 3.2: Growth Rate of Technology over Time

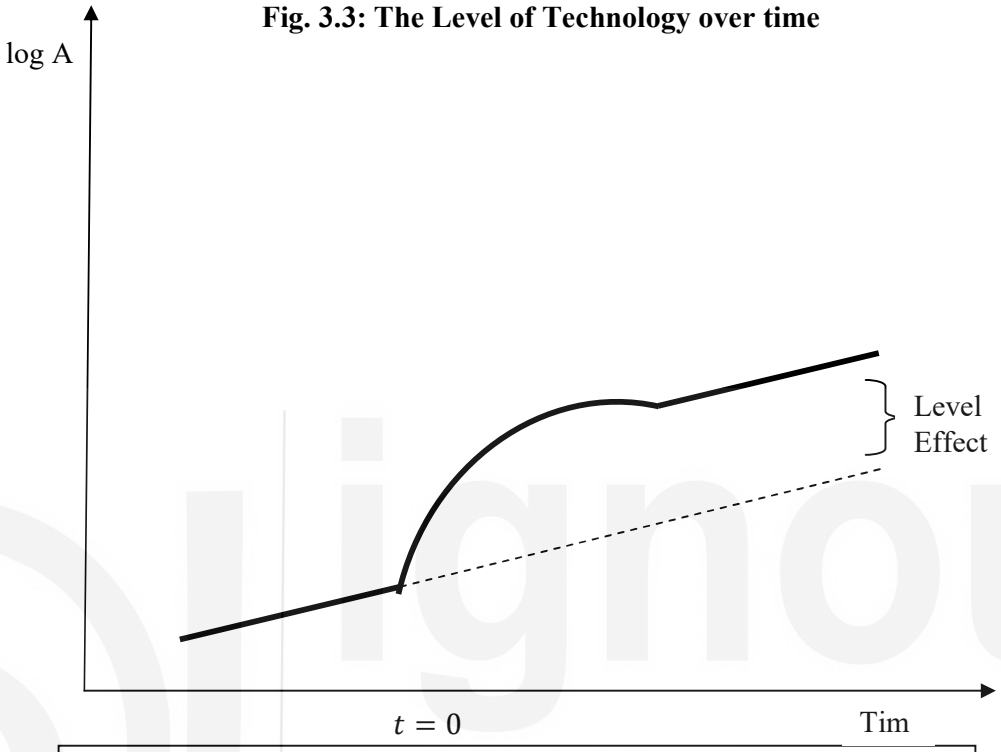


The ratio of $\frac{L_A}{A}$ continues to decline until the economy returns to the balanced growth path where $g_A = n$. Rate of technological progress raises only temporarily.

What happens to the level of technology in this economy? Fig. 3.3 answers this question. The level of technology is growing along a balanced growth path at rate g_A until time $t = 0$. At this time, the growth rate increases and the level of technology rises faster than before. Over time, however, the growth rate falls until it returns to g_A. The level of technology is permanently higher as a result of the permanent increase in R&D. Thus a permanent increase in the share of

population devoted to research has only a level effect on technology. The level of technology is permanently higher as a result of the permanent increase in R&D. The long-run growth rate of the model returns to the balanced growth path after increasing temporarily.

Fig. 3.3: The Level of Technology over time



The level of technology is growing along a balanced growth path at rate g_A until time $t = 0$. At this time, the growth rate increases and the level of technology rises faster than before. Over time, however, the growth rate falls until it returns to g_A. The level of technology is permanently higher as a result of the permanent increase in R&D.

Check Your Progress 3

1) What is the steady state growth rate of output per worker in the Romer model?

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2) Describe the determinants of the long run growh rate of output per worker?

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3) Derive the equation for the level of steady state output-technology ratio.

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4) Explain the effect of a permanent increase in the share of population engaged in R&D on the growth rate of technology and the level of technology?

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3.9 LET US SUM UP

Endogenous growth models are an important theoretical framework for understanding the growth process. They highlight inter – relationships within the society that helps policy makers. These theories are important because they emphasize that capital accumulation and innovations can induce economic growth, while diminishing returns can reduce it. These models show how long run economic growth can be achieved through spillovers and scale effects of ideas and research within the economy. The models of endogenous growth are primarily concerned with establishing how technological progress can bring about increasing returns to scale. The AK model by Arrow (1962) emphasizes the possibility of productivity depending on output per worker. This implies that technological progress can occur, though unintended, by "learning by doing". As workers continue to specialize in the production process, the productivity of their input will become higher through this specialization. Technological progress in the AK model is modeled as the difference in the initial productivity of the factor before learning by doing and the productivity of the factor after learning by doing – which will be higher. In the AK model, economic growth is induced by savings, capital accumulation, and efficiency. Efficiency is defined as the increase in the productivity of factor inputs by "learning by doing".

The Romer model focuses on the distinction between ideas and objects. The assumptions of the model, yields four equations: (1) Producing output requires knowledge and labor. The production function has constant returns to scale in objects alone, but increasing returns to scale in objects and ideas. (2) New ideas depend on the existence of ideas in the previous period, the number of workers producing ideas, and their productivity. (3) The number of workers producing ideas and the number of workers producing output sums to the population. (4) Some fraction of the population produces ideas. With these equations, Romer model produces the desired long-run economic growth that Solow did not. The Romer model does not have diminishing returns to ideas because they are non-rival.

The Romer model has a *balanced growth path* – on which the growth rates of all endogenous variables are constant and is equal to $g_Y = g_K = g_A = \left(\frac{\dot{A}}{A}\right)^* = \frac{\lambda}{1-\Theta} n$. The long run growth rate of output per worker in this model depends positively on three factors. The parameter λ, the strength of the "standing on shoulders" effect, θ and the growth rate of the number of workers, n. Increase in the level of technology as a result of the permanent increase in R&D has only a level effect on technology. The long-run growth rate of the model returns to the balanced growth path after increasing temporarily.

3.10 ANSWERS/HINTS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) It uses the assumption that the production function does not exhibit diminishing returns to scale to lead to endogenous growth.
2) The growth rate of output in equation 3.5 depends on the saving rate.

Check Your Progress 2

1) Output Y is produced using labor L_Y and a number of different capital goods, x_i which we call intermediate goods.
2) λ is an index of how slowly diminishing marginal productivity sets in for researchers. θ represents a positive externality associated with the "giant shoulder" effect.

Check Your Progress 3

1) The steady state growth rate of output per worker equals the steady state growth rate of A. That is $g_Y = g_K = g_A$
2) The long run growth rate of output per worker in this model depends positively on three factors. The parameter λ, the strength of the "standing on shoulders" effect, θ and the growth rate of the number of workers, n.
3) Refer to equations (3.31) to (3.47) in the text.
4) A permanent increase in the share of population devoted to research has only a level effect on technology. The level of technology is permanently higher as a result of the permanent increase in R&D. The long-run growth rate of the model returns to the balanced growth path after increasing temporarily.

UNIT 4 BUSINESS CYCLE*

Structure

4.0 OBJECTIVES

After going through the unit you will be able to

- explain the concept and features of Business cycle;
- identify the various phases of Business cycle;
- ascertain the theoretical framework which explains the occurrence of business cycle;
- distinguish between the monetary and real factors behind business cycle; and
- distinguish between the leading, lagging and coincident indicators.

4.1 INTRODUCTION

Rapid economic growth witnessed by many developed economies during the past two centuries has not been a smooth one. There have been periodical ups and downs in the GDP levels of these countries. Along with output, there have been fluctuations in various economic aggregates such as income, employment and prices and their long term trends. These economies have experienced phases of

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expansion and contraction in output and other economic aggregates alternatively. These alternating phases of upswings and downswings are known as business cycles.

Theoretical explanations of business cycles evolved in the early 20th century. Periods of expansion and contraction in an economy exhibited a remarkable degree of regularity. The characteristics of these phases are carefully documented by economists like Wesley Mitchell, Simon Kuznets and Frederick Mills. Mitchell documented the co-movement of variables over the cycles; Mills documented the co-movement of prices and quantities over expansions and contractions, while Kuznets studied the patterns of both growth and fluctuations. The 1930s was a very active period of business cycle research as the National Bureau of Economic Research (NBER) continued its program (begun by Mills and Mitchell) of empirically documenting the features of business cycles. However, interest in business cycles waned after the publication of Keynes' General Theory which turned attention away from Business cycles to short run management of the economy. Interest in business cycles revived in the 1970s when the prevalent economic crisis in many countries could not be explained by Keynesian model.

In this unit we first explain the features of business cycles and the various phases of business cycles. We proceed further to examine how to identify business cycles and measure the aggregate state of the economy using various economic series. Subsequently we explain the important theoretical frameworks of business cycles.

4.2 FEATURES OF BUSINESS CYCLES

Business cycles are economy-wide fluctuations in output, unemployment, prices, revenue, profits, and interest rates, among other variables. These fluctuations occur across the economy and over a number of years. Fluctuations always take place in an economy. Business cycles, however, do not refer to fluctuations that are specific to one geographic region or industry within an economy. To identify business cycles, we must look at factors that can have an effect on the entire economy.

Business cycles consist of recurrent alternating phases of expansions and contractions in a number of economic variables including employment, production, real income, and real sales. Business cycles involve multidimensional processes, in which quantities and prices, stocks and flows, outputs and inputs, real, monetary, and financial variables all tend to move together. These are asymmetric in the sense that expansions typically exceed contractions in size and duration. Business cycles can be distinguished from the other fluctuations in that they are usually *larger, longer,* and *widely diffused.*

The major features of business cycles are as follows:

1) Though business cycles do not show the same regularity, they have some distinct phases such as expansion, peak, recession, trough and recovery. The duration of cycle can vary between two years to twelve years.
2) Business cycles are *synchronic*. Depression or contraction occurs simultaneously in most industries or sectors of the economy. Recession passes from one industry to another and chain reaction continues till the whole economy is in the grip of recession. Similarly, expansion spreads through various linkages between industries or sectors.
3) Fluctuations occur simultaneously in the level of output as well as employment, investment, consumption, etc.
4) Consumption of durable goods and investment are affected the most by cyclical fluctuations. As stressed by Keynes, investment is very unstable as it depends on profit expectations of private entrepreneurs. Any change in these expectations makes investment unstable. Thus the amplitude of fluctuation in the case of durable household effects is higher than that of GDP.
5) Consumption of non-durable goods and services do not vary much during the different phases of business cycles. Past data of business cycles reveal that households maintain a great stability in the consumption of non-durable goods. Thus the amplitude of fluctuations in the case of non-durable consumption goods is lower than that of GDP.
6) The immediate impact of recession or expansion is on the inventories of goods. When recession sets in, inventories start accumulating beyond the desired level. It leads to cut in production of goods. In contrast, when recovery starts, the inventories go below the desired level. It encourages business houses to place more orders for goods which boost production and stimulates investment.
7) Profits fluctuate more than any other type of income as the occurrence of business cycles causes lot of uncertainty for the businessmen and makes it difficult to forecast economic conditions. During depression, profits turn negative and many businesses go bankrupt.
8) Business cycles are international in character. That is, once started in one country, they spread to other countries through contagion effect. The downslide in financial market, for example, in one country spreads rapidly to other country as financial markets are linked globally through capital flows. Further, recessions in one country, say the United States can spread to other country as the imports of the U.S.A. will decline. Countries which are major exporter to the U.S will witness a decline in their exports and may witness recession.

4.3 PHASES OF BUSINESS CYCLES

Business cycles are characterized by expansion of economic variables in one period and contraction in the subsequent period. In Fig. 4.1 you can observe the

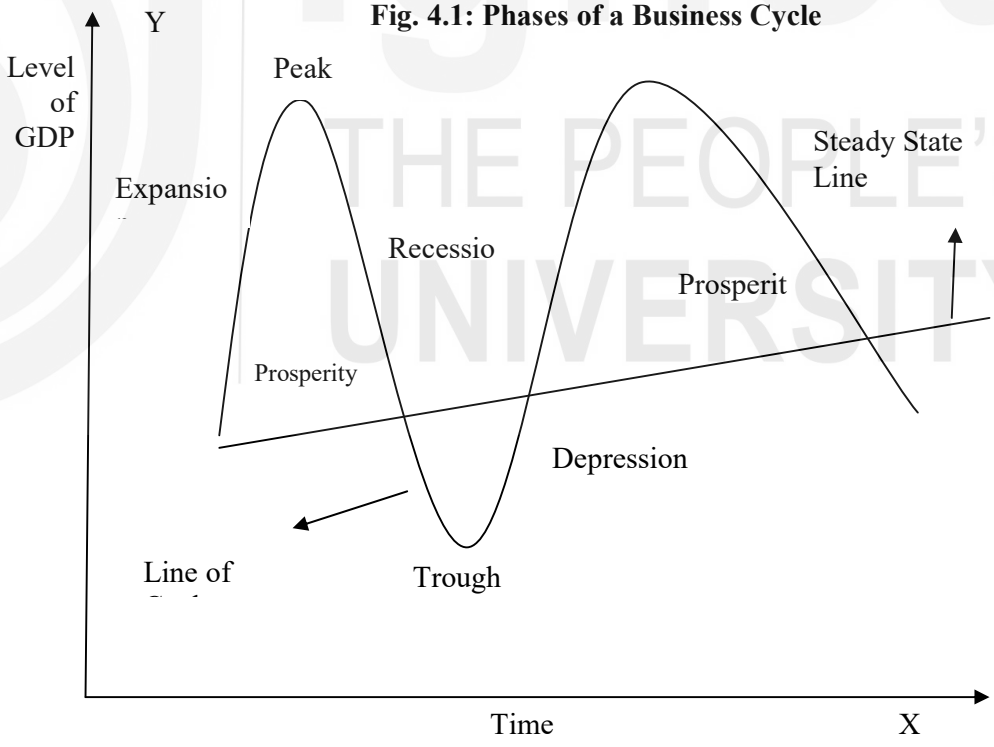
upward sloping curve (expansion phase) there is acceleration in growth rate. The downward sloping segment of the curve indicates the 'contraction phase'.

In Fig. 4.1 the upward sloping straight line indicates the steady state growth path or the long run growth path of the GDP. The actual GDP fluctuates around the steady state growth path due to business cycles.

According to some researchers there are four phases of a business cycle, viz., expansion, recession, depression and recovery. The four phases of a business cycle are also depicted in Fig. 4.1. In fact, the expansion phase comprises both recovery and expansion. Similarly, the contraction phase consists of both recession and depression. You should note that the difference between recession and depression is one degree. In the recession phase there is a deceleration in the growth rate. In the depression phase, economic growth is below its long run trend and the economy can witness negative growth rate also.

Similarly, the difference between recovery and expansion is one of degree and extent. After negative growth, the economy passes through the recovery phase and then through the expansion phase. The point at which the expansion ends and a recession begin is called 'peak' of a business cycle. The point at which a depression ends and recovery begins is called a 'trough'. Thus peak and trough are 'turning points' in a business cycle.

Fig. 4.1: Phases of a Business Cycle



4.3.1 Expansion Phase

In the expansion phase, there is an increase in various economic factors, such as production, employment, output, wages, profits, demand and supply of products, and sales. An expansion stage can begin as the result of many forces, including

willingness of financial institutions to lend more and willingness of business houses to borrow more. There is overall optimism in the economy. The expansion phase continues till the economic environment is favourable.

During the expansion phase, the economy often gets overheated in the sense that various constrains and frictions develop in the economy. Wage rate and prices increase much faster than output leading to hike in production cost and decline in profits. The central bank pursues a restrictive monetary policy so that inflation is in under control.

Economic growth in the expansion phase eventually slows down and reaches its peak. During the peak of a business cycle, economic variables such as production, profits, sales and employment are high; but do not accelerate further. There is gradual decrease in the demand for various inputs due to the increase in input prices. The increase in input prices leads to increase in production prices while real income of people does not increase proportionately. It leads consumers to restructure their monthly budget and the demand for products, particularly luxuries and consumer durables, starts falling. The peak also occurs before various economic indicators such as retail sales and the number of employed people falls. When the decline in the demand for products become rapid and steady, recession takes place

4.3.2 Contraction Phase

In recession phase, all the economic variables such as production, prices, saving and investment, starts decreasing. Generally, in the beginning of the downturn, producers are not aware of the decrease in the demand for their products and they continue to produce goods and services. In such a case, the supply exceeds demand and there is accumulation of inventories. Over the time, producers realize that there is an unwanted accumulation of inventories, escalation in production cost, and decline in profits. Such a condition is first experienced by few industries and slowly spreads to the whole economy. During the recession phase, producers usually avoid new investments which lead to the reduction in the demand for factors of production, and consequent decline in input prices and unemployment. Firms reduce levels of production and the number of people on their payrolls. A chain reaction starts, lower income, lower demand, lower output, lower employment, and so on. The adverse effects of recession extent beyond the purely economic realm and influence the social fabric of society as well. Social unrest and crimes tend to rise during recession.

When recession continues further, economic growth rate may be negative also. This phase is sometimes termed as ‘depression’. During depression, there is not just a decline in the growth rate; there is a decline in the absolute level of GDP. As sales declines, business houses find it difficult to repay their debts. As business sentiments are low enough to carry out new investments, demand for credit declines. Banks also become cautious in their lending as the chances of default on repayment increases. The economy however revives its growth rate over a period of time and optimism build up in certain sectors of the economy. This leads to reversal of the recession phase and the recovery phase starts.

Individuals and organizations start developing a positive attitude towards the various economic factors, such as investment, employment and production. In the recovery phase, there is an increase in consumer spending and demand for consumer goods. This provides incentive to firms to increase production, carry out new investments, hire more labour, etc. Further, there could be some investment during the recession phase due to replacement of obsolete machines and maintenance of existing capital stock.

Price level plays a very important role in the 'recovery phase' of an economy. As pointed out earlier, during the recession phase decline in input prices is greater than the decline in product prices. This leads to a reduction in the cost of production and increase in profits. Apart from this, in the 'recovery phase, some of the depreciated capital goods are replaced by producers and some are maintained by them. As a result, investment and employment by organizations increases. As this process gains momentum, an economy again enters into the phase of expansion. Thus, the business cycle gets completed.

Check Your Progress 1

1) What is meant by business cycle?

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2) Point out the important features of business cycle.

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3) What are the different phases of business cycle?

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4.4 IDENTIFICATION OF BUSINESS CYCLES

Understanding the various phases of business cycles is essential, because it will help the government in taking counter-cyclical measures. This requires identifying the turning points of a business cycle. In the United States, the National Bureau of Economic Research (NBER) has a dedicated research programme for identifying the dates of business cycle turning points.

Similarly the Euro Area Business Cycle Dating Committee of the Centre for Economic Policy Research (CEPR) identifies the chronology of recessions and expansions of the Euro Area member countries. In India also there have been some attempts by scholars to identify the chronology of business cycles (See, for example, Dua and Banerjee (2000) and Chitre (2001)).

The NBER's Business Cycle Dating Committee maintains a chronology of the United States business cycle. The chronology comprises alternating dates of peaks and troughs in economic activity. A recession is a period between a peak and a trough, and an expansion is a period between a trough and a peak. According to NBER a recession is a significant decline in economic activity spread across the economy, lasting more than a few months, normally visible in real GDP, real income, employment, industrial production, and wholesale-retail sales. Similarly, during an expansion, economic activity rises substantially, spreads across the economy, and usually lasts for several years. Thus, the NBER approach identifies cycles as recurrent sequences of alternating phases of expansion and contraction in the levels of a large number of economic time series. This working definition of business cycle has been in use at the NBER for over fifty years, and it is currently employed by the NBER to identify and date the United States business cycle. These dates are widely accepted by government, researchers and business analysts.

In both recessions and expansions, brief reversals in economic activity may occur – a recession may include a short period of expansion followed by further decline; an expansion may include a short period of contraction followed by further growth. The Business Cycle Dating Committee applies its judgment based on the above definitions of recessions and expansions and has no fixed rule to determine these upturns and downturns.

The Committee does not have a fixed definition of economic activity. It examines and compares the behaviour of various measures of broad activity: real GDP measured on the product and income sides, economy-wide employment, and real income. The Committee also may consider indicators that do not cover the entire economy, such as real sales and the Federal Reserve's index of industrial production (IIP).

Table 4.1: NBER Chronology for United States Business Cycles

(duration in number of months)

Peak month	*Trough month*	*Peak month number*	*Trough month number*	*Duration, peak to trough*	*Duration, trough to peak*	*Duration, peak to peak*	*Duration, trough to trough*
	December 1854	---	660	---	---	---	---
June 1857	December 1858	690	708	18	30	---	48
October 1860	June 1861	730	738	8	22	40	30
April 1865	December 1867	784	816	32	46	54	78
June 1869	December 1870	834	852	18	18	50	36

October 1873	March 1879	886	951	65	34	52	99
March 1882	May 1885	987	1025	38	36	101	74
March 1887	April 1888	1047	1060	13	22	60	35
July 1890	May 1891	1087	1097	10	27	40	37
January 1893	June 1894	1117	1134	17	20	30	37
December 1895	June 1897	1152	1170	18	18	35	36
June 1899	December 1900	1194	1212	18	24	42	42
September 1902	August 1904	1233	1256	23	21	39	44
May 1907	June 1908	1289	1302	13	33	56	46
January 1910	January 1912	1321	1345	24	19	32	43
January 1913	December 1914	1357	1380	23	12	36	35
August 1918	March 1919	1424	1431	7	44	67	51
January 1920	July 1921	1441	1459	18	10	17	28
May 1923	July 1924	1481	1495	14	22	40	36
October 1926	November 1927	1522	1535	13	27	41	40
August 1929	March 1933	1556	1599	43	21	34	64
May 1937	June 1938	1649	1662	13	50	93	63
February 1945	October 1945	1742	1750	8	80	93	88
November 1948	October 1949	1787	1798	11	37	45	48
July 1953	May 1954	1843	1853	10	45	56	55
August 1957	April 1958	1892	1900	8	39	49	47
April 1960	February 1961	1924	1934	10	24	32	34
December 1969	November 1970	2040	2051	11	106	116	117
November 1973	March 1975	2087	2103	16	36	47	52
January 1980	July 1980	2161	2167	6	58	74	64
July 1981	November 1982	2179	2195	16	12	18	28
July 1990	March 1991	2287	2295	8	92	108	100
March 2001	November 2001	2415	2423	8	120	128	128
December 2007	June 2009	2496	2514	18	73	81	91
February 2020	---	---	---	---	128	146	---

You can observe from Table 4.1 that the duration of a cycle is not uniform (see from trough to trough or from peak to peak).

Secondly, the duration of peak to trough (contraction phase) has been shorter than the duration of trough to peak (expansion phase).

4.5 BUSINESS CYCLE INDICATORS

As you already know, a major objective of macroeconomic policy is to maintain stability in economic growth and price level. An important part of the job of the central bank is therefore to gather information of the current and if possible, future economic conditions. The theoretical concept of measuring current business activities using economic series such as GDP, sales, investment, stock prices, etc. is rather simple though its practical application is difficult. Usually, the time pattern of these fluctuating economic series is diverse. While some economic series are expanding at a given point in time, others have already reached their upper turning point (peak) and still others are on the downswing; a few economic activities might even be at a lower turning point (trough). Thus the question is how to measure the overall state of the economy using these economic variables as they have diverse trends.

Economic indicators were conceived at the NBER originally by W.C. Mitchell and A. F. Burns in the 1930s. This approach requires monitoring of economic variables that tend to be sensitive to cyclical changes no matter what their cause. There could be three scenarios: (i) certain economic variables move ahead of business cycles (they 'lead' a business cycle), (ii) certain other economic variables lag behind a business cycle (the turning points in these variables take place later that with certain 'lag'), and (iii) there are still other economic variables which 'coincide' with business cycles. Burn and Mitchell studied a group of about 487 variables to see if the turning points in the variables persistently led, coincided with, or lagged behind the turning points in the U.S. business cycle. Seventy one series were chosen and arranged according to the average lead or lag with regard to the reference revivals. For example, six time series had no average lead or lag. On the average, the leading series were from one to ten months ahead of the reference revivals. The lagging series were on the average from one to twelve months behind.

According to Business Cycle Indicators Handbook 2020, a business cycle indicator should fulfil the following criteria:

(i) Conformity: the series must conform well to business cycles;

(ii) Consistent Timing: the series must exhibit a consistent timing pattern over time as a leading, coincident or lagging indicator;

(iii) Economic Significance: the cyclical timing of the series must be economically logical;

(iv) Statistical Adequacy: data on the variable must be collected and processed in a statistically reliable way;

(v) Smoothness: month-to-month movements in the variable must not be too erratic; and

(vi) Currency: Data on the variable must be available on a reasonable prompt schedule.

Those series are selected which are similar in timing at peaks and troughs with business cycles. Business cycle indicators are classified into three groups, viz., leading, roughly-coincident and lagging.

4.5.1 Leading Indicators

Leading economic indicators help us assess where the economy is headed. They foreshadow what is coming, such a turning point, before it actually happens.

One of the most significant leading indicators is the stock market itself, gauged by an index such as the S&P 500. It will begin to rise before economic environment seems favourable, and it will begin to decline before economic conditions seem to warrant it. Another important leading indicator is interest rates. Low interest rate stimulates borrowing and buying, which favours the economy. An increase in interest rates shows the economy is doing well, but eventually rising interest rates lead to a slowdown because less people borrow money to start new projects.

4.5.2 Lagging Indicators

Unlike leading indicators, lagging indicators turn around after the economy changes. Although they do not typically tell us where the economy is headed, they indicate how the economy changes over time and can help identify long-term trends. Lagging economic indicators reveal past information about the economy.

Gross Domestic Product (GDP) is how much a country is producing. There is significant lag time between when the data is compiled and when it is released, yet it is still an important indicator. Many consider a recession to be underway if two quarters see back-to-back declining GDP. Other indicators, such as the Consumer Price Index (CPI), are also sometimes considered lagging indicators, since they reveal information that is already known to most consumers.

4.5.3 Coincident Indicators

Coincident indicators change (more or less) simultaneously with general economic conditions and therefore reflect the current status of the economy. They give consumers, business leaders, and policy makers an idea about where the economy is currently, right now. When the economy rises today, then coincident indicators are also rising today. Similarly if the economy declines today, then coincident indicators are also declining today. Typical examples of coincident indicators are industrial production or turnover. In Table 4.1 we present a list of business cycle indicators.

Table 4.2: Business Cycle Indicators

Leading	Roughly-Coincident	Lagging
I. Investment in Fixed Capital and Inventories		
New building permits; housing starts; residential fixed investment; New business formation; New capital appropriations; Contracts and orders for plant and equipment; Change in business inventories	Production of business Equipment; Machinery and equipment sales	Backlog of capital appropriations; Business expenditures for new plant and equipment; Trade inventories
II. Consumption, Trade, Orders, and Deliveries		
New orders for consumer goods and materials; Change in unfilled orders, durable Goods; Vendor performance (speed of deliveries); Index of consumer sentiment	Production of consumer Goods; Trade sales	
III. Employment, Production, and Income		
Average workweek; overtime Hours; Accession rate; layoff rate; New unemployment insurance claims; Productivity (output per hour); Rate of capacity utilization	Non-agricultural employment; unemployment rate; GDP; personal income; industrial production	Average duration of unemployment; Long term unemployment
IV. Prices, Costs, and Profits		
Bond prices; Stock prices; Sensitive materials prices; Profit margins; Total corporate profits; net cash flows		Unit labour costs; Labour share in national income

V. Money, Credit, and Interest		
Monetary growth rates; Change in liquid assets; Change in consumer credit; Total private borrowing; Real money supply	Velocity of money	Short-term interest rates; Bond yields; Consumer credit outstanding; Commercial and industrial loans outstanding
Note: The selection is based on the U.S. indicators published in *Business Conditions Digest,* a monthly report by the Bureau of Economic Analysis, U.S. Department of Commerce		

Check Your Progress 2

1) What are the criteria that form the basis for selection of a business cycle indicator?

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2) What is the importance of a lagging indicator?

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4.6 THEORIES OF BUSINESS CYCLES

We have explained above the various phases and common features of business cycles. Now, an important question is what causes business cycles. Several theories of business cycles have been propounded from time to time. Each of these theories spells out different factors which cause business cycles.

4.6.1 Keynes' Theory of Business Cycle

J.M. Keynes in his seminal work 'General Theory of Employment, Interest and Money' made an important contribution to the analysis of the causes of business cycles. According to Keynes, the changes in the level of aggregate effective demand will bring about fluctuations in the level of income. The aggregate demand is composed of demand for consumption goods and demand for investment goods. According to Keynes, propensity to consume is more or less stable in the short run. Private investment however depends upon profit motive and business expectations about the economy. Thus fluctuation in aggregate

demand depends primarily upon fluctuations in investment demand. Multiplier plays a significant role in causing magnified changes in income following a reduction or increase in investment.

Keynesian theory however fails to explain the cumulative character of business cycle. For example, suppose that investment rises by 100 rupees and that the magnitude of multiplier is 4. From the theory of multiplier, we know that national income will rise by 400 rupees and if multiplier is the only force at work that will be the end of the matter, with the economy reaching a new stable equilibrium at a higher level of national income. But in real life, this is not likely to be so, for a rise in income produced by a given rise in investment will have further repercussions in the economy. This reaction is described in the 'principle of accelerator' (accelerator is the impact of income on investment). Samuelson combined the accelerator principle with the multiplier and showed that the interaction between the two can bring about cyclical fluctuations in economic activity.

4.6.2 Schumpeter's Innovation Theory of Business cycles

Joseph Schumpeter considered trade cycles to be the result of innovation activity of the entrepreneurs in a competitive economy. Schumpeter calls the equilibrium state of the economy as a "circular flow" of economic activity which just repeats itself period after period. The circular flow of economic activity gets disturbed when an entrepreneur successfully carries out an innovation. According to Schumpeter, the primary function of an entrepreneur is innovation activity which yields him/ her real 'profit'.

According to Schumpeter, introduction of a major innovation leads to a business cycle. As the innovator-entrepreneur begins bidding away resources from other industries, money incomes increase and prices begin to rise thereby stimulating further investment. As the innovation steps up production, the circular flow in the economy swells up. Supply exceeds demand. The initial equilibrium is disturbed. There is a wave of expansion of economic activity. This is what Schumpeter calls the "primary wave". This primary wave is followed by a "Secondary wave" of expansion. This is due to the impact of the original innovation on the competitors. You can imagine the impact of innovation if you relate it to some real life examples such as the Internet, mobile phone, and on-line transactions.

As the original innovation proves profitable, other entrepreneurs follow it in "swarm-like clusters". Innovation in one sector induces innovations in related sectors. Money incomes and prices rise. As potential profits in these industries increase, a wave of expansion in the whole economy follows.

This period of prosperity ends as soon as 'new' products induced by the waves of innovations replace old ones. Since the demand for the old products goes down, their prices fall and consequently their producer-firms are forced to reduce their output. When the innovators begin repaying their bank loans out of the newly-earned profits, the quantity of money in circulation is reduced as a result of which prices tend to fall and profits decline.

In this atmosphere, uncertainty and risks increase. Recession sets in. The economy cannot continue in recession for long. Entrepreneurs continue their search for profitable innovations. The natural forces of recovery bring about a revival.

4.6.3 Samuelson's Model of Business Cycles: Interaction between Multiplier and Accelerator

Samuelson in his seminal paper convincingly showed that an autonomous increase in the level of investment raises income by a magnified amount depending upon the value of the multiplier. This increase in income further induces the increases in investment through acceleration effect. The increase in income brings about increase in aggregate demand for goods and services. To produce more goods we require more capital goods for which extra investment is undertaken. Thus the relationship between investment and income is one of mutual interaction; investment affects income which in turn affects investment demand and in this process income and employment fluctuate in a cyclical manner.

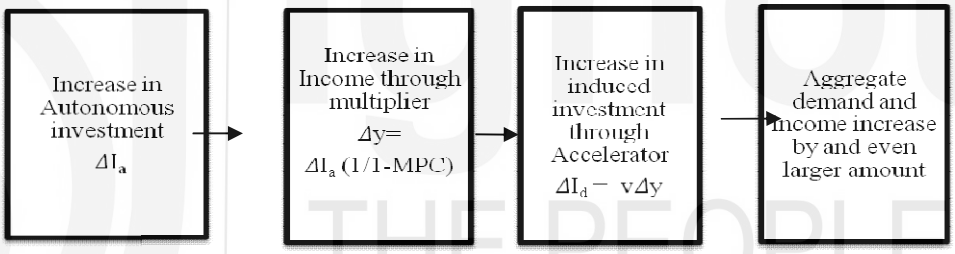


Fig. 4.2 shows how income and output will increase by even larger amount when accelerator is combined with the Keynesian multiplier.

ΔI_a = Increase in Autonomous Investment

Δy = Increase in Income

$\frac{1}{1-MPC}$ = Size of multiplier when MPC = Marginal Propensity to Consume

ΔI_d = Increase in Induced Investment

v = Size of Accelerator

Let us assume that there is an increase in investment in the economy. This will result in a magnified increase in output and income due to multiplier effect. When output increases under the influence of multiplier effect, it induces further increase in investment. The extent to this induced investment in capital goods industries depends on the capital-output ratio (v).

Increase in investment leads to further increase in income, which again leads to increase in investment. The pattern of the interaction between multiplier and accelerator however differs depending upon the magnitudes of the marginal propensity to consume and capital-output ratio. It implies that the interaction between multiplier and accelerator can give rise to business cycles.

The model of interaction between multiplier and accelerator can be mathematically represented as under:

$$\boldsymbol{Y_t = C_t + I_t} \quad ...(4.1)$$

$$\boldsymbol{C_t = C_a + c\,(Y_{t-1})} \quad ...(4.2)$$

$$\boldsymbol{I_t = I_a + v\,(Y_{t-1} - Y_{t-2})} \quad ...(4.3)$$

where Y_t , C_t , I_t stand for income, consumption and investment respectively for period *t*, C_a stands for autonomous consumption, I_a for autonomous investment, *c* for MPC and v for capital-output ratio or accelerator.

From the above equation it is evident that consumption in a period t is a function of income of the previous period, Y_{t-1}. That is, one period lag has been assumed for income to determine the consumption of a period. As regards induced investment in period t, it is taken to be a function of the change in income in the previous period. It means that there are two period gaps for changes in income to determine induced investment. In the equation (4.3) above, induced investment equals $v\,(Y_{t-1} - Y_{t-2})$. Substituting equations (4.2) and (4.3) in (4.1), we have the following:

$$\boldsymbol{Y_t = C_a + c\,(Y_{t-1}) + I_a + v\,(Y_{t-1} - Y_{t-2})} \quad ...(4.4)$$

Equation (4.4) indicates how changes in income are dependent on the values of MPC (c) and capital-output ratio v, (i.e., accelerator).

By taking different combinations of the values of *c* and *v*, Samuelson could describe different paths which the economy would follow. The various combinations of the values of c and v are shown in Fig. 4.3.

Fig. 4.3: Combinations of c and v

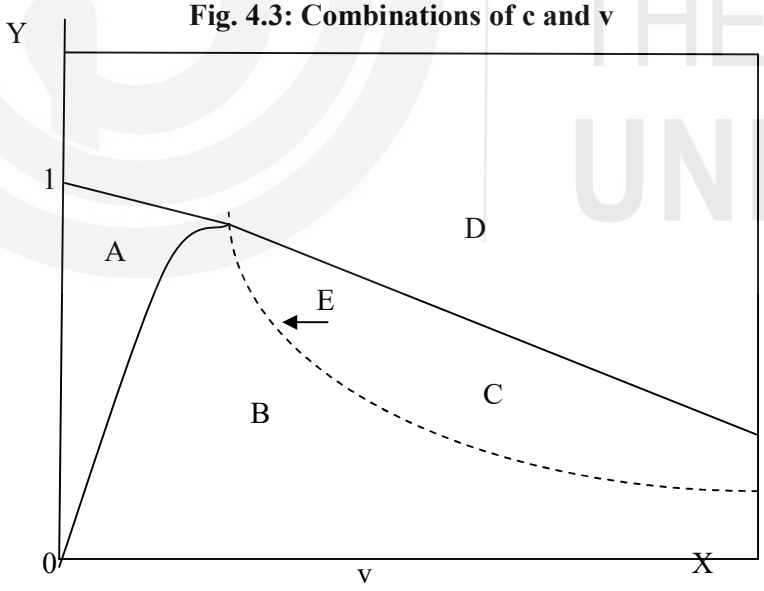
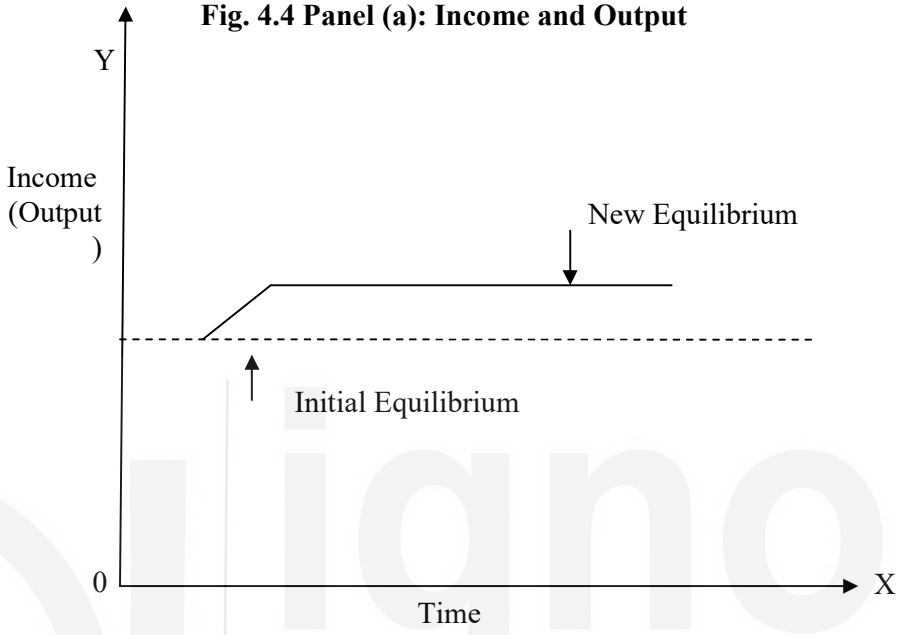


Fig. 4.3 shows the four paths which the economic activity can have depending upon combinations of the values of marginal propensity to consume (c) and capital-output ratio (v).

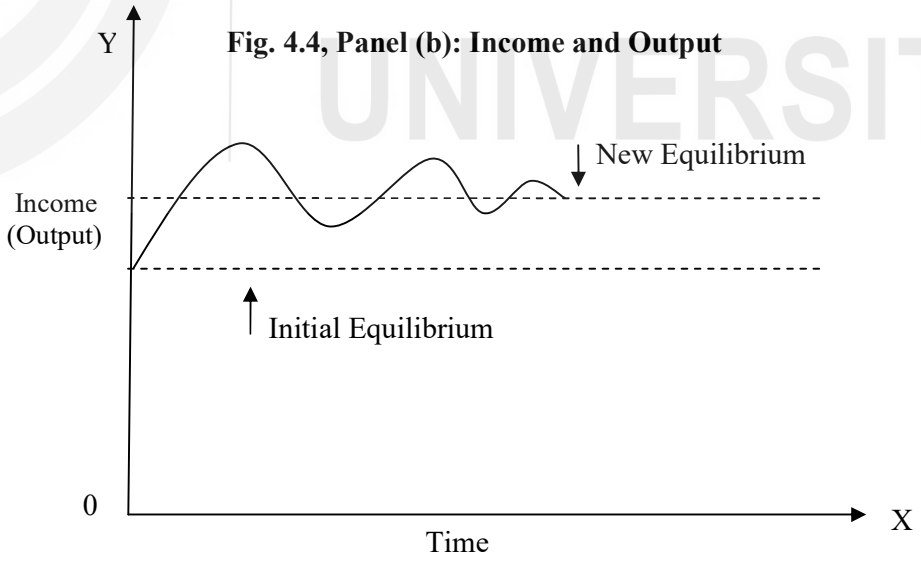
The five paths or patterns of movements in output or income can have depends upon the combinations of the values of c and v. We depict these paths in Fig. 4, Panels (a) to (e). When the combinations of c and v lie in the region marked A, an increase in investment will increase output a decreasing rate. Finally it reaches a new equilibrium as shown in panel (a) of Fig. 4.4.

Fig. 4.4 Panel (a): Income and Output



If the values of c and v lie in region B of Fig. 4.3, a change in investment will generate fluctuations in income which follow the pattern of a series of damped cycles as shown in panel (b) of Fig. 4.4. It means that the amplitude goes on declining until the cycles disappear over a period of time.

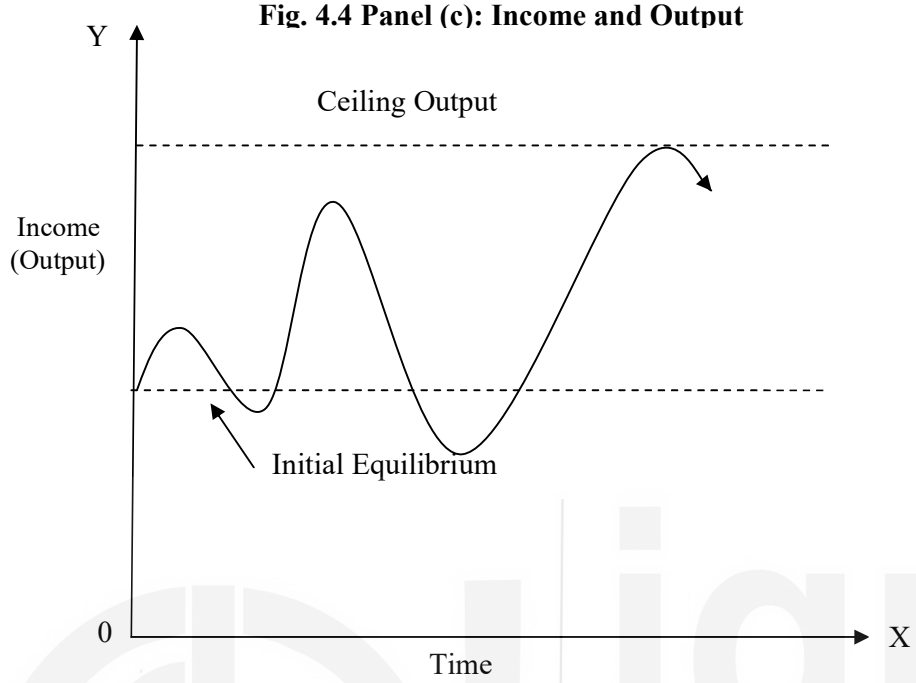
Fig. 4.4, Panel (b): Income and Output



You should note that region C of Fig. 4.3 represents the combinations of c and v which are relatively high as compared to the region B. Such values of multiplier and accelerator bring about explosive cycles as given in panel (c) of Fig. 4.4.

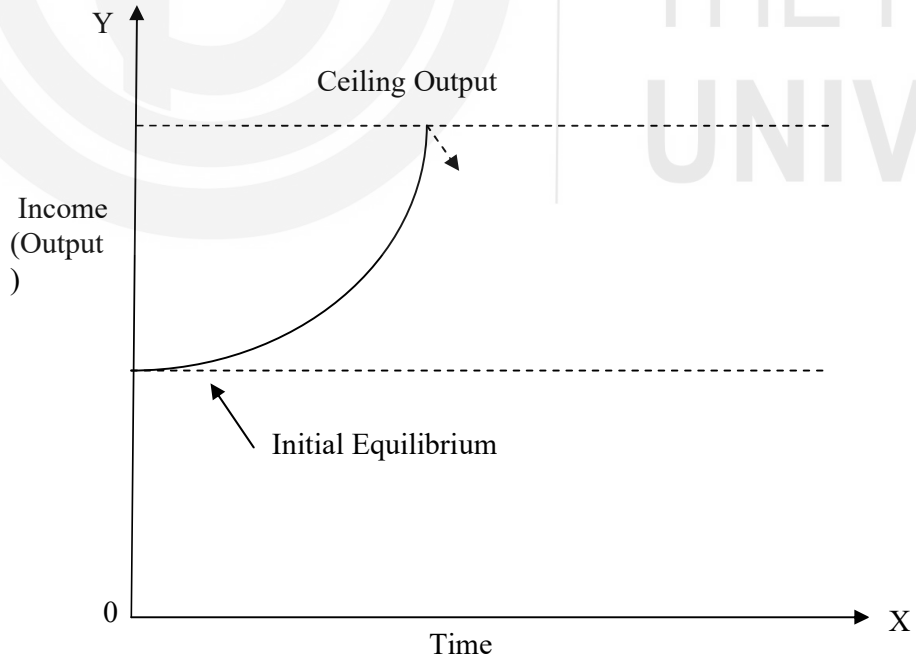
It implies that the fluctuations of income will be successively greater and greater in amplitude.

Fig. 4.4 Panel (c): Income and Output



The region D of Fig. 4.3 describes the combinations of c and v which cause income to move upward or downward at an increasing rate. We have depicted it in panel (d) of Fig. 4.4.

Fig. 4.4 Panel (d): Income and Output



In a special case when values of c and v lie in the region E of Fig. 4.3, they produce fluctuations in income of constant amplitude and are shown in panel (e) of Fig. 4.4. You should note that all the above five cases do not give rise to

cyclical fluctuations or business cycles. It is only combinations of c and v lying in the regions B, C and E that produce business cycles.

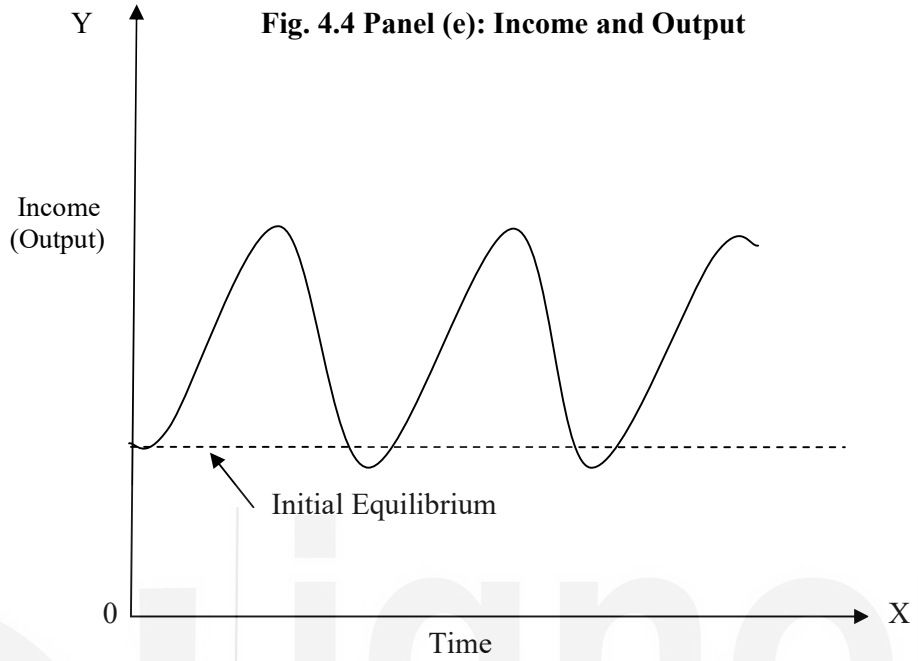


Fig. 4.4 Panel (e): Income and Output

Fig. 4.4 Panel (a) to (e) shows different patterns of income (output) movements for various values of c and v which respectively determine the magnitudes of multiplier and accelerator.

4.6.4 Real Business Cycle Theory

According real business cycle theory, monetary shocks or expectation changes have no role to play in a business cycle. The real business cycle theory makes the fundamental assumption that root cause of business cycle is real shocks to an economy. These shocks could be from the supply side such as technology shocks (changes in total factor productivity). Technological shocks include innovations, bad weather, stricter safety regulations, etc.

Business cycles are primarily caused by real or supply side shocks that involve exogenous large random changes in technology. An initial shock in the form of technical progress shifts the production function upward. This leads to increase in available resources, investment, consumption and real output. With the increase in investment, the capital stock increases which further increases real output, consumption and investment. This process of expansion of the economy continues erratically due to changes in technology over time.

Real business cycle theory explains the causes of recession as follows: A recession in the real business theory is just the reverse of expansion. Negative real shocks decreases the available resources, and shifts the production function downward as a result of which output declines.

There could be several examples of negative real shocks such as decline in technology (i.e., technical regress), unexpected rise in input prices (crude oil crisis), scanty rainfall (severe drought), etc. This starts a process of decline in

investment, consumption, output and employment. But the models of real business cycle do not explain a recession.

Check Your Progress 3

1) Explain in brief how multiplier and accelerator interact to generate business cycles.

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2) Explain the real business cycle theory.

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4.7 LET US SUM UP

In this unit we focussed on three issues: characteristics of business cycle, indicators of business cycle, and some important theories of business cycle. Business cycle should be thought of as apparent deviations from a trend in which many economic variables move together. The fluctuations are typically irregularly spaced and of varying amplitude and duration. Nevertheless, the one very regular feature of these fluctuations is the way variables move together. Business cycle is characterised by four phases, viz., expansion, recession, depression and recovery.

A major problem in empirical identification of business cycle is the lack of a single and consistent measure of aggregate economic activity. In view of this, movements in a number of indicators are considered for identification of turning points of a business cycle. Timing and amplitude of these variables are used to group them into leading, lagging and coincident indicators.

Some of the important theories which explain these feature of business cycles are: (a) Keynesian theory which showed that changes in the level of aggregate effective demand bring about fluctuations in the level of income, output and employment; (b) Samuelson model of business cycle which shows that the interaction between multiplier and accelerator gives rise to cyclical fluctuations in economic activity; and c) real business cycle theory which says that business cycles are due to real shocks to an economy.

4.8 ANSWERS/ HINTS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) Business cycle consists of recurrent alternating phases of expansion and contraction in a large number of economic activities.
2) Business cycles are periodic, synchronic and once they start in one country, they spread to other countries through trade relations between them. See Section 4.2 for details.
3) There are four phases of a business cycle, viz., expansion, recession, depression and recovery. See Section 4.3 for details.

Check Your Progress 2

1) A business cycle indicator should fulfil six criteria as described in Section 4.5.
2) The importance of a lagging indicator is its ability to confirm that a pattern is occurring. Unemployment is one of the most popular lagging indicators. If the unemployment rate is rising, it indicates that the economy has been doing poorly.

Check Your Progress 3

1) You should describe equation (4.4) and draw inferences on the basis of Fig. 4.3.
2) According to real business cycle theory, supply shocks generate business cycles. Refer to Section 4.6.4.

UNIT 5 INTERTEMPORAL CHOICE - I*

Structure

5.0 OBJECTIVES

After going through this Unit, you will be in a position to

- describe the concept of Secular Stagnation;
- explain the concept of Kuznets' puzzle;
- explain how a consumer optimises on consumption over time;
- construct intertemporal budget constraint;
- explain the impact of increase in income on consumption in an intertemporal set up; and
- analyse the impact of change in interest rate on consumption over time.

5.1 INTRODUCTION

In microeconomic theory (BECC-101) you learnt that consumption decision of a household or individual is based on prices of commodities and budget constraint. In microeconomics, the choice decision of the household is limited to a single time period. Individuals, however, continuously make choices regarding consumption, saving, borrowings, etc. When these choice decisions occur over time, it is called intertemporal choice decision. In this unit we focus on the consumption decision of households over time. As you are aware, consumption

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accounts for a large fraction of aggregate demand, more than all other sectors (such as investment, government expenditure and net exports) combined. Although fluctuations in consumption closely follow GDP fluctuations (in a business cycle), it is somewhat lesser in magnitude than in GDP. Because consumption of goods and services has direct implication on the utility people derive, at the aggregate level this has welfare implications for an economy.

Soon after Keynes proposed the Psychological Law of Consumption, economists began empirical testing of Keynes' conjectures. Although Keynesian consumption function met with early success, soon anomalies arose regarding his conjecture that average propensity to consume falls as income rises. Several economists tried to explain those anomalies through their advanced theories of consumption. Here in this Unit and the next one, we present the views of certain prominent economists, viz., Keynes, Simon Kuznets, Irving Fisher, Franco Modigliani, and Milton Friedman. We will also discuss the impact of Government's debt financing policy on household's intertemporal consumption decision.

5.2 KUZNETS' PUZZLE

As you have learnt in BECC 103, Keynesian consumption function has two main features. First, marginal propensity to consume (MPC = $\Delta c/\Delta y$) is between zero and one. Second, average propensity to consume (APC = c/y) falls as income rises. During the Second World War (WW II), Keynes' ideas were found to be different from empirical observations.

5.2.1 Secular Stagnation Hypothesis

During the WW II, as investment opportunities in the economy dried up, following Keynes' proposition, economists predicted that as income of the economy grows over time APC would be falling lower and lower. Simultaneously average propensity to save (APS) would be higher and higher but there will not be enough profitable investment opportunities to absorb the saving. In other words, these economists predicted that economy would experience a long depression of indefinite duration unless government expenditure increases at a faster rate than the aggregate income. This is called the *secular stagnation hypothesis.* The fear this hypothesis poses can be seen with the help of the following aggregate demand equation in real terms.

y (real income) = c (real consumption) + i (real investment) + g (real government expenditure)

Dividing both sides by 'y' we get

1 = c/y + i/y + g/y **… (5.1)**

In equation (5.1) notice that c/y is the APC. So, according to Keynes, as y increases over time, c/y keeps falling (conversely, APS = s/y keeps increasing). Due to the lack of profitable investment opportunity during the WW II, it was thought that i/y would not be rising as the economy grew. In other words, in

equation (5.1), as y increases, c/y is falling and i/y is not rising. An implication of the above is that, g/y has to increase. Increase in g/y means, government expenditure increases at a faster rate than income (y). Otherwise, the economy will not grow; it will stagnate.

Fortunately, after the end of the WW II, economy did not go into another recession. Although the economy was experiencing higher income in the post-WW II period, it did not lead to large increases in the saving rate (s/y). Hence Keynes' conjecture that APC would fall as income rises did not hold. It implies that the secular stagnation hypothesis miserably failed.

5.2.2 Kuznets' Empirical work

Simon Kuznets (in 1946) studied consumption and income data for a fairly long period, from 1836 to 1938, for the US economy. Kuznets' data brought out two important features of long run consumption behaviour.

First, on an average, the long run APC (c/y) showed no downward trend as proposed by Keynes' consumption function. It remained fairly stable over long time period. The implication the above is that MPC = APC in the long run. Recall that on a Keynesian consumption function, we measured APC as the slope of the straight line connecting the origin and the concerned point on the consumption function. Thus APC keeps on decreasing as income increases. On the other hand, we measured MPC as the slope of the consumption function. Equality between APC and MPC can be established only if the consumption function passes through the origin (see Fig. 5.1).

Second, Kuznets' data suggested that for any year when the APC (= c/y) was below the long run average c/y, it was a boom period. Similarly, any year when the APC (=c/y) was above the long run average c/y, it was a slump period. The explanation behind the above is as follows: in boom year income of the economy is more than the long run average income. According to the Keynesian consumption function APC (c/y) declines as the economy grows and have higher output level. Looking from the other side, for a particular year, suppose c/y ratio is lower than the average c/y ratio. It means it must be a year with higher income than the long run average y and hence that year is the boom period. Similar logic explains the slump period's c/y as well.

Kuznets' empirical finding that the remarkably stable ratio of consumption to income decades after decades refuted Keynes' conjecture that APC would fall as income increases. Kuznets showed that except for the Great Depression years, APC in the US economy was fairly stable over the period 1836-1938; it fluctuated in a narrow range between 0.84 and 0.89. Thus, even if income increased a lot during this time period, consumption remained as a stable fraction of income. This empirical finding by Kuznets made the central principles of the consumption theory by Keynes inconsistent. Milton Friedman (1957) named this seemingly contradictory fact as **"Kuznets' Puzzle"** or **"Consumption Puzzle".**

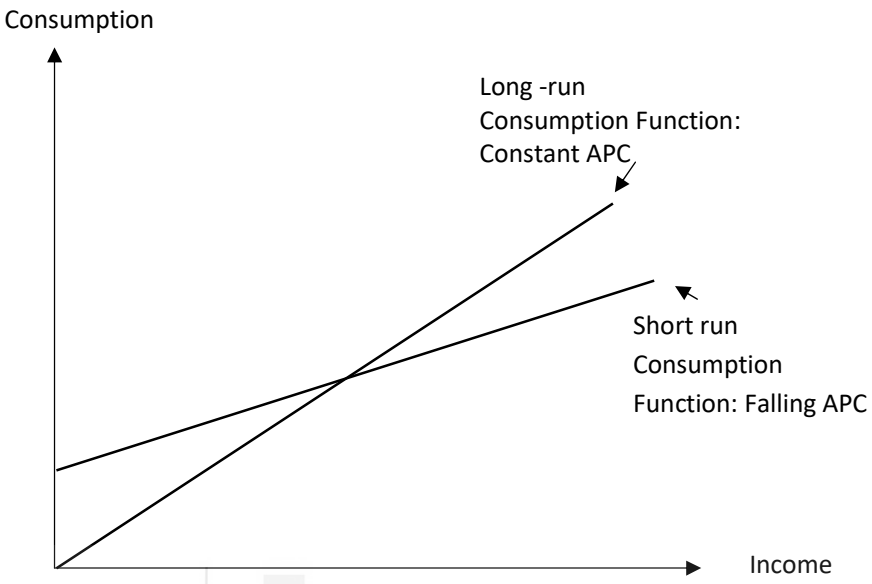

Fig. 5.1: Kuznets' Puzzle
The long run consumption function and short run consumption function exhibited seemingly puzzling or inconsistent relationship of APC with income, y.

In Fig. 5.1 we present two consumption functions as suggested by empirical evidence. The one which is passing through the origin is the long run consumption function based on the studies of long run time series data of aggregate consumption expenditure and income. The long run consumption function indicates having constant APC. On the other hand, the short run consumption function of households based on cross section data and short time series, is flatter than the long run consumption function and having positive intercept. The short run consumption function indicates falling APC.

Keynesian consumption function worked well in the short run as the short run consumption function showed falling APC just as Keynes postulated in his consumption theory. But for the long run time series, the long run consumption function appeared to give a constant APC. So, if we add the time dimension, the APCs relationship with the income turned out to be inconsistent with each other. This is often termed as the **Kuznets' Puzzle.**

The Kuznets' puzzle threw a challenge to economists who tried to explain how these two consumption functions of different time dimensions could be consistent with each other. By the late 1940s it was clear that a theory of consumption should account for three observed phenomena.

1. Cross sectional budget studies (household consumption-income data) show that c/y falls as y rises, so that in cross section of the population, MPC < APC {Consistent with the Keynesian consumption function}.
2. Business cycle or short run data show that c/y ratio is smaller than average during boom and greater than average during slump period. Thus,

in the short run, as income fluctuates, MPC < APC {Consistent with the Keynesian consumption function}

3. Long run data show that as income grows along the trend, MPC = APC. {Inconsistent with the Keynesian consumption function}

Kuznets' findings that consumption is a proportion rather than a mere function of income, economists trying to model consumption theory post-1946 period, needed to explain the apparent effect of wealth/ asset in determining consumption too.

5.3 FISHER'S THEORY OF CONSUMPTION IN TWO-PERIOD MODEL

Keynesian consumption function emphasised the relationship between the current consumption and current income. In Section 5.2 we observed that Keynesian consumption function could not explain the long run consumption behaviour. Intuitively this is not very hard to understand. A consumer knows that her/his current consumption choice depends not only on the current income but also on her/his preference towards future consumption choice, future income and borrowing constraints. More consumption today implies that (s)he will be able to consume lesser tomorrow. This is a trade-off. We all consciously or unconsciously face this trade-off while we choose our action. For example, if a typical student in the current period choose to spend her/his time on binge watching web series in Netflix (leisure), then to pass the semester, tomorrow (s)he will have to study more hours and will have very little time to enjoy leisurely moments. In the case of income-saving trade-off, if you consume less today, you will be able to save more. If you save more, you will receive more interest on your saving, and your future income will increase. Thus, less consumption today implies more consumption tomorrow.

Irving Fisher developed a multi-period model of consumer behaviour in which he showed how a rational, forward looking consumer understands this trade-off, and optimally distributes her/his consumption over time.

5.3.1 Intertemporal Budget Constraint

In order to explain Fisher's intertemporal budget constraint, we assume that there are only two time periods, viz., present and future. We further assume that our representative consumer is rational and lives for only two time periods. We also assume that the consumer has no wealth/ asset at the beginning of the present time period. The consumer receives wage or labour income if (s)he works. Since it is a two-period model, our representative consumer dies at the end of the second time period, i.e., future time period. Hence there is no question of leaving any *bequest* for the future generation; there will be no future generation at the end of the future time period. We use the following notations for building up the model:

Y_1 = Consumer's present time period's labour income.

Y_2 = Consumer's future time period's labour income which is known to the consumer.

C_1= Consumption in the present time period.

C_2 = Consumption in the future time period.

So, the trade-off before the consumer is present consumption (C_1) versus future consumption (C_2). Let us list the array of choice the consumer is facing in Table 5.1.

Table 5.1: Consumer's Choice Alternatives

Consumer's Choice	Implication
Case 1: If the consumer chooses to spend her/his entire income on consumption in each period	$C_1 = Y_1$ & $C_2 = Y_2$
Case 2: If the consumer deposits all her/his income in the bank which pays the real interest rate 'r' in the first period	$C_1 = 0$ & $C_2 = Y_1(1+r) + Y_2$
Case 3: If the consumer chooses to save some of her/his income in the first time period (present time)	$C_1 = (Y_1 – S_1)$ & $C_2 = Y_2 + (1+r) S_1$ (Note that $C_1 < Y_1$)
Case 4: If the consumer spends more than her/his income in the first (present) time period by borrowing at the interest rate 'r'	$– S_1 = C_1 – Y_1$ & $C_2 = Y_2 – S_1(1+r)$ (Note that $C_1 > Y_1$)
Case 5: If the consumer plans to spend less than her/his income in the future time	$C_1 = Y_1 + (Y_2 – C_2)/(1+r)$ & $C_2 = (Y_2 – S_2)$ (Note that $C_2 < Y_2$)
Case 6: If the consumer plans not to spend anything in the second (future) time period	$C_1 = Y_1 + Y_2/(1+r)$ & $C_2 = 0$

In Table 5.1 we describe how consumer's income constrains consumption in both the time periods. Note that we use the variable S as saving and borrowings (dis-saving). The consumer needs to borrow when her/his consumption expenditure exceeds her/his income and hence negative saving (–S) is equivalent to borrowing.

Recall that r is the real interest rate. For simplicity we assume that both lending (saved amount of money when lent out) rate and borrowing rate are the same (i.e., 'r').

To derive the budget constraint, let us begin with **Case 3 (**see Table 5.1**)** where the consumer saves S_1 amount ($S_1 = (Y_1 – C_1)$, C_1 is less than Y_1) in the first

period, which is being lent out at the interest rate 'r'. So, in the second period, the consumer has second period's income Y_2 and the first period's accumulated saving including interest earned on that saving, i.e., $S_1(1+r)$ at his /her disposal. This total income during the second period has to be consumed in the second period, i.e., there is no bequest (Recall our assumption that the consumer does not leave behind any income at the end of the second period).

Therefore,

$C_2 = (1+r)\, S_1 + Y_2$

or, $C_2 = (1+r)\,(Y_1 - C_1) + Y_2$

Re-arranging the terms, we can write the equation as

$(1+r)\, C_1 + C_2 = (1+r)\, Y_1 + Y_2$

Dividing both sides of the above equation by (1+r) gives us

$$\boldsymbol{C_1 + \frac{C_2}{(1+r)} = Y_1 + \frac{Y_2}{(1+r)}} \qquad \textbf{...(5.2)}$$

Equation (5.2) shows the relationship between the consumption and income during the two time periods. This is the typical way of representing the intertemporal budget constraint of a consumer. Slope of the budget constraint is **(1+r).** Fig. 5.2 shows the graphical representation of the consumer's intertemporal budget constraint.

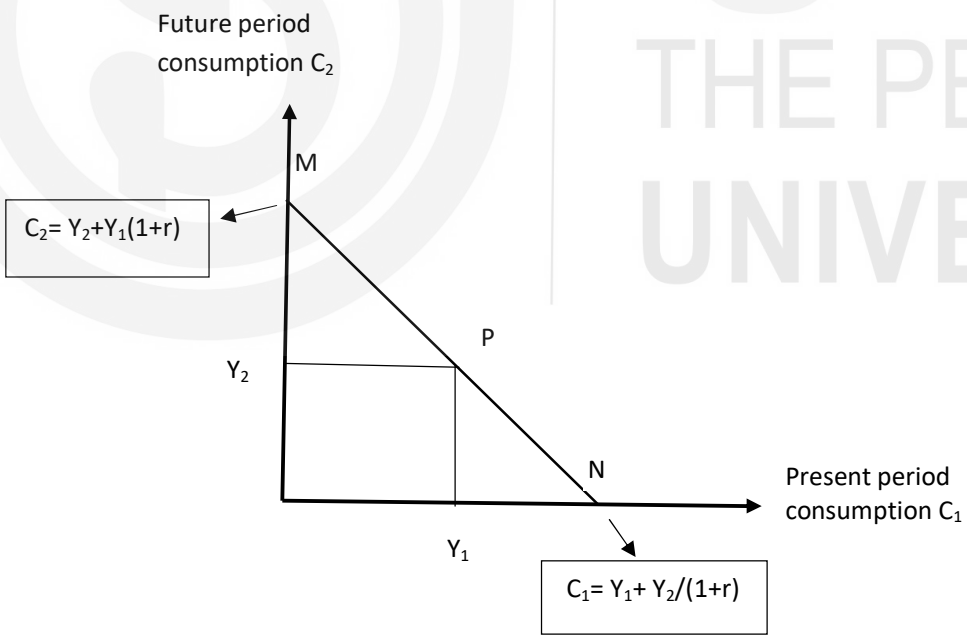

Fig. 5.2: Intertemporal Budget Constraint

More of present period consumption implies less of future period consumption. Thus the budget constraint is downward- sloping.

In Fig. 5.2 the consumer's two-period income is represented by the **point P**. If the consumer saves 1 unit of consumption in the present period, (s)he is depriving himself/ herself of 1 unit of present period's consumption. That saved amount becomes (1+r) units of future consumption. So, the value of the 1 unit of future consumption in terms of the present consumption is just 1/(1+r) of present consumption. That means, the present value of the 1 unit of future consumption is 1/(1+r) of present consumption. Thus, future consumption and future income are discounted by the factor (1+r).

If the consumer's two-period consumption choice coincides with **point P,** which is also the two-period income point, the consumer is neither borrowing nor saving in any of the periods. Therefore, $C_1 = Y_1$ and $C_2 = Y_2$ **[Case 1, Table 5.1].**

Point M on the budget constraint represents Case **2** (see Table 5.1). Here the consumer decides to put all her/his present income in the bank, consumes nothing in the present time period (implies, $C_1 = 0$, $S_1 = Y_1$). In the future time period, (s)he uses her/his future period income Y_2 and the accumulated saving and interest earned on the saving, i.e., $Y_1(1+r)$. Therefore, $C_2 = Y_1(1+r) + Y_2$.

If the consumer chooses any point (on the budget constraint) exhibiting her/his choice of C_1 and C_2, **between point M and point P**, then the consumer is consuming less in the first period and (s)he is saving in the first period **[Case 3, Table 5.1].**

On the other hand, if her/his choice of combination of C_1 and C_2 turns out to be **between point P** and **point N** on the budget constraint, then the consumer is consuming more than (s)he can earn in the first period, hence (s)he is borrowing in the first period **[Case 4, Table 5.1].**

If the consumer chooses any point (on the budget constraint) exhibiting her/his choice of C_1 and C_2, **between point P and point N**, then the consumer is consuming more than Y_1 (i.e., borrowing) in the first period and (s)he is consuming less than Y_2 in the second period **[Case 5, Table 5.1].**

Point N on the budget constraint represents Case **6** of Table 5.1. Here the consumer consumes everything in the present period and nothing in the future time period (implies $C_2 = 0$). So, the present value of her/his future period income, Y_2, becomes $Y_2/(1+r)$. Therefore, present period consumption is $C_1 = Y_1 + Y_2/(1+r)$.

5.3.2 Consumers' Preference

Consumer's utility depends on her/his consumption level of the present time period and future time period. From the individual's utility function, we can have a set of intertemporal indifference curves. Each indifference curve indicates a utility level and the consumer is indifferent between different combinations of present period consumption and future period consumption. The slope of an

intertemporal indifference curve measures the rate of time preference for present consumption which is nothing but the MRS (Marginal Rate of Substitution) between future consumption and current consumption.

We have already seen that if the consumer decides to consume more today, he will be able to save less. Consequently, interest on his saving will be less. and interest earned on that saving (or, more will be the debt which needs to be repaid in future time), lesser will be the availability for future consumption. Hence, the slope of the intertemporal indifference curve will be negative.

We assume that the MRS between future and current consumption is decreasing. It implies that each equal successive extra amount of present consumption needs to be compensated by giving up of smaller amount of future consumption, so that the consumer remains on the same indifference curve. To put things in simple microeconomics jargon, the intertemporal indifference curves are convex to the origin.

Individual Consumer's Utility Function: $U = U(C_1, C_2)$

where, $MRS_{C1,C2} = MU_{C1} / MU_{C2} < 0$ and decreasing

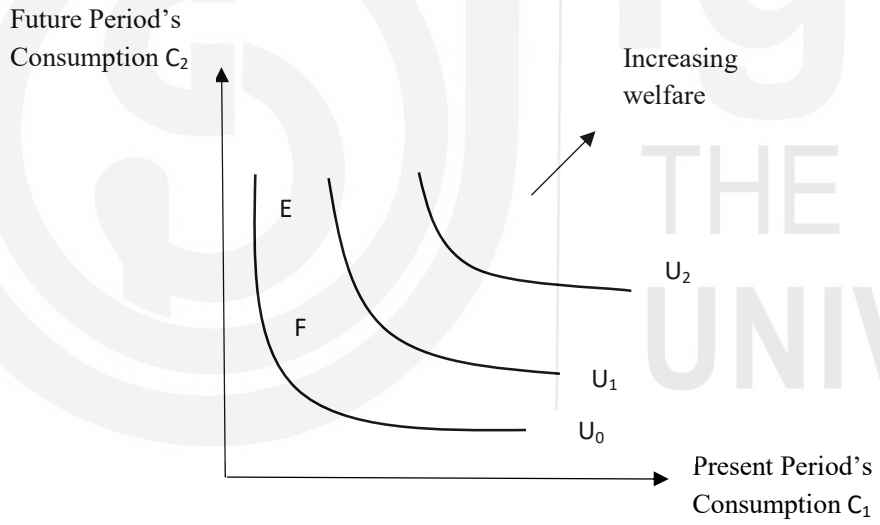

Fig. 5.3: Intertemporal Indifference Map

The set of intertemporal indifference curves represent the consumer's preferences over first (present) period and second (future) period consumption. Higher the indifference curve higher is the satisfaction or welfare level.

If the consumer has lot of one period's consumption and very little of the other period's consumption, then (s)he places a higher value on the scarce commodity (that period's consumption which he has very little). Hence the consumer is ready to give up the abundant commodity (that period's commodity which he was

having lot of it) in order to get a little more of the scarce commodity. This explains why the indifference curve is so steep between points E and F.

Check Your Progress 1

1) Distinguish between cross sectional and time series data.
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……..…
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2) What is meant by secular stagnation hypothesis?
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3) What type of inconsistency is observed in cross-sectional and time series data on consumption? Why is it called Kuznets' puzzle?
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4) Assume that a consumer survives for two time periods. His income in both the time periods are Y_1 and Y_2 while his consumption are C_1 and C_2. Draw the intertemporal budget constraint. Prepare a table to show the alternative consumption levels available to him.
……..…
……..…
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5.4 CONSUMER'S OPTIMIZATION PROBLEM

Keynesian consumption function, which appeared to work well in cross section studies and short time series, was based on the behavioural nuances of the consumers. But when Keynesian consumption function could not explain Kuznets' puzzle, economists such as Franco Modigliani, Milton Friedman and Robert Hall tried to explain the apparent smoothness of the long run consumption

function. They discarded the behavioural approach of Keynes and used the standard tools of optimization.

They relied heavily on the theory of consumer behaviour proposed by Irving Fisher. In such optimization problems, consumers are forward looking rational economic agents, unlike Keynes' consumers who had a very myopic view about relating current consumption to only current income.

Now that we have already discussed intertemporal budget constraint and intertemporal indifference curves, the next question is, how much will the consumer consume so that her/his utility gets maximized subject to her/his budget constraint? If we put together the intertemporal budget constraint and the indifference curves, we have a complete analysis of the consumer's optimum consumption decision. Assuming that the consumer is rational and would like to maximize her/his welfare, (s)he would like to choose the combination of first period consumption and second period consumption that puts her/him on the highest indifference curve possible. This is shown in Fig. 5.4 where the consumer chooses the affordable intertemporal consumption bundle that gives her/him the maximum welfare.

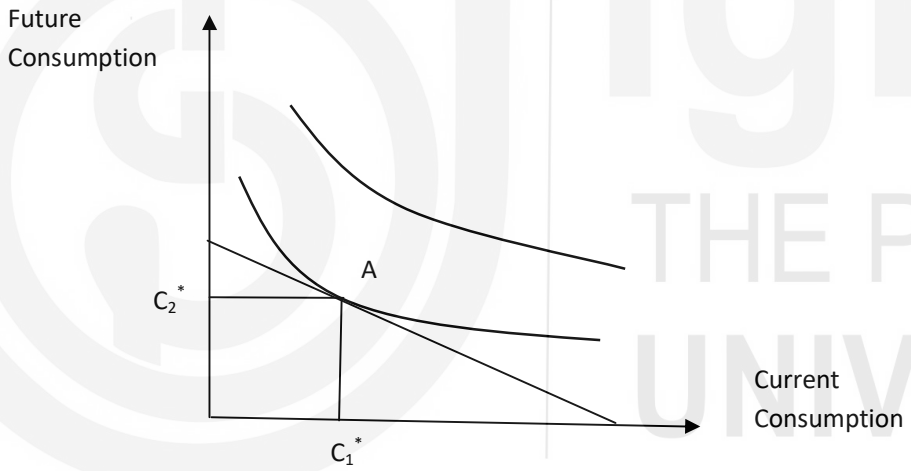

Fig. 5.4: Consumer's Optimal Choice

The optimal consumption level is at point A where an indifference curve is tangent to the intertemporal budget line.

Consumers dislike volatility in consumption – they prefer approximately equal amounts of consumption each year (consumption smoothing). For this reason, consumer equilibrium is not located at either ends of the indifference curve. Of course, if the consumer strongly favours the current period consumption then the consumer's equilibrium would have occurred on the lower segment of the budget line and vice versa. A distinct feature of Irving Fisher's model is that economic agents are not only responsive and tied up to the current income (unlike Keynesian consumption theory), they also have a perfect foresight of the future

income. Consumers take into account future income while deciding the current period consumption.

5.4.1 Effect of Change in Income on Optimum Consumption

Now let us discuss how a consumer responds to a temporary one-time increase in income. Let us recall the equation of the budget constraint:

$\mathbf{C_1 + C_2/ (1+r) = Y_1 + Y_2 / (1+r)}$ Budget Constraint Equation

An increase (decrease) in either Y_1 or Y_2 would shift the budget constraint outward (inward). A higher budget constraint allows the consumer to reach a higher indifference curve. Fig. 5.5 explains the case where we see an outward shift of the intertemporal budget constraint due to an increase in income (of either period). The consumer revises her/his consumption and (s)he chooses more of both present consumption and future consumption.

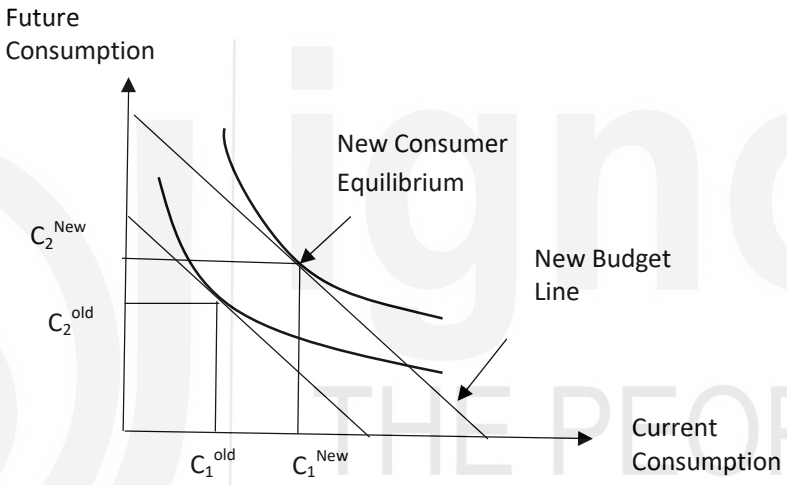

Fig. 5.5: Effect of Increase in Income on Optimum Consumption

The budget line has shifted outward due to an increase in either the current period's or the future period's income. The consumer now consumes more in both time periods.

In Fig. 5.5 the indifference curves are drawn under the assumption that consumption in both periods are normal goods. The assertion is pretty simple, as it is obvious from the diagram that whenever the income of any period increases, consumption of all periods increase. Such spreading the incremental income over consumption in both periods, regardless of which period's income increases is called *consumption smoothing*. This is happening because unlike the Keynesian consumption theory, the consumer is forward looking and either period's increase in income has incremental impact on the present value of income. This in turn has positive impact on the consumption in both periods.

Present value of income = $Y_1 + Y_2 / (1+r)$

Similarly, present value of consumption = $C_1 + C_2/ (1+r)$

So, Fisher's intertemporal model suggests that present value of consumption depends on present value of income stream. That gives us the general formulation of the theory as follows:

$$C_t = f(PV_t);\ f' > 0 \qquad \ldots(5.3)$$

Equation (5.3) is nothing but rewriting the intertemporal budget constraint for two or more time periods. Here t indicates the time period. So, consumption of any time period, C_t, does not solely depend on the income of time period t; rather it depends on the present value of the consumer's future income stream (life time income), PV_t.

You should note that every consumer mentally discounts future satisfaction arising out of future consumption. The rate at which (s)he discounts the future satisfaction is subjective, and depends on the nature of the consumer. Some consumers are impatient; they do not want to wait for the future time period. Such consumers have a greater time preference and they apply a *higher* discount rate on future income. When income of either time period increases, consumption of both time periods being normal goods, the consumer spreads her/his incremental income on both period's consumption. But if we assume that the consumer is impatient, he will allocate *higher* fraction of her/his incremental income on present consumption and lower fraction on tomorrow's consumption. On the other hand, if the rate at which the consumer discounts the future is zero, and income increases in either period, then the consumer allocates his incremental income *equally* on both period's consumption.

5.4.2 Effect of Change in Interest Rate on Optimum Consumption

In intertemporal optimisation, interest rate plays an important role on the level of consumption. The effect of interest rate on consumption, however, is a bit complex. Fisher's model shows that, depending on consumer's preferences, changes in the real interest rate could either raise or lower consumption.

There are two types of consumers in the present time period: (i) the consumer spends more in the current time period than his/her current period income (i.e., there some borrowing in the current period), and (ii) The consumer spends less in the current period than his/ her income (i.e., there is some saving in the current period). Accordingly, in the first case (s)he is a *net borrower* and in the second case (s)he is a *net lender*. Let us discuss the case where the consumer is a net lender. The other case (net borrower) is an assignment you should attempt yourself.

Let us look into the intertemporal budget constraint again,

$$C_1 + C_2/(1+r) = Y_1 + Y_2/(1+r) \qquad \ldots (5.2)$$

Let us take the case where there is an increase in the real rate of interest. The slope of the budget line is (1+r); so, there is an increase in the slope (with the same amount of saving in the first period, the consumer now earns higher interest earnings; his/her consumption in the second period increases). Remember that

there is no change in the income of any period; only the interest rate has increased. Consider an individual with income stream (Y_1, Y_2). If (s)he consumes (Y_1, Y_2) she will be at point P in Fig. 5.6. However, (s)he is net lender, as we have assumed. So, the new budget line (dotted line) will be passing through the point P in Fig. 5.6 and a rise in the interest rate will make the new budget line steeper. The intertemporal budget constraint rotates through point P in a clockwise direction.

In Fig. 5.6 the consumer is a net lender in the current time period. This simply means that his/her current period consumption (C_1) is less than his/her current period income (Y_1). How would the increase in the rate of interest effect his/her consumption in both the time periods? The total effect can be decomposed into two parts: Income Effect and Substitution Effect.

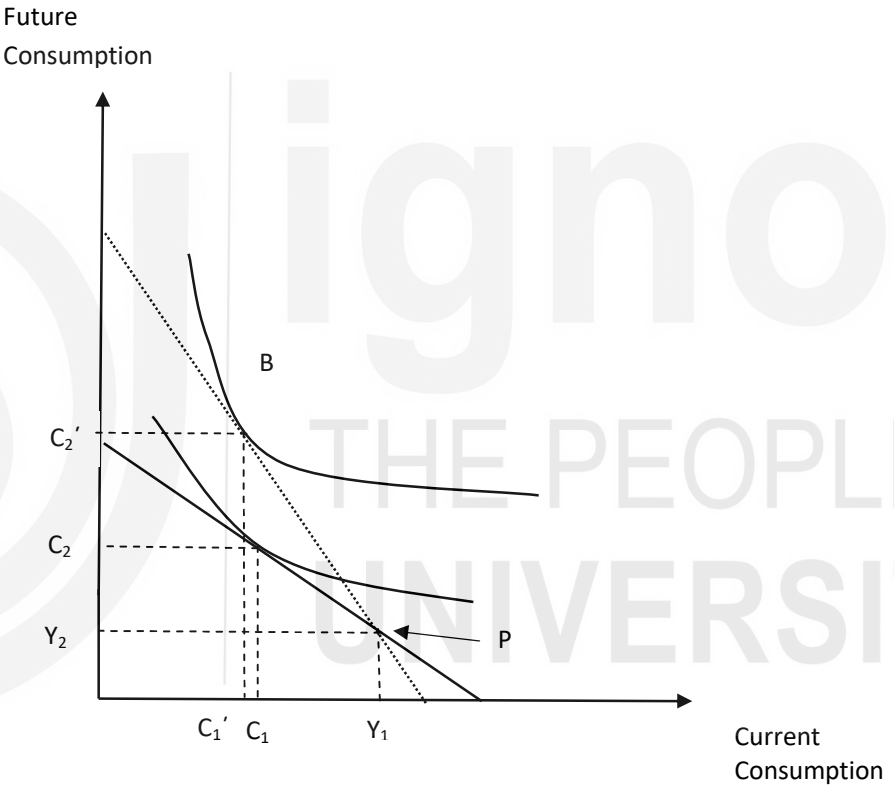

Fig. 5.6: Effect of Increase in Interest Rate

When the consumer is a net lender in the current time period, an increase in the rate of interest reduces his current period consumption and increases his future period consumption.

Substitution Effect: The substitution effect is the change in consumption that results from the change in the relative price of consumption in both the time periods. When the rate of interest increases, every unit (s)he saves, enable her/him to consume more in the future period than before. Therefore, the opportunity cost of current consumption or the relative price of current

consumption, which is (1+r) has gone up. Following the same logic, the relative price of future consumption, 1/(1+r) has gone down.

Substitution effect will influence the consumer to reduce current period consumption and increase future period consumption.

Income Effect: The income effect is the change in consumption in both the time periods due to the change in income of the consumer.

Here although neither Y_1 nor Y_2 has increased, but keep it in mind that the consumer is a net lender or saver. So, when the rate of interest increases, interest income on his/ her saving has increased. So, his/her stream of life time income has increased. As we assume that consumption is a normal good, the income effect would increase consumption in both the periods.

The consumer's choice depends on both the income effect and the substitution effect. Both the effects have incremental impact on the future period consumption. So, unambiguously future period consumption will increase. But same cannot be said about the current period consumption. In Fig.5.6 we have shown the case where the substitution effect dominates the income effect, thus the higher interest rate reduces the current period consumption of the consumer.

Applying the same analogy, we can analyse the case of the consumer being a net borrower. We can also analyse the impact of a decrease in the rate of interest on consumption. These are left as exercises which you should do yourself.

5.4.3 Constraints on Borrowing

We assumed that could be net lender (saver) or net borrower in the present time period. When he is a net borrower, he consumes some of his future consumption in the present time period. But in reality, there is limit to which the consumer can borrow; that is called 'borrowing constraint'. So, in addition to the intertemporal budget constraint, the consumer faces the following borrowing constraint:

$$C_1 \leq Y_1 \qquad \ldots(5.4)$$

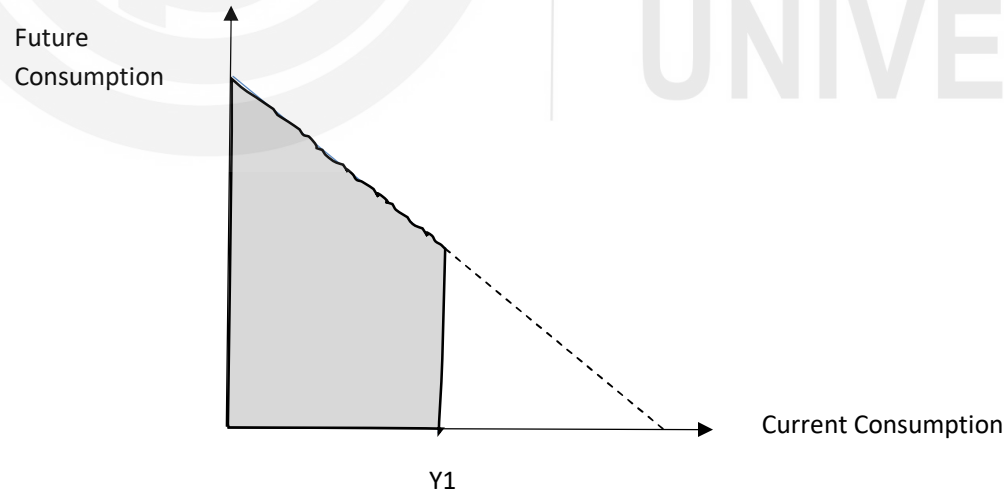

Fig. 5.7: Consumption Choice Set under Borrowing Constraint

The consumer facing the borrowing constraint will have the shaded region as his choice set of consumption of both the periods.

These two constraints, equations (5.2) and (5.4), shrink the choice set of the consumer. The shaded region of Fig. 5.7 shows the limited choice set of the consumer.

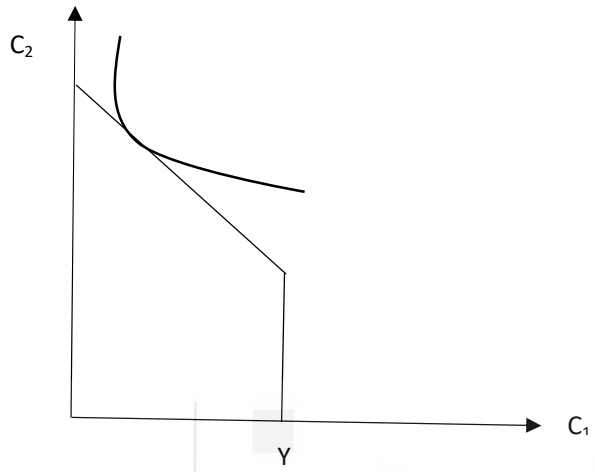

Fig. 5.8: Borrowing Constraint is not Binding

The consumer chooses the first period's consumption to be less than the income. So, the borrowing constraint is not binding on him and equilibrium consumption is unaffected.

As mentioned earlier, there are two types of consumers: net saver and net borrower. Net saver consumes less than his income in the current time period. Net borrower, on the other hand, consumes more than his income in the present time period. Borrowing constraint is equally applicable on both types of consumers. The only difference is when the consumer is net saver, (s)he will not face the brunt of the borrowing constraint and there will be no change in his/her equilibrium point. Thus, the borrowing constraint is not binding on the net saver (see Fig. 5.8). On the other hand, if the consumer is a net borrower, (s)he would like to consume more than her/his income in the first period, but (s)he cannot do so due to the borrowing constraint. So, (s)he will be restricted to limit her/his first period consumption by the first period income. Hence the borrowing constraint is binding on the net borrower (see Fig. 5.9).

Notice a very interesting fact. When the consumer is a net saver, the borrowing constraint is there; but it is not binding. Hence the consumer is facing only the intertemporal budget constraint like before. Therefore, her/his consumption of both periods depends on the present value of her/his lifetime income, i.e., $Y_1+Y_2/(1+r)$. On the other hand, when the consumer is a net borrower in the first period, the borrowing constraint is binding on her/him. In this case due the presence of the borrowing constraint, the consumer is compelled to restrict her/his present-day consumption to his present-day income. Therefore, her/his

consumption function is: $C_1 = Y_1$ and $C_2 = Y_2$. This just looks like the Keynesian consumption function, where current consumption depends on the current income exclusively.

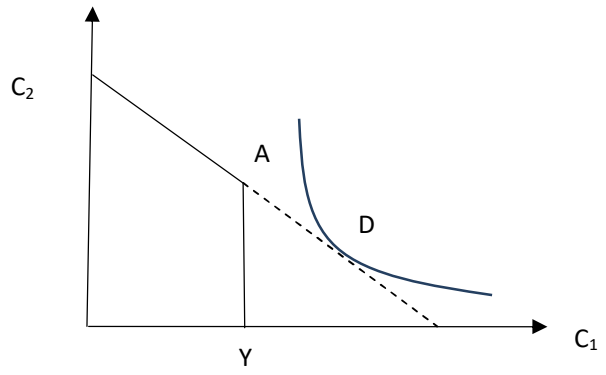

Fig. 5.9: Borrowing Constraint is Binding

The consumer would like to consume more than his income and choose the equilibrium point D. But because of the borrowing constraint he is compelled to choose the best available consumption of the first period at A, i.e., the first period income. The borrowing constraint is binding on him.

Check Your Progress 2

1) In the Fisher's two-period model assume that consumption is a normal good and the consumer is a net borrower. If there is an increase in the rate of interest, analyse its impact on consumption of both the time periods.

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2) Assume that in the Fisher's two-period model, the consumer is a net borrower in the first period. If the rate of interest rate decreases then discuss the income and substitution effects on consumption in both time periods.

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5.5 LET US SUM UP

In this unit we have seen the departure from the traditional Keynesian concept of consumption theory. In the basic Keynesian model consumption is dependent on current income and MPC is less than APC. The Keynesian model is primarily a short run model. During the WW II, Kuznets' work on the US economy over a long period of time invalidated the Keynesian proposition on consumption theory. It came as a puzzle or paradox to economists and policy makers.

In trying to find answers to Kuznets' puzzle, economists such as Franco Modigliani, Albert Ando, Richard Brumberg, Milton Friedman and Robert Hall used the Fisher model of optimization of consumer behaviour to study the features of the consumption function. Fisher offered a new idea where consumers optimize their life time utility function subject to the intertemporal budget constraint. According to Fisher, consumption depends on a person's lifetime income.

5.6 ANSWERS/ HINTS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) Time-series data is a set of observations collected at usually discrete and equally spaced time intervals. It is a dataset over a period of time. Cross-sectional data are observations that come from different individuals or groups at a single point in time.
2) According to Keynesian consumption function, there is a decline in average propensity to consumer (APC) as income increases. Consequently, average propensity to save (APS) will increase. This tendency is accompanied by declining opportunities for investment, which will cause stagnation in output. Go through Sub-Section 5.2.1 and answer.
3) The cross-sectional data shows that MPC < APC. The long-run data shows that MPC = APC. It is called Kuznets' puzzle, as it was first pointed out by Simon Kuznets. Go through Section 5.2 for details.
4) Refer to Fig. 5.2 and Table 5.1; and elaborate.

Check Your Progress 2

1) Here, the consumer is a net borrower and there is an increase in the rate of interest. The increase in rate of interest would decrease the consumer's stream of life time income (since the present value of future income less; it is discounted). Since we assume that consumption is a normal good, there will be a relative decline the consumption in both the time periods due to income effect. As a result of substitution effect, current period consumption will fall and future period's consumption will increase.

If the substitution effect is stronger than the income effect, the current period's consumption would fall unambiguously and the future period's consumption would increase. You should draw the diagram as per Fig. 5.6.

2) If the consumer is net borrower in the current time period then his current consumption expenditure exceeds the current period income. As the rate of interest decreases, opportunity cost of current consumption falls and the relative price of future consumption increases. Due to the substitution effect the consumer would consume more than before in the current period and less than before in the future time period. Since the consumer is a net borrower, a decrease in the rate of interest makes him richer. Thus, due to the income effect both future consumption and present consumption could rise. If the substitution effect is stronger than the income effect, then current consumption will increase and future consumption will fall. On the other hand, if the income effect is stronger than the substitution effect, then both present consumption and future consumption will rise. It would be a good idea if you try to draw the diagram for the same and see the effect yourself.

UNIT 6 INTERTEMPORAL CHOICE - II*

Structure

6.0 OBJECTIVES

After going through this Unit, you will be in a position to

- explain the reasons for differences in saving rate across countries;
- identify the determinants of consumption;
- explain the dynamic relationship between consumption and income;
- bring out the salient features of life cycle hypothesis
- bring out the important features of permanent income hypothesis.

6.1 INTRODUCTION

It was pointed out in the previous Unit that consumption function based on cross-section data has a different shape than consumption function based on time series data. Household surveys at a point of time shows that MPC < APC. Long run time series data, however, shows that MPC = APC. Thus, analyses on the basis of long run data are not consistent with Keynes' fundamental psychological law of consumption. This inconsistency is known as Kuznets' Puzzle, as it was brought out by Simon Kuznets.

There have been several attempts to reconcile the inconsistency between the shape of the short-run and long-run consumption functions. We will discuss two

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hypotheses in the present Unit: (i) life cycle hypothesis, and (ii) permanent income hypotheses.

6.2 LIFE CYCLE HYPOTHESIS

In line with Irving Fisher's two-period intertemporal model (1930), Franco Modigliani, Richard Brumberg and Albert Ando in the 1950s through their series of papers developed a model called 'Life Cycle Hypothesis' (LCH). According to this hypothesis, individuals maximise their lifetime utility. In this model we consider a representative consumer who is rational and forward looking. He optimally allocates his resources on consumption at any period of time on the basis of his life time resources (present value of labour income and bequest, if any) and not at all on his current level of income. The life cycle hypothesis points out that 'one *of the important motives for saving is the need to provide for retirement'.* You should note that income varies systematically over people's lifetime. People save during high income phase, so that they maintain a smooth consumption path throughout their life.

6.2.1 Description of the Model

The basic (stricter version) model which describes the life cycle path of saving and wealth has various stylized assumptions about consumer's opportunities and preferences. These are

(i) Income of the representative consumer is constant until his retirement and zero thereafter.
(ii) The consumer is rational and forward looking. He has a finite lifetime.
(iii) The consumer prefers to have constant consumption throughout his life.
(iv) The consumer does not leave anything for the bequest purpose.

One of the major sources of income variation for an individual is retirement. Most people expect to have a fall in the income (in our basic model it falls to zero) when they retire. Yet they would like to maintain more or less the same life style (in our basic model it is exactly the same) in terms of consumption. The only way to maintain the same life style after retirement is to save during their working years. This kind of saving is called 'hump saving', saving which is done in order to be able to spend it at some later stage of life.

Let us assume that the representative consumer started to work at the age of 20 years and at the age 65 years he retires. Also, assume that he is expected to live till 85 years and expects to earn Y per year (Labour Income) till he retires. When he started work at the age of 20 years, he had wealth W.

The span of his working life = (65 – 20) = 45 = WL

The Life time resources = Working Life Span × Average Labour Income = WL × Y

Counting from the age 20, number of years he lives = NL = (85-20) = 65

The individual is supposed to spread his life time resources (WL × Y) over his lifetime (NL) to allow himself annual consumption C = (WL × Y)/NL

Under these conditions, the consumer must on the average save in the earlier part of his life in order to accumulate a stock of wealth (retirement insurance) which will eventually be used to support consumption through dis-saving in the later part of his life. In **Fig. 6.1** we illustrate the consumer's income, consumption, and wealth over his lifetime. In the figure, the bright orange line indicates the flow of income which stops at retirement. The consumer will save during the working years so that he maintains constant level of consumption throughout his life.

The assumption of non-growing population signifies that the size of the younger population is roughly the same as the older population. An implication of the above is that aggregate rate of saving would be zero as positive saving of younger households would be offset by the dis-saving of the retired households. Wealth will remain constant in aggregate though it is continuously being transferred from the dis-savers to the savers.

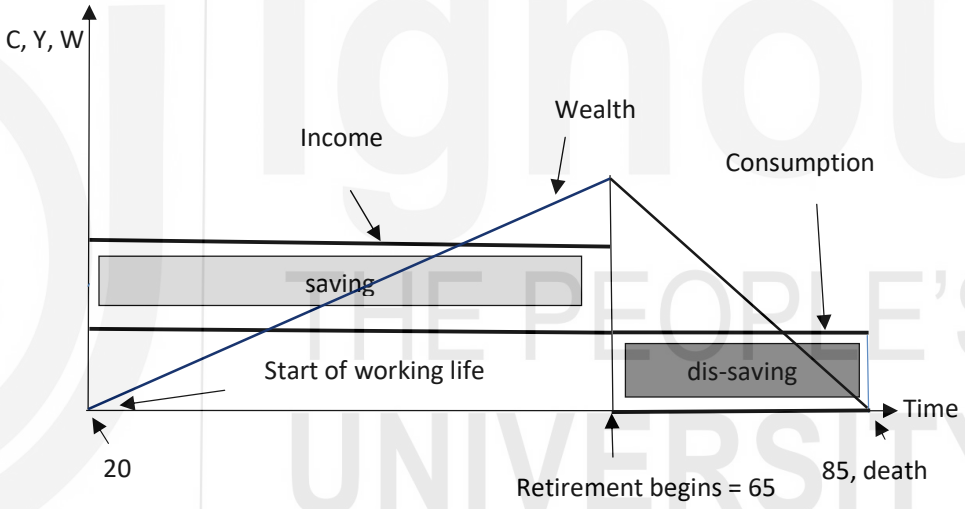

Fig. 6.1: Consumer's Wealth Accumulation over Life Cycle

The consumer likes to have smooth (constant) consumption throughout his life. He saves and accumulates wealth during his working years. He depletes wealth with dis-saving during his retirement years leaving no bequest.

Now let us assume that life of the consumer is divided into three phases, viz., youth, middle age and old age (in mathematical formulation of the model, in the next sub-section, we will extend it further to *t* time periods). The consumer works during the first two phases and leads a retired life during the third phase (see Fig. 6.2). In the youth phase, when the consumer just started work, his income is low. As he knows that he will be earning more during his middle age, he will tend to dis-save during the youth phase. In the middle years, income rises to peak and the individual saves to repay his earlier debts and provide for the retirement years. When individuals reach their retirement phase of life, their income (pension which he receives due to his past work) significantly falls and they make it up by

the savings they made during working years. Hence, there are two periods of dis-saving, viz., early working years (youth phase) and retirement phase. It implies that there is only one phase of saving, i.e., middle age. Therefore, one's saving is determined by one's stage in the life cycle.

Let us assume that the present value of the future utility what the representative consumer is supposed to be derived from the future consumption is discounted at the rate δ. When a consumer forgoes a unit of present consumption, it becomes saving. The return from the saving is 'r' and it allows the consumer to enjoy r units of future consumption. If $\delta < r$ then the intertemporal consumption relation reveals that it pays to save so that one can consume later. Thus, the consumption path of the individual consumer would be rising over time.

In Fig. 6.2, we measure consumption, income and wealth on y-axis, while x-axis indicates time. We depict an upward sloping consumption line. The income line is given by inverted-U shaped red line. You should notice that consumption line is above the income line in the first and third phases; thus there is dis-saving. In the second phase, income is more than consumption; thus there is saving.

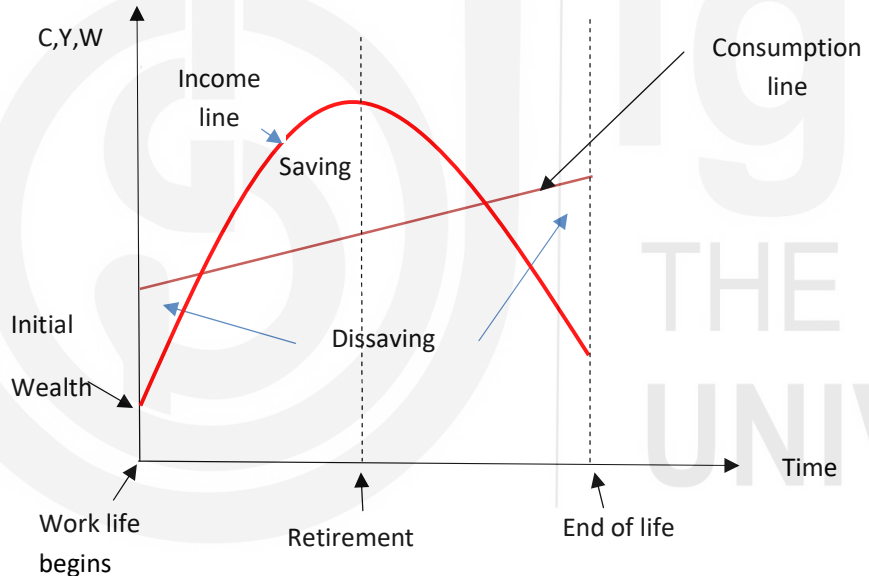

Fig. 6.2: Consumption, Saving, and Income in a Person's Life Cycle

The consumption and saving decision of a person, at each point of time, reflects the conscious attempt of the person to achieve his/ her preferred distribution of consumption over life cycle subject to the constraints.

In a static economy, the basic assumption of zero net aggregate saving implies that aggregate stock of wealth will remain constant over time. Suppose we allow the economy's population to grow but retain the basic assumptions of constant income and consumption throughout life with no bequest. In that case, the ratio of the younger population in the accumulation phase will be higher than the older population in their dis-saving phase. This will give rise to positive net aggregate flow of saving; there will be growth in the stock of wealth.

Now let us assume that there is no population growth, but there is growth in income over time due to the growth in productivity. As a result, successive cohorts (age groups) will be earning higher income than the preceding one. Hence, each successive cohort will enjoy a higher level of consumption (though the consumption level remains constant throughout life of that cohort) than the earlier cohort. As a result, any active cohort will aim to have a larger consumption path for themselves than the consumption level enjoyed by the existing retired cohort. To support this larger level of consumption, the active households will have to save on a scale exceeding the dis-saving of the existing retired group of households. It means that even if we have stationary population, there will be net positive aggregate saving and growing stock of wealth in the economy. In fact, if income tends to grow at a constant rate, then both saving and wealth will tend to grow at the same rate implying a constant saving-income and wealth-income ratio.

6.2.2 Mathematical Treatment of the Model

We have seen in Section 5.3 of Unit 5 that in Fisher's two-period model that if consumption is not an inferior good, then whenever any period's income rises, consumption in all periods rises. Let us extend the analysis to a multi-period framework. The implication of the model is that consumption of current period does not depend on the current period's income, rather it depends on the present value of the consumer's entire income stream. The relationship between the present value of the income stream and current consumption gives us the first general formulation of the consumption function, [recall equation (5.3) from previous Unit]

$$\mathbf{C_t = f\,(PV_t)\ ;\ } f' > 0 \qquad \ldots(5.3)$$

where the PV_t is the present value of current and future income at time t. It can be given by

$$PV_t = \sum \frac{y_t}{(1+r)^t}$$

The present value of income for the t^{th} period, y_t, is given by $\frac{y_t}{(1+r)^t}$. We add the stream of income for all time periods. t = 0 to T periods.

We can write the utility function of the consumer as

$$\mathbf{U = U\,(C_0, C_1, C_2, \ldots, C_T)} \qquad \ldots (6.1)$$

where the consumer lives for T more periods starting from his working life years (assumed to be '0' here)

In a multi-period model let us assume that the underlying utility function is logarithmic, additively separable over time, and future utilities are discounted at the discount rate δ. We have to find out the first order condition of the utility maximization subject to the budget constraint $\sum \frac{C_t}{(1+r)^t} = \sum \frac{y_t}{(1+r)^t}$ for the representative consumer.

For consumer *i*, if PV_t^i rises, all his C_t^i will rise more or less proportionately.

Therefore, for an individual consumer *i* we can write his consumption function as

$$C_t^i = k^i(PV_t^i);\ 0 < k^i < 1 \quad \ldots (6.2)$$

Here k^i is the proportion of the present value of the representative consumer *i*'s income which he spends on current period consumption.

If the population distribution by age and income is relatively constant, and tastes between present and future consumption (shape of the indifference curves) are stable through time, we can add up all the individual consumption functions in equation (6.2) to a stable aggregate consumption function,

$$C_t = k(PV_t) \quad \ldots (6.3)$$

Ando and Modigliani, divided the PV of income term in equation (6.3) into labour income (y_t^L) and property income (y_t^P). We discount both types of income by interest rate r. Let us take '0' as our current period,

$$\text{PV}_0 = \sum_{t=0}^{T} \frac{y_t^L}{(1+r)^t} + \sum_{t=0}^{T} \frac{y_t^P}{(1+r)^t} \quad \ldots (6.4)$$

So, the present value of the income stream is the present value of labour income plus the present value of property income.

If we assume that the property market is reasonably efficient and stable, then the present value of the property income is the value of the property itself, that is, $\sum_{t=0}^{T} \frac{y_t^P}{(1+r)^t} = \text{a}_0$. Therefore, equation (6.4) can be written as,

$$\text{PV}_0 = y_0^L + \sum_{t=1}^{T} \frac{y_t^L}{(1+r)^t} + \text{a}_0 \quad \ldots (6.5)$$

Now notice that in equation (6.5), the present (current) of labour income (y_0^L) is observable and the property income a_0 are observable and known to the consumer. But the future incomes $y_1^L \cdot \cdots y_T^L$ are not observable and at the most can be guessed. Now it would be very difficult for the consumer to guess each future year's income. Let us assume that there is an average expected labour income y_0^e (expectations formed in time '0' about future income). So, leaving the current period '0', the present value of the future (T-1 periods) income (the second term of the equation (6.5) will be equal to $(T-1)y_0^e$. Therefore, equation (6.5) can be written as

$$PV_0 = y_0^L + (T-1)y_0^e + a_0 \quad \ldots (6.6)$$

Now let us see how we can determine the value of the average expected labour income y_0^e. Ando and Modigliani suggest that the average expected labour income is just a multiple of the present-day labour income, that is,

$$y_0^e = \beta y_0^L \quad \ldots (6.7)$$

where β is the multiplier and greater than zero.

The above assumption implies that if current income rises, people adjust their expectations for future income upwardly. Consequently, there is an upward shift in the present value of the income stream.

Since current consumption depends on the present value of the income stream (equation 6.5), the current consumption moves up too. Through this chain of reasoning, we can say that a shift in the current period income may shift the present value of peoples' income stream substantially (since β could be large). It can have a much larger effect on current consumption.

Substituting $y_0^e = \beta y_0^L$ in equation (6.6) we get,

$$PV_0 = [1+\beta(T-1)]\, y_0^L + a_0 \quad \ldots (6.8)$$

Substituting the above in equation (6.3) we get

$$C_0 = k\,[1 + \beta(T-1)]\, y_0^L + ka_0 \quad \ldots (6.9)$$

Equation (6.9) is the Ando-Modigliani consumption function followed from the LCH. Notice that for any time period t, this consumption function has an intercept, ka_t and a positive slope, $k\,[1 + \beta(T-1)]$. The marginal propensity to consume (i.e., the slope of the consumption function) is the coefficient of y_t^L, that is, $k\,[1 + \beta(T-1)]$.

A representative statistical estimate of the equation (6.9) based on the work of Ando- Modigliani on annual US data, is

$$c_t = 0.7y_t^L + 0.06a_t \quad \ldots (6.10)$$

Thus, according this estimate the MPC out of the labour income is 0.7 and MPC out of the wealth is 0.06. Remember that we will come back to this conclusion later when in Section 6.3 we discuss Friedman's Permanent Income Hypothesis.

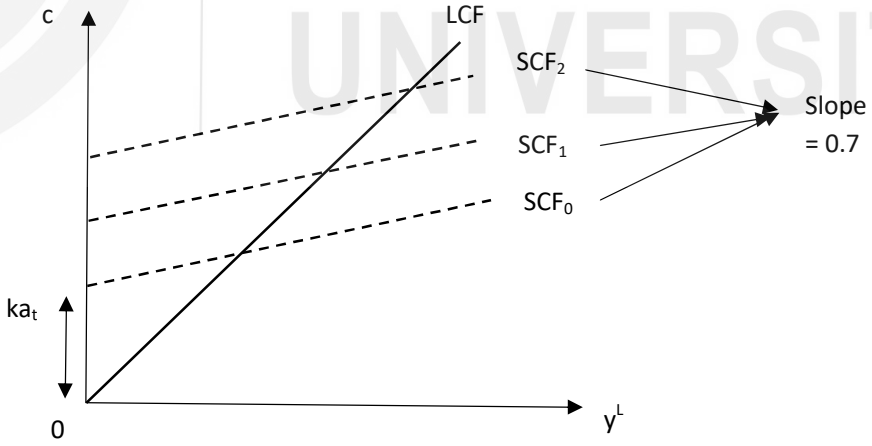

Fig. 6.3: Ando and Modigliani's Consumption Function

With increase in income, there is increase in saving and assets. This shifts the Short Run Consumption Function (SCF) upward. Tracing these SCFs we get the Long Run Consumption Function (LCF). In the short run, Ando-Modigliani's consumption function looks like Keynesian Consumption Function where APC falls as income increases. In the long run APC remain constant unlike Keynes'.

According to the LCH, the relationship between the consumption and current income is non-proportional as seems to be the case in the short run time series estimate (equation 6.10). The intercept of the consumption function in equation (6.10) is set by the level of asset, a_t. In the short run the cyclical fluctuations with assets is fairly stable. So, the short run consumption function is a positively sloped line with positive intercept, ka_t. Remember that the intercept is not constant over time. In the long run as saving rises, there is a rise in assets (a_t) too. Thus, the consumption function shifts upward as illustrated in Fig. 6.3. The shifting short run consumption functions trace out a long run consumption function as depicted in Fig. 6.3. In the figure, we depict short run consumption function (SCF) with slope 0.7 and long run consumption function (LCF) passing through the origin.

If we divide both sides of equation (6.10) by total real income y_t then, we get

$$\frac{c_t}{y_t} = 0 \cdot 7\frac{y_t^L}{y_t} + 0.06\frac{a_t}{y_t} \quad \ldots(6.11)$$

In equation (6.11), the average c/y is the sum of two ratio: (i) share of the labour income in total income ($\frac{y_t^L}{y_t}$), and (ii) share of capital output ratio ($\frac{a_t}{y_t}$). If these two ratio are constant, then c/y will be constant. Ando-Modigliani's empirical work on the US data confirmed that c/y is constant in the long run.

Ando-Modigliani's consumption function (see Fig. 6.3) confirms three observed phenomena: (i) It explains the $MPC < APC$ result of cross sectional budget studies; (ii) It explains the long run constancy of APC; and (iii) it includes assets as an explanatory variable in consumption decision.

6.2.3 Limitations of the Model

The life cycle hypothesis is somewhat attractive in the sense that it remains close to Fisher's original intertemporal optimization. It brings out many important factors such as population growth, productivity growth, income growth, social security measures, saving plans, etc. into the analysis. It discusses the impact of these factors on net aggregate saving flow for the economy and of the wealth stock of the economy. The life cycle hypothesis, however, has been criticised on certain grounds.

The relationship between age structure of the population and aggregate saving n the economy is a debatable issue. In the two-period model, if there is population growth then the number of savers will be higher than the number dis-savers. This may lead to a situation where there is positive net saving in the economy. Further, it is unrealistic to assume that the income of retired people is zero. There are various social security measures such as old age pension for retired people.

If we take equation (6.10) literally then all increase in the current labour income would increase the current consumption by 70 per cent, which is somewhat on the higher side.

This conclusion was made possible because of Ando-Modigliani's approximation of the relationship between the current labour income and average expected labour income (Recall $y_0^e = y_0^L$).

Simple life cycle hypothesis cannot fully explain the dis-saving behaviour of the elderly people. Studies suggested that elderly people do not dis-save as quickly as suggested by the model. The elderly does not run down their wealth as quickly as expected in the model, due to their concern for unpredictability of expenses and desire for leaving bequest.

Check Your Progress 1

1) Suppose a person starts his life at age 20, plans to work until age 65, and will die at 80. The annual labour income is Rs. 30,000. He spreads his lifetime earning over the number of years of life. What would be his annual consumption expenditure? Find out marginal propensity to consume (MPC).

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2) Suppose a person lives for 4 periods and earns ₹ 30, ₹60, ₹90 in the first three periods, and ₹ 0 in the 4th period when he is retired. Assume that the interest rate is zero. He wants to maintain a constant consumption stream throughout his life cycle. Determine in which period he saves the most? The person received a wealth ₹15 at the end of the first period unexpectedly. How much will be the change in the consumption expenditure of the person, second period onward, if he recalculates?

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6.3 PERMANENT INCOME HYPOTHESIS

Milton Friedman developed the permanent income hypothesis (PIH) in his 1957 book '*A Theory of Consumption Function'*. The basic argument of the PIH is that people plan their current consumption on the basis of their average expected income over their lifetime and, not on the basis of their current period income. The permanent income hypothesis describes how a household's consumption and saving decision are affected by changes in its permanent income. The permanent income hypothesis provided an explanation for Kuznets' consumption puzzle. Further, the permanent income hypothesis questioned some of the Keynesian ideas of demand management. According to Friedman, there are two components of income: permanent and transitory.

According to PIH, a household does not alter its consumption pattern if the household perceives that the income change is temporary or transitory.

6.3.1 Description of the Model

The concepts 'permanent income' and 'permanent consumption' play critical role in the theoretical analysis of PIH. Both these terms are not readily observable by the individual consumer unit, households.

Let y be the measured income of a consumer during a time period, say a year. Friedman treated measured income as a sum of two components: a permanent income (y_P) and transitory income (y_t).

$$y = y_p + y_t \quad \ldots(6.12)$$

Permanent income is that component of income which depends on factors such as accumulated saving of the consumer, his skill, his ability, occupation, location of the economic activity, etc. On the other hand, transitory component of income can be interpreted as accidental, unforeseen and unpredictable. Some of the factors giving rise to transitory income component are individual consumer specific (for example, illness, bad guess, etc.). There could be group specific factors as well behind transitory income (for example, impact of draught in a locality, pandemic effect of a virus on migrant workers, etc.). If we consider the individual specific factors, then for a group of random consumers, the resulting transitory component would average out and the mean measured income of the group would be equal to the mean permanent component of income. It implies that mean transitory income would be zero.

Similarly, c represents, consumer's measured consumption and is made up of two parts: permanent component (c_p) and transitory component (c_t).

$$c = c_p + c_t \quad \ldots (6.13)$$

Like before, some of the factors giving rise to the transitory component consumptions are individual consumer specific (such as sudden illness), and some are group specific (such as extended harsh winter or bountiful harvest). In the former case, the transitory component will average out (it implies mean transitory consumption of the group would be zero) and in the latter case, either the mean transitory consumption would be positive or negative depending upon the situation. Note that individual consumer is not expected to attach precise meaning to the term 'permanent'. The distinction between permanent and transitory is intended in the theory to be interpreted by the actual consumption and income data corresponding to the consumer's behaviour.

Friedman along with Ando-Modigliani, assumes that the consumer wants to smooth his consumption during his lifetime. This gives rise to the equation which describes the relationship between the permanent income and permanent consumption, where a consumer's permanent consumption is proportional to his permanent income.

$$c_p^i = k^i y_p^i \quad \ldots (6.14)$$

In equation (6.14) the superscript i represents individual consumer. The k^i in equation (6.14) depends on (i) the rate of interest at which the individual consumer lends or borrows, (ii) relative importance the individual consumer attaches to property and non-property income, and (iii) the individual's tastes and

preferences towards consumption vis-à-vis saving. If we assume that these factors do not depend on the income level of the consumer, then we can take the average of k^i of all income classes as $\bar{k}$. Therefore, the same relationship between average permanent consumption of an income class ($\overline{c_p^i}$) and average permanent income of an income class($\overline{y_p^i}$) can be written for an income class as:

$$\overline{c_p^i} = \bar{k}\overline{y_p^i} \quad \ldots (6.15)$$

In equation (6.15) the superscript *i* represents individual consumer.

Friedman made his hypothesis specifying the characteristics of the transitory component. He hypothesised that the transitory components of income and consumption are unrelated with each other, and with the corresponding permanent components. The proposition can be translated as:

$$\rho_{y_t y_p} = \rho_{c_t c_p} = \rho_{y_t c_t} = 0 \quad \ldots (6.16)$$

In equation (6.16), we use symbol ρ for correlation coefficient between the variables shown in the subscripts. The first two correlations are self-explanatory by the definition of these variables itself. They are simply translating and completing the definition of transitory and permanent components. The last one, which shows the correlation between transitory income and transitory consumption to be zero is a bit difficult to comprehend. According to Friedman, consumption is determined by long term considerations. An increase in transitory income (say, a windfall gain) leads primarily to increase in savings (creation of assets or to the use of previously accumulated balances), not increase in consumption.

After all, why would not you spend your windfall gain on consumption which is over and above its smooth consumption trend line? Why are you likely to add the whole of the windfall gain to your wealth? Why not some of it is used in consumption?

Friedman provides **three** arguments in favour of his assumption where transitory components of income and transitory components of consumption are unrelated: (i) Contrary to the usual practice, Friedman does not include spending on consumer durable goods as a part of consumption expenditure. The definition of consumption according to Friedman is in terms of the value of the services. This definition of consumption made the assumption more applicable to empirical data. (ii) Windfall with the transitory income is not precise. If the windfall gain is expected then it is already being incorporated in the calculation of permanent income, except that the consumer was unable to borrow against this expected windfall gain. In that case, there would not be any change in transitory consumption.

On the other hand, if the windfall gain is unexpected and it is happening in the final year of the consumer's life, then this will increase the consumption expenditure of the final year itself, not the current year. (iii) If transitory increase in income could increase transitory consumption, there are instances where it could decrease transitory consumption (for example, long working hours, getting transferred to small town or village, etc). Such negative and positive correlation tends to offset each other. Friedman admitted that the zero correlation between transitory income and transitory consumption assumption need not necessarily be

a stronger and stricter one as proposed. It implies a fairly close approximation to consumer behaviour.

Going by the third argument above, c_t is just a random variation around c_p and y_t. It means that, for any random sample of population classified according to income levels, for each income class 'i', average transitory consumption would be zero. It implies that average permanent consumption of a group (or, class) will be equal to the average measured consumption of that group (or, class).

$$\bar{c}_{ti} = 0 \quad \ldots (6.17)$$

$$\bar{c}_i = \bar{c}_{pi} \quad \ldots (6.18)$$

We can write equation (6.15) and (6.18) together as:

$$\bar{c}_i = \bar{c}_{pi} = \bar{k}\bar{y}_{pi} \quad \ldots (6.19)$$

Equation (6.19) is true for all income class, whether above average income class ($\bar{y}_{ti} > 0$ and $\bar{y}_i > \bar{y}_{pi}$) or below average income class ($\bar{y}_{ti} < 0$ and $\bar{y}_i < \bar{y}_{pi}$).

For an above average income class, (i) the average measured consumption $\bar{c}_i$ is equal to $\bar{k}\bar{y}_{pi}$; (ii) the average income of that class is $\bar{y}_i$; and (iii) $\bar{y}_i > \bar{y}_{pi}$. Therefore, its measured APC, $\frac{\bar{c}_i}{\bar{y}_i}$ will be less than $\bar{k}$ as $\frac{\bar{y}_{p_i}}{\bar{y}_i} < 1$. Similarly, for a below average income class, the measured APC, $\frac{\bar{c}_i}{\bar{y}_i}$ will be more than $\bar{k}$.

We depict these results in Fig. 6.4.

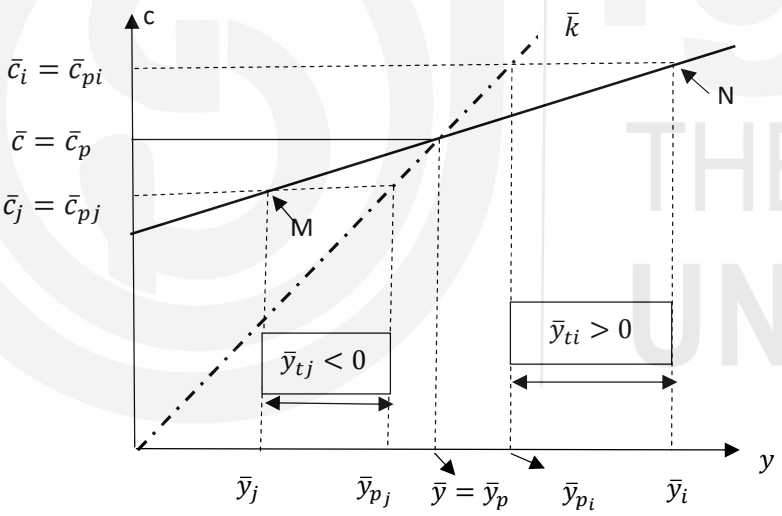

Fig. 6.4 Friedman's Cross-sectional Consumption Function

This cross-sectional consumption function is constructed by connecting the points like M and N. This function has a smaller slope than the underlying permanent function (the dotted line). In cross sectional budget studies we expect to see MPC $< APC$ if Friedman's PIH is correct.

In Fig. 6.4 two income classes have been taken. The j[th] class, whose average income is lower than the average income of the total population, and the i[th] class whose average income is above the population average income. So, the average transitory income of the below-average income group is negative while that for the above-average income group is positive. Further, we observe from equation (6.19), that $\bar{c}_i = \bar{c}_{pi} = \bar{k}\bar{y}_{pi}$ for the i[th] group and $\bar{c}_j = \bar{c}_{pj} = \bar{k}\bar{y}_{pj}$ for the j[th]

group. This relationship gives us point M which connects $\bar{c}_j$ and $\bar{y}_j$, and point N which connects $\bar{c}_i$ and $\bar{y}_i$. Connecting points M and N we get cross-sectional budget studies consumption function. This function has smaller slope than the underlying permanent function ($\bar{k}$). Thus, for the cross-sectional budget studies we expect MPC<APC if Friedman's permanent income hypothesis is correct.

To explain the relationship between the long run time series consumption function we need to understand the functioning of the business cycle. A nations output grows along the business cycle over the time but not at a steady rate. It reaches its peak during the boom time period and lowest point in the slump time period. In between you have the recession and recovery phases. This fluctuation of income can be explained with the permanent income hypothesis. Permanent income over a time period can be interpreted as the long-term trend income. In any period, if the GDP or income is less than the long-term permanent income then we can say in that period the transitory income is negative and, in the year, when the income is more than the long-term trend permanent income, the transitory income of that period is positive. So, in the boom year transitory income is positive and in the slump year transitory income is negative.

Since according to the PIH, transitory components of income are unrelated to both the transitory consumption and transitory consumption, it is just a random component around the permanent consumption, the MPC of transitory income is zero or very negligible. That is why households do not alter their long-term permanent consumption plan even if they are going through the boom time or trough time of the economy.

This cyclical movement is explained through the Friedman's time series consumption function diagram in the Fig. 6.5.

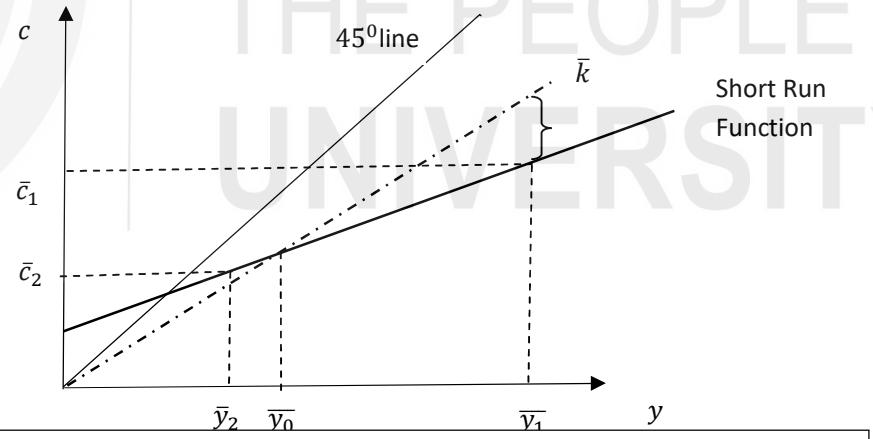

Fig. 6.5: Friedman's Time Series Consumption Function

The long run time series consumption function ($\bar{k}$) has lower slope than the 45^0 line. Hence the c/y ratio, which is fairly stable along the long run consumption function, is less than 1. This explains the consumption smoothening behaviour of the consumers and also shows that fluctuation in consumption is less than that in income.

Over time, as the economy and the national average permanent income grow along the trend, the cross sectional consumption function (see the red line in Fig. 6.4**)** shifts up. In Fig. 6.5, year 1 is the boom period. In that year the income of

the country, $\bar{y}_1$ is more than the long run trend income. Therefore, the average transitory income of the population in year 1 is positive. On the other hand, year 2 is the time period when the income of the country $\bar{y}_2$ is less than the trend income. Therefore, the average transitory income of the population in year 2 is negative. The measured average consumption of the country in both these years is influenced by neither the positive transitory income of the year 1 nor the negative transitory income of the year 2. In fact, it is the $\bar{k}\ proportion$ of the permanent incomes of the country that determines the actual measured consumptions of both the years as average transitory consumption of both years is zero, so that $\bar{c} = \bar{c}_p = \bar{k} \cdot \bar{y}_p$. Thus, the APC, which is nothing but the measured consumption divided by the measured income can be interpreted as:

For year 1: APC $= \frac{\bar{c}_1}{\bar{y}_1} = \frac{\bar{c}_{p1}}{\bar{y}_1} = \frac{\bar{k}\bar{y}_{p_1}}{\bar{y}_1}$; and $\bar{y}_{p_1} < \bar{y}_1$.

Thus, APC for year 1, when y is above the trend, will be less than $\bar{k}$.

For year 2: APC $= \frac{\bar{c}_2}{\bar{y}_2} = \frac{\bar{c}_{p2}}{\bar{y}_2} = \frac{\bar{k}\bar{y}_{p_2}}{\bar{y}_2}$; and $\bar{y}_{p_2} > \bar{y}_2$

Thus, APC for year 2, when y is below the trend, will be more than $\bar{k}$.

Thus, the short run consumption function is having lower slope than the long run consumption function. Further, over the short run cyclical fluctuation we find that MPC$< APC$; and for the long run observation, notice that APC= MPC.

6.3.2 Implications of the Model

Permanent income hypothesis has important implications for fiscal stabilization policies of the government. It directly challenges the ability of the government to revive the economy from recession downturn through temporary fiscal stimulus measures (such as tax cuts and transfer income). In the process the model explains the failure of the transitory Keynesian demand management technique.

In a simple Keynesian framework, MPC is constant. Therefore, any tax cut policy can have large stimulatory effect on the consumption demand through its multiplier effect. The permanent income hypothesis, however, points out that an unanticipated transitory cut in taxes would only increase the transitory component of disposable income of the consumers. As transitory increase in income does not have any significant positive impact on the consumption demand, it would increase savings of the consumers. Thus, a fiscal policy of this nature is likely to fail.

A strong interpretation of the PIH predicts that social security measures (such as unemployment allowance) and tax cut policy deliver equivalent outcomes. These measures lead to transitory income and therefore, do not impact consumption spending of households. It was noticed, however, that stoppage of the spending bill due to 16 days Federal Government shutdown in the USA in October 2013, resulted in a loss of 6.6 million working days and also considerable drop in the aggregate consumption expenditure among the government employees in the US. Although this shutdown should not have impacted the expected lifetime income

of those government employees (as they knew that they will be paid later for the loss of work), their consumption expenditure declined. Majority of the workers responded to the short-term income shock by cutting down their spending as opposed to the PIH.

One of the inferences which can be made readily and mistakenly from the PIH is the secularly growing inequality in most economies. The theory explains that in cross-sectional budget studies, the lower income groups have an average negative transitory income compared to the higher income groups. In order to maintain smooth consumption, permanent consumption depends on the permanent income. Therefore, the lower income groups have negative saving and higher income groups have positive savings. This accentuates the income inequality over time. In this context, Friedman clarified that if the definition of income is according to the measured income then perhaps this implication could be true. According to Friedman, however, if the definition of income is taken strictly as the permanent income, then PIH does not give any evidence on the secular behaviour of inequality of income. Further, measured income is a poor index of wealth.

6.3.3 Implications and Limitations of the Model

Friedman's permanent income hypothesis is criticised mostly on the following grounds:

- The PIH model decomposes income and consumption variables into permanent and transitory components. Although theoretically sound, these components are not observable for empirical work.
- The concept of property income is taken into account in the implicit estimation of permanent income. The importance of property income or the impact of fluctuations in the property market on consumption behaviour is not clearly spelt out in the model.
- To support the third, and probably the most controversial, assumption of the PIH, i.e., no correlation between transitory income and transitory consumption, Friedman did not take into account the spending on consumer durables as a part of consumption expenditure.
- Many economists object to Friedman's idea of zero marginal propensity to consume from transitory income. Empirically, certain evidences suggest that marginal propensity to consume from transitory income is more than zero. For a low income poor person, marginal propensity to consume from an unexpected windfall gain will definitely be positive. Same is the case with the binding borrowing constraint.
- Some economists oppose Friedman's idea of constant APC irrespective of the income class. According to them, poor people feel more pressure to spend a higher fraction of their permanent income than richer people. The APC from permanent income should be falling with rising income.

Check Your Progress 2

1) Assume that a Software Engineer has been working from home for last three months during the COVID-19 lockdown period and the company has rewarded him with ₹10,000. According to the permanent income hypothesis, will he spend most of this bonus if (a) he knows that he would be receiving this amount of bonus every 3 months, and (b) he knows that it is a onetime bonus?

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2) Give reasons for no correlation between transitory income and transitory consumption.

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3) Suppose up to the end of the year 0 the government was running a balanced budget such that T = G = 0. In year 1 the government decided to cut taxes by 1. This deficit the government is financing through debt, which the government has decided to repay in year 2. Suppose the government is to keep its spending path unchanged. Analyse how does this tax cut policy affects consumer's consumption and savings if the real interest rate is 0.05?

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4) In the above problem, assume that the consumer is supposed to die at the end of year 1 and he does not care for his future generation. How would his consumption be affected because of the tax cut?

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6.4 LET US SUM UP

Ando and Modigliani in their Life Cycle Hypothesis, highlighted that although income of persons vary substantially over their life time, they maintain a smooth

consumption path over life time. Consumers use borrowing and saving to smoothen their consumption path. The model had strong implication for policy makers to analyse the inter country difference in the saving rate and its effect on growth of wealth.

Friedman explained the variation in one's lifetime income by introducing the concept of permanent income and transitory income. Permanent income hypothesis suggested that there is no correlation between transitory components of income and consumption. Consumption depends primarily on permanent income. This model questioned the effectiveness of the Keynesian policy prescription of short term fiscal stimulus measures.

6.5 ANSWER/HINTS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) Consumer's lifetime income = working years × annual labour income = $(65-20)\times 30{,}000 = 1{,}350{,}000$.

Annual average consumption expenditure = Life Time income / life time

= 1,350,000 / (80−20) = 22500

You will obtain the same result by the following method also.

$\frac{65-2}{80-20} \times 30000 = 22500$

MPC = $\frac{65-20}{80-20} = 0.75$

2) His annual consumption expenditure = (30+60+90+0)/4 = 45

Hence, in the first period saving = (30 – 45) = – 15

Second period saving = (60 – 45– 15) = 0 (he paid off first period's dis-saving)

Third period saving = (90– 45) =45

Fourth period saving = (0– 45) = −45 (he used his third period's saving)

In the first period the person dis-saves (borrows) ₹15.

At the end of the first period he received ₹15 wealth, he will repay his debt with that.

He will re calculate his even consumption stream again = (60+90+0)/ 3 = ₹ 50

Earlier his consumption expenditure = ₹ 45

Change in the consumption expenditure second period onwards = (50−45) = 5

Check Your Progress 2

1) In the first case the person knew that he is going to get the bonus every 3 months, so it is a permanent increase in his lifetime income. According permanent income hypothesis, consumption depends on permanent income. Therefore, as permanent income increases, the consumer will spend more of this bonus income.

In the second case, the consumer knew that the bonus was only one time, so it is transitory. According to permanent income hypothesis, correlation between transitory consumption and transitory income is negligible or zero. So, in this case the consumer will not spend his bonus amount.

2) Friedman gives three reasons for no correlation between transitory income and transitory consumption. Go through sub-section 6.4.1 and answer.

3) In the year 1, as the government expenditure path remains the same, $G_1 = 0$ and there is a tax cut in the year 1, thus $T_1 = -1$. Therefore, size of the government deficit in year one = $(G_1 - T_1) = 1$. So, in year 1 size of debt, $B_1 = 1$ (as there was no accumulated debt from the previous year 0).

In year 2, the size of the government debt = $B_2 = B_1 \times (1+r) = 1 \times (1+0.05) = 1.05$

If the government has to repay this debt in year 2, then the government has to make primary surplus of the size of debt B_2. If the government also needs to maintain the same government expenditure path (that means $G_2 = 0$), then the only way to make this primary surplus is to increase taxes by 1.05 in year 2.

Knowing this with perfect foresight, consumers know that a tax cut by 1 in year 1 is equivalent to a rise in taxes by 1.05 in year 2. So, in year 1, although the disposable income of the consumers increase due to the tax cut, consumption demand will remain same and entire increase in disposable income will go for saving. In year 2, saved amount of money in year 1 and the rate of interest earned on it will be used to pay for the increased tax in year 2. So, in year 2, consumption demand and saving will remain the same.

4) The consumer is supposed to die at the end of year 1, and he does not care about the future generation. Due to the tax cut the consumer's disposable income increases in period 1. He will use this increased disposable income on extra consumption spending rather than saving because the higher taxes in future will be paid by the future generations.

UNIT 7 INVESTMENT FUNCTION*

Structure

7.0 OBJECTIVES

After going through this Unit, you will be in a position to

- identify the factors that drive investment;
- describe the speed of adjustment of actual capital stock to the optimum capital stock;
- identify the link between the fluctuations in investment and fluctuations in stock market;
- explain how home loan and tax policies affect home buyers' decision to investment on residential projects; and
- identify the motives behind keeping aside a part of output as inventories.

7.1 INTRODUCTION

In the previous two units we analysed a household's consumption choices. In this unit we will analyse the theoretical aspects of investment decision. As you know, private investment is an important component of aggregate demand both in terms of long-term growth and short-term business fluctuations. From the point of view of growth, the allocation of society's resources into consumption and various types of investment (in the form of physical capital, financial capital, human

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capital, and research & development) are very important for determining the size of GDP and steady state growth of an economy. There are three types of investment we will be discussing in this unit: (i) business fixed investment, (ii) residential investment, and (iii) inventory investment. Investment spending is the most volatile component of aggregate demand and thus a major source of fluctuations of economic activities, often leading to business cycle.

Importance of investment can also be highlighted through the financial market that affects the economy. We will examine the two-way relationship between the investment and financial market.

7.2 BUSINESS FIXED INVESTMENT

Business fixed investment represents spending by firms to increase production capacity. It is traditionally decomposed into (i) equipment (computers, machines etc), (ii) structures (land, plants, warehouses etc), and (iii) intellectual property (software, R&D, etc). There are three important theories of investment: (i) neoclassical theory, (ii) accelerator theory, and (iii) q-theory. The neoclassical theory, developed mostly by Dale W. Jorgenson, helps in determination of output and prices through optimal capital stock in an economy. The accelerator theory analyses the process of adjustment in the level of capital stock. The q-theory of James Tobin extends the neoclassical theory to include adjustment cost. According this theory firms choose that invest level where expected present value of a firm is maximum. We discuss these theories below.

7.2.1 Neoclassical Theory of Investment and Optimum Capital Stock

The neoclassical model of investment assumes a well-functioning and efficiently coordinating market system. Dale W. Jorgenson contributed significantly to the development of the neoclassical investment theory. The neoclassical investment theory is based on the idea that firms maximise profits and use cost-benefit analysis to reach the optimum level of capital stock.

In our model a typical profit maximizing firm employs labour (**L**) and capital **(K**) to produce its output **Y**. The production function specifies this relationship:

$$\mathbf{Y = F (L, K)} \quad \ldots (7.1)$$

It is a typical neoclassical production function where it exhibits diminishing marginal productivity of factor of production.

We assume that there is perfect competition in both goods market and input market so that a firm can sell its product at a given price **P.** The firm employs labour at the ongoing wage rate **w.** Let us assume that $\boldsymbol{P_K}$ is the supply price at which one unit of capital good may be purchased by the firm.

Now to decide how much capital the firm would use, recall the basic optimisation principle from microeconomics. The firm will work according to the profit maximizing principle

$$Max\ \Pi = (Total\ Revenue - Total\ Cost)$$

$$= [\boldsymbol{P} \cdot \mathbf{F}(\mathbf{L}, \mathbf{K}) - (Total\ Labour\ cost + Total\ Capital\ cost)] \quad \ldots (7.2)$$

Total labour cost = w.L

Total Capital Cost = User cost of one unit of capital × K

We need to define this ***user cost of per unit of capital***. It has three components:

(i) The firm can purchase capital goods by borrowing from the market at interest rate ($\boldsymbol{i}$) or from its own resources. If capital is bought by borrowing, then the borrowing cost of one unit of capital would be $\boldsymbol{P_K.i}$. If the firm bought the capital by using its own resources, that money the firm could have lent instead and earned $\boldsymbol{P_K.i}$. In the latter case it is the opportunity cost of capital. In both the methods of financing, $\boldsymbol{P_K.i}$ is the interest cost of capital.

(ii) You know that capital goods are durable, but they are subjected to depreciation (i.e., wear and tear, and also obsolescence). Suppose $\boldsymbol{\delta}$ is the rate of depreciation. Therefore, money cost of depreciation is $\boldsymbol{P_K.\delta}$.

(iii) If the price of capital goods, $\boldsymbol{P_K}$, decreases, then the value of the capital goods goes down. The cost of this loss is $-\boldsymbol{\Delta P_K}$ (the $\boldsymbol{\Delta}$ symbol indicates change and the minus sign signifies our measurement of cost, not benefit).

Thus, the user cost of one unit of capital (in nominal terms) the firm bought is:

$$= \boldsymbol{P_K.i} + \boldsymbol{\delta.P_K} - \boldsymbol{\Delta P_K}$$

$$= \boldsymbol{P_K}\left(\boldsymbol{i} + \boldsymbol{\delta} - \left(\frac{\boldsymbol{\Delta P_K}}{\boldsymbol{P_K}}\right)\right) \quad \ldots (7.3)$$

To make things simple, let us assume that increase in the price of capital goods is the same as the rise in prices of other goods. Then, $\frac{\boldsymbol{\Delta P_K}}{\boldsymbol{P_K}} = \text{inflation rate} = \pi$. Substituting this value in equation (7.3) we obtain the user cost of one unit of capital

$$= \boldsymbol{P_K}(\boldsymbol{i} + \boldsymbol{\delta} - \boldsymbol{\pi})$$

Since *nominal interest rate (i) − inflation rate (π) = real interest rate (r),* we obtain

User cost of capital $= \boldsymbol{P_K}(\boldsymbol{r} + \boldsymbol{\delta})$ … (7.4)

And, total capital cost $= \boldsymbol{P_K}(\boldsymbol{r} + \boldsymbol{\delta}) \times \boldsymbol{K}$ … (7.5)

Substituting the value of capital cost (equation **7.**5) in the firm's optimization problem (equation **7.**2) we obtain

$$\mathbf{Max}\ \boldsymbol{\Pi} = [\boldsymbol{P} \cdot \mathbf{F}(\mathbf{L}, \mathbf{K}) - \boldsymbol{w.L} - \boldsymbol{P_K}(\boldsymbol{r} + \boldsymbol{\delta}) \times \boldsymbol{K}] \quad \ldots (7.6)$$

The firm will maximize its objective function (equation **7.**6) with respect to labour (L) and capital (K) respectively. The first order condition with respect to the capital is

$$\frac{\partial \Pi}{\partial K} = \boldsymbol{PF_k - P_K(r + \delta) = 0}$$

$$\Rightarrow \boldsymbol{P.MP_k = P_K(r + \delta)} \text{ [Note: } F_k = MP_k = Marginal\ Product\ of\ capital\text{]}$$

$$\Rightarrow \text{Value of Marginal Product of capital} = \boldsymbol{P_K(r + \delta)} \quad \ldots (7.7)$$

Equation (**7.**7) is the profit maximization condition of the firm with respect to capital. It means that an additional unit of capital will cost $\boldsymbol{P_K(r + \delta)}$**,** and the additional unit of capital will increase output by $\boldsymbol{MP_k}$ units, which generates revenue $\boldsymbol{P.MP_k}$. So, quantity of capital input will be increased as long as the additional revenue (benefit) exceeds the additional cost incurred to add to the capital stock and vice versa. The optimum capital stock will be determined at the point where the additional revenue is equal to the additional cost.

Equation (**7.**7) can be rewritten as

$$\boldsymbol{MP_k = \frac{P_K}{P}.(r + \delta) = rc} \quad \ldots (7.8)$$

Here, the term $\boldsymbol{\frac{P_K}{P}.(r + \delta)}$ = *real rental cost of capital* = $\boldsymbol{rc}$

If the marginal product of capital exceeds the real rental cost of capital then the firm finds it profitable to add to its capital stock such that $\Delta K > 0$.

Solving equation (**7.**8) for K we will obtain the optimum or desired stock of capital K^*. The general relationship among the desired capital stock K^*, the rental cost of capital $\boldsymbol{rc}$**,** and the level of output is given by

$$\mathbf{K^* = f(rc, Y)} \quad \ldots (7.9)$$

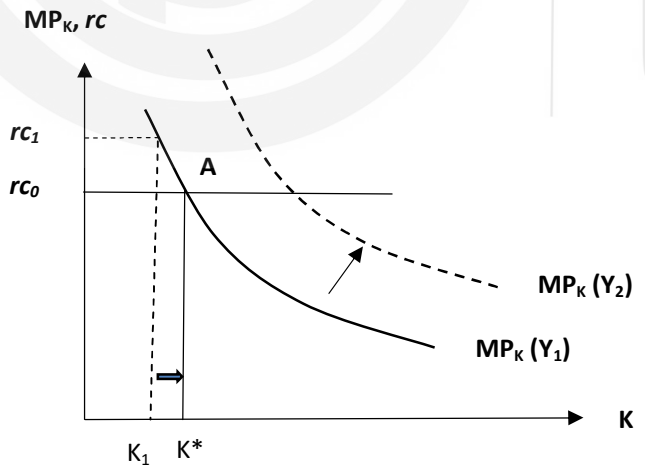

Fig.: 7.1: Optimum Stock of Capital

The optimum capital stock K* is that level of the capital at which MP_K is equated with the rc_0. The MP_K schedule is drawn for a given level of output Y_1. An increase in output shifts the MP_K schedule upward to the right.

In equation (7.9), an increase in the rental cost decreases the optimal or desired level of capital stock. Further, an increase in GDP increases the optimal level of capital stock. We depict this relationship in Fig. 7.1. When rental cost is rc_0, desired capital stock is K_0. An increase in rental cost to rc_1, decreases the level of desired capital stock to K_1. An increase in output from Y_1 to Y_2 will shift the MPK curve upward to the right. Consequently, equilibrium capital stock will increase.

Thus, business fixed investment depends on the marginal product of capital, the real rate of interest, and the depreciation rate. A decrease in the real interest rate lowers the cost of capital. It raises the profit from owning capital and increases the incentive to accumulate more (means increase investment) and vice versa. Therefore, the equation (7.8) shows the inverse relationship between the rate of interest and investment.

7.2.2. Adjustment Speed of Capital Stock

If the actual capital stock at any point of time differs from the optimum capital stock, then at what speed the firm would go about adjusting its capital stock towards the optimum level. The ***flexible accelerator model*** (also called, gradual accelerator model) helps us in finding out the adjustment speed.

Let us assume that K_{t-1} is the actual capital stock at the end of period (t-1) and the optimum capital stock is K^*. The firm plans to close a fraction, λ, of the gap between the optimum and actual capital stocks in each period. Therefore, t^{th} period's capital stock K_t would become:

$$K_t = K_{t-1} + \lambda(K^* - K_{t-1}) \quad \ldots (7.10)$$

We can therefore write the t^{th} period's net investment as

$$I_t = K_t - K_{t-1} = \lambda(K^* - K_{t-1}) \quad \ldots (7.11)$$

Similarly for the $(t+1)^{th}$ period, the net investment is

$$I_{t+1} = K_{t+1} - K_t = \lambda(1-\lambda)(K^* - K_{t-1}) \quad \ldots (7.12)$$

So, in t^{th} period, λ fraction of the initial gap between K_{t-1} and K^* is being invested. In the $(t+1)^{th}$ period, $\lambda(1-\lambda)$ fraction of the original gap in the amount of investment is being made. You should note that as λ is a fraction, $\lambda(1-\lambda)$ is less than λ. So, in each subsequent period, amount of investment is getting smaller and smaller in order to close the gap between the actual capital stock and the optimum capital stock. Therefore, $< \cdots < I_{t+1} = K_{t+1} - K_t < I_t = K_t - K_{t-1} < \cdots <$

In Fig. 7.2 we depict this speed of adjustment. Notice that the investment that is made, to bridge the gap between actual level and desired level, decreases over time.

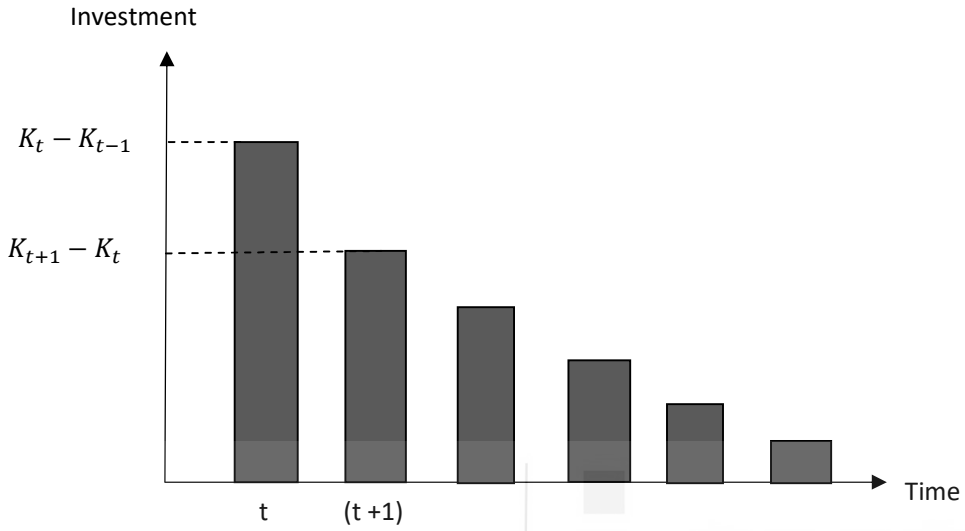

Fig. 7.2: Speed of Investment in Flexible Accelerator Model

Investment continues until the actual capital stock reaches the optimum level of capital. Larger the value of λ, faster is the speed of adjustment.

7.2.3. Stock Market and Tobin's q-Theory

So far we have assumed the sources of funds for a firm are either borrowed funds or own resources. A third source of funding for a firm, however, could be the shares or equities of a firm. A firm can issue fresh equities in a stock market and mobilise funds. Equities are financial instruments that can be traded in a stock market.

This is how the link between the fluctuations in investment and in the stock market is established. James Tobin first put forth formally the connection between investment and the stock market in his famous 'q-theory'. It is widely believed that stock market movements are poor indicator of the state of the firms or the economy, as the stock market is influenced by exogenous factors. In today's world, however, we cannot ignore the connection between the stock market and the growth of corporate firms.

Stock market plays a key role in helping firms to raise capital. Buyers of these equities, i.e., shareholders earn dividend and capital gain (that arise due to change in equity price) from holding these equities. According to the q-theory, level of investment depends on the ratio between the market value a firm's assets and the replacement cost of those assets. Tobin noted that *if the value of a company on a stock market is substantially more than the replacement cost of the asset (some form of business fixed capital) that the firm employs, then in principle that company has a major incentive to increase investment.* The q-ratio can be written as

$$q = \frac{\text{Market value of installed capital}}{\text{Replacement cost of capital}} \quad \text{... (7.13)}$$

Or,

$$q = \frac{\text{Value the stock Market places on a fi}\ \ ' \text{s assets}}{\text{Actual current worth of the firm}' \text{s assets}}$$

So, if $q > 1$ then for each unit of money worth of new capital the firm plans to buy, the firm can sell the shares for q units of money and get the profit $(q - 1)$. Thus there is an incentive for the firm to expand its capital stock through floating new shares. It implies increase in investment for the firm. Applying the similar logic, if $q < 1$, the market places a lower value on the firm compared to its actual value. Thus, there is no incentive for the firm to add to its capital stock.

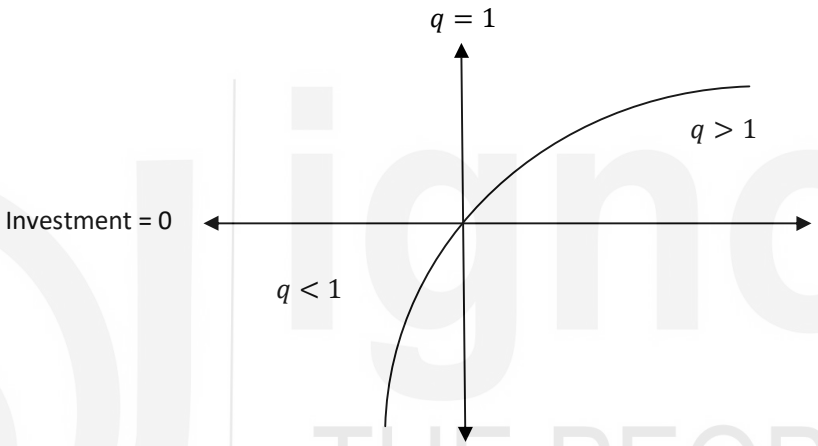

Fig. 7.3: The q-theory of Investment

If q is > 1 then there is an incentive to undertake net investment. When $q < 1$ firms should start selling their capital because they would get more for it on the second hand market than the value shareholders placed on it.

The q theory is closely linked to the neoclassical investment theory that firms should invest if the rate of return on new capital exceeds the cost of capital. As a theory of investment, the q-theory implies that when the stock market is bullish, there is usually an over-valuation of stocks. This encourages firms to increase investment by issuing fresh shares. Going by the same logic, when the stock market is bearish, investment could be low. Further, firms would consolidate their position through mergers and acquisitions during the bearish phase. Despite Tobin's proposition, in reality the positive link between the investment and stock prices are not very strong. The main reasons behind this weak link are high volatility of stock prices, adjustment cost of investment, failure of the stock market to convey accurate information to the shareholders, impact of exogenous factors on stock market, and investors' sentiments.

Check Your Progress 1

1) Assume that MPK = 20 – 0.02K, is the expected future marginal product, where K is the future capital stock. The depreciation rate is (–) 20% and the real rate of interest is 10% per period. The firm pays taxes equal to 50% of output. The price of a unit of capital is 1 unit of output. What is the value of the tax-adjusted desired capital stock?

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2) For a Cobb-Douglas production function, ϒ (Gamma, the coefficient of capital) = 0.3, Y (output) = 10 and rc (rental cost) = 0.12. If the output is expected to rise to 20, how much will be the change in the desired capital stock? Suppose that the capital stock was at desired level before the change in the income was expected. Suppose further that $\lambda = 0.2$ in the flexible adjustment model of investment. What will be the rate of investment in the first year after the expected income changes?

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3) Consider a short-lived investment project, one that costs Rs. 1000 to set up today (in the first period). The project generates Rs. 500 profit in the second year and further Rs. 700 in the third year. By the end of the third year the factory has disintegrated. Should the project be undertaken if the interest rate is 10%?

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4) A country loses much of its capital stock to a war. What effect will the loss of capital stock have on the desired investment?

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5) In the context of the q-theory of investment, suppose q is less than unity. Is it a correct move for a firm to increase its capital stock? Justify your answer.

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7.3 RESIDENTIAL INVESTMENT

The global financial meltdown of 2007-2009 which originated in the US was triggered by a large decline in home prices after the collapse of the housing bubble. Declines in residential investment preceded the recession and were followed by reductions in household spending and then business investment. Here in this section we will analyse the determinants of investments in housing with reference to the market for rental apartments.

7.3.1 Theoretical Structure

The housing market comprise two segments, viz., (i) the stock of existing houses (just like stock of capital), which determines the price of houses, and (ii) the flow of new construction (like flow of investment), which determines the level of new investment. Shocks to either of the segments can affect house prices. To model this, we need to have certain set of assumptions and also need to clarify the meaning of few notations.

- At any given point of time, a fixed sock of 'housing capital' exists H = $\bar{H}$ in the economy because a negligible percentage of the stock are added annually to the stock. The short run variation in construction activity will have very little impact on the stock of housing capital. The housing stock at the beginning of each period is determined by past investment.
- Home buyers view themselves as investors and their self-occupying house as one among the many assets that wealth holders can own in their investment portfolios.

- Homeowners can claim tax deductions for some of their expenses, notably property taxes and mortgage interest, but they are not taxed on their imputed rental income.
- For simplicity in analysis, we assume that all housing units are homogeneous.

  R_H = Marginal (1 unit of house) value of the rental services per period on owner occupied house.

  P_H = The price of one unit of existing housing stock = asset price of housing

  θ = Investor's marginal tax concession rate

  When a home buyer buys a house for self-possession by taking loans, then (s)he has to pay the mortgage interest (i = interest rate on each unit of money loan has been taken), and property tax (τ_P as a share of house value). According to the tax law, home buyers can deduct θ proportion of these expenditures (mortgage interest and property tax) from their taxable income.

  δ = The depreciation rate on housing capital

  m = maintenance cost of housing capital per unit value

  Π^e = Investors' expected rate of nominal house price appreciation

  The market for an existing housing unit is completed by the equilibrium relation:

$$H^d = \bar{H} \quad \ldots (7.16)$$

In equation (7.16) we need to define H^d which is the demand decision made by the homebuyers while buying house based on cost-benefit analysis. The benefit of one unit of house is the imputed rental value (the rent he is saving by residing in his own house) of the house, i.e., R_H. On the other hand, the cost of possessing and occupying a unit of house has three components:

(i) Price of the house after standard deduction: This is given by $[P_H - P_H(i + \tau_P)] = P_H(1 - \theta)(i + \tau_P)$

(ii) Depreciation plus maintenance cost: This is given by $P_H(m + \delta)$

(iii) Expected capital gain or loss: If the expected price of the house in one year is $P_{H,t+1}$, then $\Pi^e = \frac{P^e_{H,t+1} - P_{H,t}}{P_{H,t}}$. Expected capital gain on the house in one year = $P_H \cdot \Pi^e$. If capital gains is positive then homebuyers are gaining (cost is negative). On the other hand, if it is negative, homebuyers are losing (positive cost). Note, here P_H and $P_{H,t}$ are equivalently used.

Homebuyers in equilibrium, ***benefit = cost.*** This implies:

$$R_H = P_H[(1 - \theta)(i + \tau_P) + (m + \delta) - \Pi^e]$$

We can re-arrange terms in the above equation to get

$$\frac{R_H}{P_H} = \underbrace{[(1-\theta)(i+\tau_P)+\delta+m-\Pi^e]}_{\text{User cost of owner occupying housing}} \quad \ldots (7.17)$$

Ratio of imputed rental value to house price

Equation (7.17) describes the equilibrium condition for stock of existing houses. Note that, in the short run, the supply of houses is fixed (inelastic supply). Demand for houses varies inversely with the current level of housing prices, P_H.

The link between the current level of housing prices and the future flow of net new construction takes the following form as the rate of residential investment:

$$\underbrace{H_t - H_{t+1}}_{\text{Net Flow of New Construction}} = \phi\left(\frac{P_H}{C_t}\right) - \underbrace{\delta H_t}_{\text{This many of old houses have gone bad}} \quad \ldots (7.18)$$

C_t is the construction cost. Construction of new housing stock begins in t time period

7.3.2 Graphical Analysis

Panel (a) of Fig. 7.4 shows that the price of existing houses P_H is determined by the interaction of the supply curve (SS), and the demand curve (DD). The supply curve is inelastic (vertical) for the existing housing stock *at a moment of time*, as supply cannot be increased in the short-run. The demand curve for housing is downward sloping because higher housing prices make people to do any of the following: (i) curb the demand to buy houses, (ii) force people to live in smaller houses, (iii) share residences, or (iv) even go homeless. Adjustment in housing prices takes place so that there is equilibrium between demand and supply. Decline in the following factors would shift the demand curve upward (so that there is increase in demand; prices remaining constant): (i) mortgage interest rate, (ii) property tax rate, (iii) depreciation rate, (iv) maintenance cost, and (v) return on other assets. Increase in the following factors will shift the demand curve for houses upward: (i) population size, (ii) wealth, (iii) income, and (iv) expected capital gains from houses.

Panel (b) of Fig. 7.4 we depict the supply curve of new houses (FS) *in a given time period*. It is given as a positive function of housing prices. An increase in housing prices provides incentives to produce more houses. If in the panel (a), price of existing housing goes up (due to the factors mentioned in the predecessor paragraph) then builders / developers respond to this by building new houses. Thus, any factor that affects the prices of existing housing will affect the construction of new houses, thereby resulting in a movement along the FS curve. Any factor (for example, construction cost) that shifts the FS curve will affect the rate of residential investment.

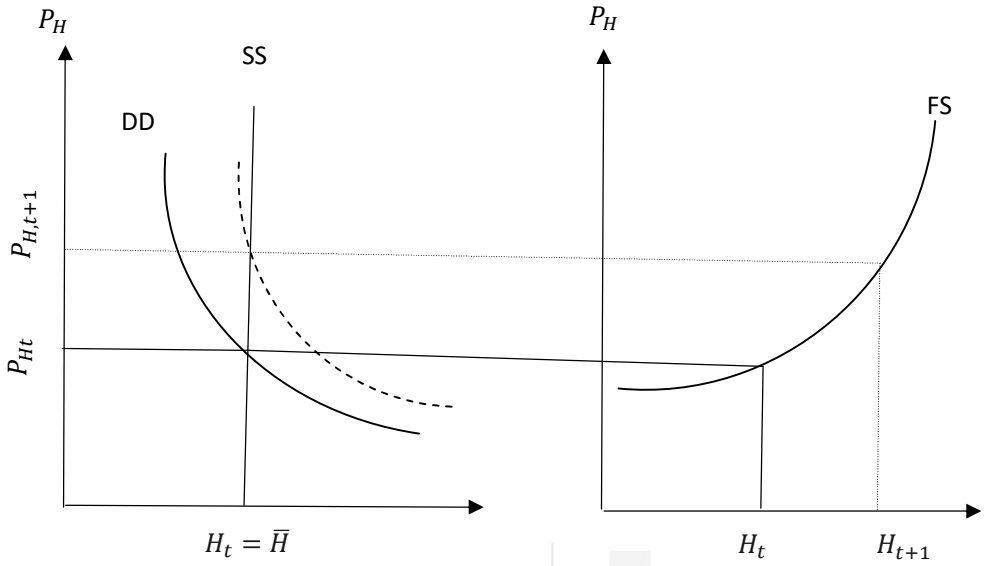

Fig. 7.4: Housing Market

An increase in housing demand leads to a rise in housing prices and residential investment.

You should note that the existing stock of housing is much larger compared to construction of new houses. Thus we often ignore the effect of the supply of new housing on the price of existing houses in the short run. However, over time, as the new construction increases the stock of existing houses. This shifts the SS curve to the right.

7.3.3 Implications of the Model

The framework we presented for residential investment has opened up several implications. Let us discuss some of them.

- The benefits of income tax rebates given on home loans do not reach poor households, as it is applicable to higher income groups who pay income tax. Similarly, when nominal interest rate rises with expected inflation, the after-tax marginal cost of borrowing, $(1-\theta)i - \Pi^e$ declines as expected inflation rises. This effect is more pronounced for high-income households and should therefore increase their demand for housing relative to that of low-income households.
- Individuals usually have higher demand for housing in the age group of 20 to 40 (due to marriage, children, etc.). The percentage of population in this age group is therefore an important determinant of the change in housing demand. Thus, any demographic change (say, for example, baby boom during the lock-down period) will have its impact on housing prices with a lag of 20 to 30 years.

- For expected inflation, Π^e, it is appealing to use the rational expectations framework. But empirical observation tells us that homebuyers extrapolate on past information (backward looking process for setting price expectations). If we incorporate this process in our model, it would result in systematic overbuilding in the housing market.
- If population, income and wealth are growing at a steady rate, then long run equilibrium would indicate that the rate of construction of houses is just sufficient to cover depreciation and the steady growth in demand. But in an economy where changes in demand are abrupt, the long run equilibrium is not necessarily ever achieved. In a static economy, long run equilibrium will be achieved when net residential investment would be zero.
- Builders take loans to finance their construction work. Hence mortgage interest rate also affects the flow supply (FS) curve.

7.4 INVENTORY INVESTMENT

Inventory is vital for the firms as well as for the economy as a whole. It is a tiny component of GDP but due to its remarkable volatility, it makes up about 70 per cent of the business cycle fluctuation. Therefore, understanding the behaviour of inventory accumulation is meaningful to predict macroeconomic fluctuations and counter it. There are two broad categories of inventories, viz., (i) Manufacturer's Inventories, and (ii) Retail Inventories. Under the Manufacturer's Inventories, we have further sub divisions like (a) Finished Goods, (b) Work–in-Progress, (c) Raw Materials and Supplies, and (d) Wholesale Inventories. The predominant types of inventories accounting for fluctuations are retail inventories, followed by raw materials and supplies. In India, changes in inventories are often a leading indicator for the overall performance of the economy. To get a broader perspective we need to examine the motives of holding inventories. Why do businesses put aside goods in storage?

7.4.1 Motives of Holding Inventory

Inventory investment is defined as the net addition to the stock of inventories. Firms hold inventories for various reasons:

(i) **Production Smoothing:** A representative firm often experiences short run shocks to the demand for its product. Firms may use inventories to absorb the unanticipated shocks to demand for their products. Instead of adjusting their production to match the fluctuations they prefer to continue their production at a steady rate. Thus, during a boom period, a firm will deplete its inventory and during the slump season it will add to its inventory.

(ii) **Production Scheduling:** Inventories give multi-product firms the flexibility in scheduling production runs.

(iii) **Reducing Delivery Lags:** Inventory may stimulate a single firm's demand by reducing delivery lags.

(iv) **Inventories as a factor of production:** Manufacturing firms stock up raw materials and other factors of production primarily for hedging against future price rise. Further, raw materials inventories are held because it is less costly for a firm to place bulk order of specific factors of production.

(v) **Stock-out avoidance:** Firms generally need to take production decision beforehand on the basis of expected sale of their product. An underestimation might lead the firm to lose sales and profit due to out-of-stock situation. In order to avoid such 'out-of-stock' situations, firms often hold inventories.

(vi) **Work-in-progress:** Certain inventories are held as an unavoidable part of the production process, especially when the production process involves several steps and takes time to produce. For example, when assembling of a car is partly completed, its components/parts are counted as a part of the automobile firm's inventory.

Categorisation of inventory investment in macroeconomic models depends on whether we consider inventories as output or input. It is widely observed that higher inventory stock lowers current output. When firms find that they are not able to sell the quantity they produce, they reduce the level of production.

The central aspect of inventory investment hinges upon the distinction between planned (intended) and unplanned (unintended) inventory investment. Planned changed in the inventory stock is the result of firms partially adjusting their inventory stock towards their targeted level. On the other hand, unplanned or passive change in the inventory stock could arise due to errors in forecast of sales.

Depending upon the specification of the nature of inventories and the motive of holding inventories, various micro models are there in the investment literature. In the Keynesian model we have seen that if the aggregate output is more than planned aggregate expenditure, then inventory begins pilling up. Such disequilibrium position of inventories gives signal to the firms to cut down their production till equilibrium is reached. This tacitly defines equilibrium as a state where inventory is constant.

7.4.2 Inventory, Real Interest Rate and Business Cycle

One of the most powerful factors causing business cycle is business investment in inventories. Although the annual amount of inventory is a very small fraction of total fixed investment, due its high degree of variability, it is considered a major factor behind the short run business cycle fluctuations. In addition, the erratic short-term behaviour of inventory accumulation creates severe forecasting problem. The role of inventories in the business cycle is a result of unanticipated and anticipated inventory change.

There are three channels through which inventory investment can destabilise the growth process in an economy: (i) demand impact, (ii) cost impact, and (iii) finance impact.

The cost of holding inventories is the rental price which comprises two components: (i) depreciation of the stock of inventory, and (ii) the interest cost that must be paid on the loan that finances the inventory (or, the interest amount the firm could have earned by selling the good today itself instead of keeping it in inventory form for tomorrow's sale). Thus, theoretically it can be said that, the real interest rate measures the opportunity cost of holding inventories. Therefore, if enterprises heavily rely on bank credits, rise in the real interest rate forces the business firms to reduce their inventory stocks. Probably that is why in the 1980s in USA, due to the prevalence of high interest rate, many firms adopted the '*just-in-time'* business strategy. It simply means producing goods just before sales.

Although the idea of interest sensitivity of inventory investment is theoretically appealing, it is neither conclusive nor definite as it depends on certain factors such as (i) the effectiveness of central bank policy in controlling interest rate, and (ii) dependence of firms on bank credit for stocking of inventories. If large enterprises do not rely on bank credits, they may escape the brunt of credit tightness. In that case high interest rate will not be able to have much of an impact on inventory accumulation.

Check Your Progress 2

1) Assume that the mortgage (home loan) interest rate has increased. Also assume that due to construction delay, the supply of new housing is a function of the price which is expected to prevail after the construction gets completed. What will happen to the rate of production of new housing, if expected prices of housing remain the same?

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2) A hypothetical automobile dealer sells 50 cars per month and holds, on an average, one-month's sales in the inventory. Assume that there is a 50 per cent drop in sales, and it takes the automobile dealer two-months to respond to the change (it means, he keeps ordering at the existing rate for two months). Corresponding to the fall in sale, the dealer would like to maintain his inventory at a new level of monthly sales of cars. How many months will he not order any new car?

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7.5 LET US SUM UP

The purpose of this Unit was to examine the determinants of investment in an economy. The main reason of examining the determinants is because of the inherent nature of instability ingrained in investment. In this Unit we covered three major types of investments, Business Fixed Investment, Residential Investment and Inventory Investment. According to the neoclassical model of business fixed investment, firms invest if the rental price of capital is more than the cost of capital. The firms disinvest otherwise. The cost of capital comprises real interest rate, depreciation rate, and the relative price of capital. The cost of capital is also affected by various tax codes and tax laws.

Firms try to bridge the gap between actual capital stock and desired capital stock only partially in each successive time period in the flexible accelerator model. In the Tobin's q-theory of investment, investment of a firm depends upon the market valuation of its assets vis-à-vis its replacement cost. If market value is higher than its replacement cost, the firm would expand its capital base by floating more equities.

The inelastic short-run aggregate supply of housing stock makes the housing prices completely dependent on the demand for housing. The demand for housing, in turn depends on mortgage interest rate, credit availability, income tax concession policy, GDP growth rate, and population size. From the suppliers' side, factors such as construction cost, and construction delay, etc. influence residential investment.

Inventories are held by the firms for various motives. This tiny component of private investment has great degree of variability and potency to influence the short run business cycle.

In addition to the factors discussed in the Unit, there are certain exogenous variables that influence investment in an economy. Political uncertainty, social unrest, corruption, natural disaster, etc. influence private investment decision to a great extent.

7.6 ANSWERS/HINTS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) One unit of capital contributes MP_K units of output. After paying 50% of that output as tax, the tax-adjusted net contribution of the one unit of capital is

   $= (1 – 50\%)\ MP_K$.

   Value of the tax adjusted $MP_K = Y$

$(1-50\%)MPK$ { $as\ value\ of\ 1\ unit\ capital = 1\ unit\ output$}.
The desired capital stock will be at

Value of the tax adjusted MPK = User cost of 1 unit of the capital = rental cost of one unit capital * price of the capital

= (20% + 10%)Y. Equate both these terms and solve for K and you will get the desired capital stock = 970 units.

2) By equating MP_K = rc, we get

Desired capital stock = $\frac{\gamma.Y}{rc}$

Putting all the values and Y = 10 in that we get the desired capital stock = 50. Similarly, for

Y = 20, desired capital stock becomes = 50

Change in the desired capital stock = (50 – 25) = 25

Initially the actual capital stock was = 25. After the income change the desired capital stock has become = 50

The rate of investment in the first period = λ (K* – K) = 1/5 * (50 – 25) = 5

3) The Present value of the future profit = $\frac{500}{(1+.1)} + \frac{700}{(1+.1)^2} = 1033$. Cost of the project was 1000. Thus, the project should be undertaken.

4) Rate of investment is = λ (Desired capital stock – Actual capital stock). Irrespective of the value of λ, rate of investment will be higher if the gap (K* – K) is higher. If the actual capital stock got reduced due to the war and the desired capital stock remain same, then the gap is higher and the rate of investment increase.

5) It will be a wrong move. In the q-theory of investment, q = value of the asset / cost of producing those assets. So, if q is low, the cost of producing those assets is more than the value of those assets. So, it is not a good idea for the firm to produce more assets.

Check Your Progress 2

1) Interest rate on home loan has increased. So, demand curve for existing houses shifts downward. The supply curve of existing houses remains the same. Thus, the current price of housing goes down.

But as the supply of new housing is not a function of the current prices of housing, rather it is a function of expected future price of housing which has not changed. Therefore, the rate of production of new housing will remain the same.

2) The dealer was selling 50 cars and keeping 50 cars in the inventory. After the 50% drop in sale, the monthly sale will become 25. For 2 months the dealer would still be ordering 50 new cars per month. Hence, he added 50 more cars to its 50 inventories in these two months. His inventory has become 100 now. If he is going to sell 25 cars per month, and would like to maintain 25 cars in his inventory, then he can take 25×3 = 75 cars from the inventory and sell for 3 months, without ordering any new cars for 3 months.

UNIT 8 DEMAND FOR MONEY: POST-KEYNESIAN VIEW*

Structure

8.0 Objectives

After going through this Unit, you will be in a position to

- identify the motives behind individuals holding money with themselves;
- find out the quantity of money that people wish to hold in cash;
- explain how and to what extent the demand for money is affected by changes in interest rate;
- identify the factors that determine the optimum composition of individuals' portfolio;
- describe how attitude towards risk influences the demand for money; and
- explain how money can be viewed as producer's and consumer's good.

8.1 INTRODUCTION

Why do we demand money? The answer appears to be simple, but there is no consensus amongst economists. There are several alternative theories of the demand for money. Keynes highlighted the concept of speculative demand for money. However, the Keynesian approach has been challenged by W. J. Baumol (1952), Tobin (1956) and Friedman (1958). In this unit we will discuss post-Keynesian theories of demand for money. In this context we will look into the

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following models: Baumol-Tobin's model of transaction demand for money, Tobin's portfolio allocation model, and Friedman's restatement of quantity theory of money.

8.2 TRANSACTION DEMAND FOR MONEY

Demand for holding money arising out of the need to facilitate transactions by economic agents is called the transaction demand for money. The transaction demand for money refers to the narrow definition of money, i.e., cash, cheque account balances, etc. Basically, it refers to the M1 definition of money. Transaction theories of demand for money take various forms depending upon how the process of obtaining money and making transactions is modelled. Some of the important models under this category are (i) Baumol-Tobin Model, (ii) Shopping-Time Model, and (iii) Cash-in-Advance Model. We discuss below the most prominent one, i.e., Baumol-Tobin Model.

8.2.1 Baumol-Tobin Model of Transaction Demand for Money

Here we would present a simpler version of the model which was independently developed by William Baumol (1952) and James Tobin (1956). It emphasises the cost and benefit of holding money using *inventory theoretic approach.* The model was originally developed to provide micro-foundations for aggregate money demand functions commonly used in Keynesian and monetarist macroeconomic models.

The following are the salient features of the model:

- Money is held for transaction purposes. Thus, it serves as a medium of exchange. Holding of cash is considered as an inventory on the part of the individual or economic agent. The individual would minimise the cost of holding the cash.
- Alternative to holding money in cash (which does not yield interest) is to hold interest-yielding bonds.
- For an individual, the time of receiving income and the time of spending money is not synchronized. Income is received once a month while purchases/expenditures are spread evenly throughout the month.
- Money is held in cash to bridge the time gap between the income receipt and flow of expenditure.
- Individual will exchange bond into cash to facilitate his evenly spread expenditure stream, use the cash, and again go for exchange.
- Each time the agent exchanges bonds to cash, there is some transaction cost/ brokerage fee which is fixed and independent of the volume of exchange. We call these exchanges as transactions.
- As each of this type of exchange (transaction) involves cost, the individual will keep in mind the trade-off between the interest earnings on bonds and the cost of transaction(exchange).
- Individual's average cash/money holding, is determined by the number of transactions (exchanges) made.

- A rational individual would minimize his cost of exchange (transactions) and decide about his optimum number of transactions.
- Aggregate demand for money will reflect this representative individual's demand for average money holding.

Let us use the following notations:

$y =$ periodical real income [time period could be a month or a year]

$T =$ length of the entire period (month or year) in days

$n =$ number of exchanges (transactions) during the time period

$b =$ brokerage fee per transactions

$r =$ real interest rate

As n number of exchanges are being made in the entire period (which has T days), the period is split into n intervals and each interval's length in days is $\frac{T}{n}$ days. To facilitate the smooth, evenly distributed expenditure stream, the agent's real periodical income y is equally distributed in these n intervals and each of these interval's expenditure requirement is $\frac{y}{n}$.

In the beginning of the time period, when the individual has received his income y, let us assume that the entire amount (income) automatically gets invested in bonds (or any interest-bearing deposit). For the first interval's expenditure requirement the individual would want to exchange $\frac{y}{n}$ amount into cash from bonds and $(y - \frac{y}{n})$ remains in the form of bonds. Therefore, for the first interval, $\frac{1}{n}$ per cent of y is held in cash and $1 - \frac{1}{n} = \frac{n-1}{n}$ per cent of y is held in the form of bonds.

The money holding pattern of the individual for the period of T days is shown in Fig. 8.1.

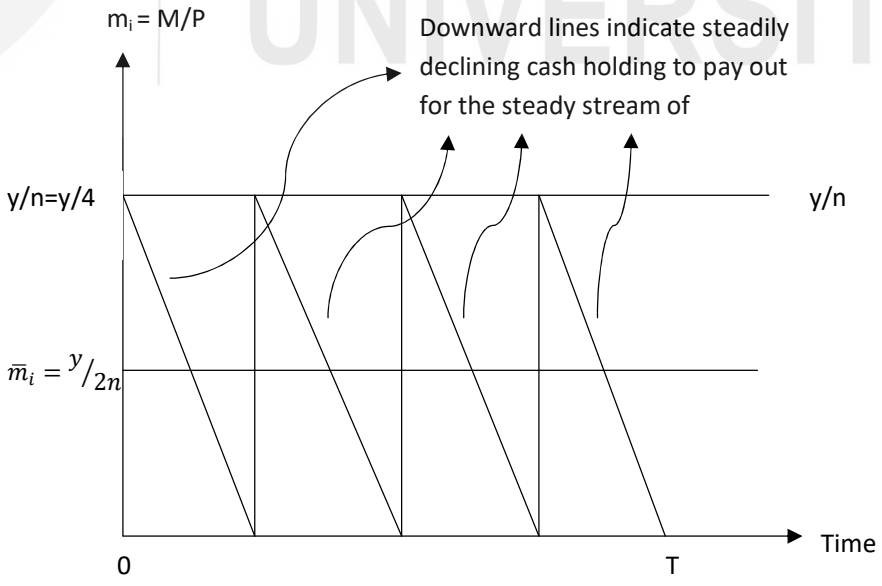

Fig. 8.1: Cash Management in the Baumol-Tobin Model

In Fig. 8.1 we split the time period into *n* (here, n = 4) sub-periods (intervals). The length of each sub-period is T/n days. Therefore, 4 transactions take place. In the beginning of each sub-period the individual converts y/n amount from bond into cash. The cash balance with the individual at the beginning of the sub-period is y/n (= y/4 in the diagram). At the end of each sub-period, as the individual exhausted the amount y/n = y/4 to pay out for that period's expenditure, his real balance becomes zero (notice the declining line, which indicates declining cash balances over the sub-period). The average real balance holding of the individual is ($\bar{m}_i$), which is the average of money holding in the beginning of the interval and money holding at the end of the interval). For Fig. 8.1, we find that

$$\bar{m}_i = \frac{(\frac{y}{n}+0)}{2} = \frac{y}{2n}.$$

8.2.2 Optimum Number of Transactions

In Fig. 8.1 we assumed that there are 4 transactions. A question arises: Is there an optimum number of transactions for an individual? For an individual, in fact, it could be a problem to determine the optimal number of transactions. We know that a rational individual would minimize the cost of converting the bonds into cash. The cost of conversion has two components: brokerage cost, and interest earnings forgone. Let us find out the details of the above two.

(i) Brokerage Cost

In each transaction, the individual will convert $\frac{y}{n}$ amount into cash. If 'b' is the brokerage fee per transaction and *n* is the total number of transactions, the total transaction cost of the entire time period will be (n.b).

(ii) Interest Earnings Forgone

If money is held in the form of bonds, it will fetch interest at the rate of *r*. On the other hand, if money is held in the form of cash, there is a loss of interest earning. Expenditure requirement of each interval is $\frac{y}{n}$ and each interval's length in days is $\frac{T}{n}$. Let us find out the interest earning foregone for each sub-period.

First Interval's Interest Cost: We know that $\frac{y}{n}$ amount of cash got converted from bonds. This could have remained in the bond form for the entire period, that is, for T days. So, the interest foregone on that amount is $\frac{r.T.y}{n}$.

Second Interval's Interest cost: Recall that again $\frac{y}{n}$ amount of cash is being converted from bond into money in the second interval. This could have remained in the bond form for the period (T– length of the first interval), that is, (T - $\frac{T}{n}$) = T ($\frac{n-1}{n}$) days. Therefore, interest amount forgone on that amount is $r.\frac{T\,(n-1)}{n}.\frac{y}{n}$

Third Interval's Interest cost: For the third interval, the interest forgone is $r.\frac{T(n-2)}{n}.\frac{y}{n}$

n[th] Interval's Interest Cost: Here $\frac{y}{n}$ amount of money could have remained in the bond form for $[\,T-\frac{(n-1).T}{n}] = \frac{T}{n}$ days. Therefore, the interest forgone = $\frac{r.T.y}{n.n}$

If we add up all the above, we obtain the total interest earnings forgone, which is given as

$$[\,\frac{r.T.y}{n}+\frac{r.T.(n-1).y}{n.n}+\frac{r.T.(n-2).y}{n.n}+\cdots+\frac{r.T.y}{n.n}\,]$$

$$=\frac{r.T.y}{n^2}[n+(n-1)+(n-2)+\cdots+1]$$

$$=\frac{r.T.y}{n^2}.\frac{n(n+1)}{2}$$

$$=\frac{r.T.y}{2}.(1+\frac{1}{n}) \qquad \ldots (8.1)$$

The total transaction cost (TC) of the period = brokerage cost + total interest earnings forgone

$$TC = n.b+\frac{r.T.y}{2}.(1+\frac{1}{n}) \qquad \ldots (8.2)$$

To solve for the optimum number of transactions, we should take the first derivative of TC with respect to *n* and equate it to zero as the individual would try to minimize the total cost. We get

$$\frac{\partial TC}{\partial n}=b-\frac{r.T.y}{2.n^2}=0 \qquad \ldots(8.3)$$

Solving for *'n'* we get,

$$n=\sqrt{\frac{r.T.y}{2.b}} \qquad \ldots(8.4)$$

So, the optimum number of transactions increases with *r, T and y* and decreases with the brokerage fee *b*. This is the famous Baumol-Tobin's 'square root formula'.

8.2.3 Aggregate Money Demand

We have found that the individual agent's average money demand (see Fig. 8.1) is

$$\bar{m}_i = y\,/\,2n$$

Substituting the value of the optimum number of transactions from equation (8.4) in the above, we get

$$\bar{m}_i=\sqrt{\frac{b.y}{2.r.T}} \qquad \ldots(8.5)$$

When an individual agent periodically converts the bond into cash, on the other side of the market there must be a firm whose money got converted into bonds. Therefore, the representative agent's bond and cash holding would reflect the firm's cash and bond holding like a mirror image. It implies that the firm's

average cash holding would also be given by the square root rule given in equation (8.4).

This explanation enables us to derive the aggregate money demand function just by doubling the $\overline{m_i}$ in equation (8.5). Thus,

$$\frac{M}{P} = 2.\overline{m_i} = 2.\sqrt{\frac{by}{2r}} = \sqrt{\frac{4by}{2rT}} = \sqrt{\frac{2b}{rT}} \quad \ldots(8.6)$$

The features of the aggregate money demand function given at equation (8.6) can be summed up as follows:

$$\frac{M}{P} = m(r, y)\ ;\ \frac{\partial m}{\partial r} < 0, \frac{\partial m}{\partial y} > 0 \quad \ldots(8,7)$$

You should note that the interest elasticity of the money demand $[= \frac{\partial \frac{M}{P}}{\partial r} . \frac{r}{\frac{M}{P}}]$ is calculated as $(-)\frac{1}{2}$. Thus, money demand is interest-sensitive even if all the demand for money is of transactions type. The presence of speculative demand for money further adds to the 'sensitivity of money demand to rate of interest'.

8.2.4 Limitations of the Model

In the Baumol-Tobin model discussed above we assumed that income is received once in a time period while expenditure takes place frequently and regularly. Therefore, the economic agent keeps the receipts or income in the form of bonds and converts it for cash periodically. Some of the limitations of the model are as follows:

(i) Expenditure payments may not be perfectly foreseen, evenly spread and continuous as assumed. It can be lumpy and unforeseen.

(ii) Baumol-Tobin's model is based on transaction demand for money. It overlooks the fact that changing bond prices may have implications on cash demand.

(iii) Cash is by no means the only assets in which transaction balances are held as assumed in the model.

(iv) If receipts of income and expenditure coincide in terms of time and amount, then it would imply zero demand for real balances.

(v) The implicit assumption that the brokerage fee would remain constant is questionable.

Check Your Progress 1

1) If most transactions are done through online payment, would you still be interested to hold some cash to meet the daily transaction needs? Give justifications in support of your answer.

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2) Find out the optimum number of transactions for an individual in the Baumol-Tobin model, if r =10 %, Price level =1, Income of the individual = Rs. 30000 per month and the brokerage cost = Rs.5000 per transaction.

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3) If there is a rapid increase in credit card fraud cases, what will be its impact on transaction demand for money?

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8.4 PORTFOLIO THEORIES

Keynes's theory of liquidity preference asserts that people's portfolio consists of either money or bonds. In general, individuals hold portfolios consisting of many assets; thus portfolios are diversified. It is observed that risky assets earn higher returns. Therefore, an individual who is concerned about both risk and return, hold a mixture of bonds and money in his portfolio.

8.4.1 Portfolio Balance Approach

Portfolio theory presented by James Tobin emphasized specifically on a particular function of money, i.e., money as a store of value. An individual investor holds his total wealth (W) in the form of bonds (B) and money (M). His collection of investments (i.e., his portfolio) is given as follows:

$$W = M + B \quad \ldots (8.8)$$

Nominal value of money remains the same as it yields no return; but it is convenient due to its security and liquidity. Let us assume that the expected return from 1 unit of money invested on bonds is '$\bar{e}$'. It comes from the market rate of interest (r, earned on each unit of bond and this is no uncertainty) and the expected percentage rate of capital gain ($\bar{g}$). There are chances that the bond price can go either up or down. The investor therefore cannot be certain about the capital gain. He can expect an average capital gain, that is, $\bar{g}$. So, his total expected return from the bond would comprise two components: (i) interest (r) which is certain, and (ii) capital gains (g) which is uncertain. Investors are uncertain about 'g' but has an implicit normal distribution of these gains around the average expected gain $\bar{g}$. Thus,

$\bar{e}$= r + $\bar{g}$ … (8.9)

As bonds are risky, we take the standard deviation σ_g as the natural measure of risk. It implies that an investor has a probability of 0.67 (check out the properties of standard normal distribution) that g will remain between $(\bar{g} - \sigma_g)$ and $(\bar{g} + \sigma_g)$.

Since the total bond holding is B, the expected return ($\bar{R}_T$) is

$\bar{R}_T = B \cdot \bar{e} = B \cdot (r + \bar{g})$ … (8.10)

Here 'r' is a known value, fixed, at least to the individual, by the bond market. The total risk of having the bond holding of the amount 'B' is:

$\sigma_T = B \cdot \sigma_g$ … (8.11)

Institutively, higher the proportion of the individual's wealth kept in bonds; more will be the return but he would expose himself to greater risk too. Mathematically we can give this intuition a concrete form. From equation (8.11) we can write

$B = \frac{\sigma_T}{\sigma_g}$ … (8.12)

Using the above in equation (8.10) we get,

$\bar{R}_T = \sigma_T \left(\frac{r+\bar{g}}{\sigma_g}\right)$ … (8.13)

The slope of the opportunity locus (OC) is given by

$\frac{d\bar{R}_T}{d\sigma_T} = \frac{r+\bar{g}}{\sigma_g}$ … (8.14)

Each of these terms apart from r, are fixed for each individual.

Let us plot equation (8.13) in Fig. 8.2. In the upper panel of Fig. (8.2), we measure expected returns from bond holding $\bar{R}_T$ on the y-axis and total risk σ_T on the x-axis. Remember that expected returns ($\bar{R}_T$) increases if the individual holds more bonds; risk also increases if the person holds more bonds. Thus, at the origin '0' both returns and risk are zero (implies that the individual is holding all his wealth in the form of money). As the person's bond holding increases, there is an increase in his returns as well as risk. Thus the OC line is upward sloping. Further, there is a trade off associated here – more bonds implies more returns; more money implies less returns. This trade off between the expected return $\bar{R}_T$ and total risk σ_T is shown by the *opportunity locus* OC. Since we assume that the rate of trade-off is constant, the 'opportunity locus' is a straight line. The investor decides at what point his risk is optimum (on the OC curve). If he is risk averse, he will be more towards the origin. If he is risk lover, he will be farther from the origin. You should note that the OC curve shifts as the rate of interest changes. The line OC_1 is the opportunity locus when the rate of interest is r_1. As the

market rate of interest increases, slopes of the line increases and individual's opportunity locus shifts from OC_1 to OC_2 to OC_3 corresponding to different rate of interests $r_1 < r_2 < r_3$ respectively.

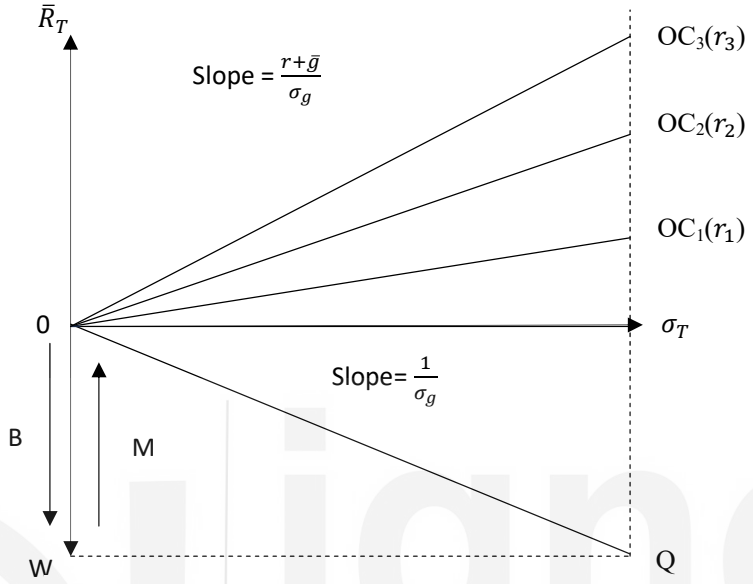

Fig. 8.2: Trade-Off between Risk and Return

In the lower panel of Fig. 8.2, we depict the relationship between risk and investment in bonds is shown by the line OQ (from equation 8.12). The length of the vertical axis in the lower panel is given by the fixed liquid wealth of the individual, W. The distance from the origin along the y-axis gives total bond holding (B), and the distance from the total wealth point (W) along the y-axis to the origin '0' gives total money holding (M). Slope of the line OQ is $\frac{1}{\sigma_g}$ from equation (8.12). The OQ line helps us in finding the composition of bonds (B) and money (M) in the portfolio of an investor for any given level of σ_T.

8.3.2 Risk Preference of the Investor and Optimum Portfolio Allocation

The investor optimises on risk and returns. Let us find out the optimum portfolio mix of B (Bond) and M (Money). To locate the optimum risk-return combination of the individual, we need to know the individual's utility function, $U = f(\bar{R}_T, \sigma_T)$. An increase in σ_T increases utility while an increase in σ_T decreases utility. We can express this utility function in the form of indifference curves (IC), such that a higher IC indicates higher level of utility (see Fig. 8.3). There are three indifference curves shown in Fig. 8.3.

Tobin distinguished broadly two kinds of investors (i) *Risk Lover* and (ii) *Risk Averter.* Risk lovers are individuals willing to accept lower expected return in order to have the chance of unusually high capital gains. They prefer high risk.

Their indifference curves will be concave to the origin. Risk averters on the other hand will not accept high risk unless they are compensated and satisfied with higher expected return. Empirically it has been observed that majority of investors are risk-averse. Their ICs will be convex to the origin. We will focus our analysis on locating the optimum portfolio allocation of the risk averters in Fig. 8.3.

Let us begin with the situation when interest rate is r_0 and indifference curve is IC_0 (see upper panel of Fig. 8.3). The investor is at the equilibrium point where OC_0 is tangent to IC_0. Thus, the investor will hold OB_0 amount of bonds and B_0W amount of money (see lower panel of Fig. 8.3). This is the optimum portfolio allocation of the investor.

Suppose there is an increase in the rate of interest to r_1. The investor is willing to take more risk, as the returns is higher now. The investor can attain a higher level of utility given by IC2. The equilibrium condition is given by the point where OC_1 is tangent to IC_1. Look into the lower panel of Fig. 8.3. The optimum portfolio allocation of the investor is given by OB_1 and B_1W of money.

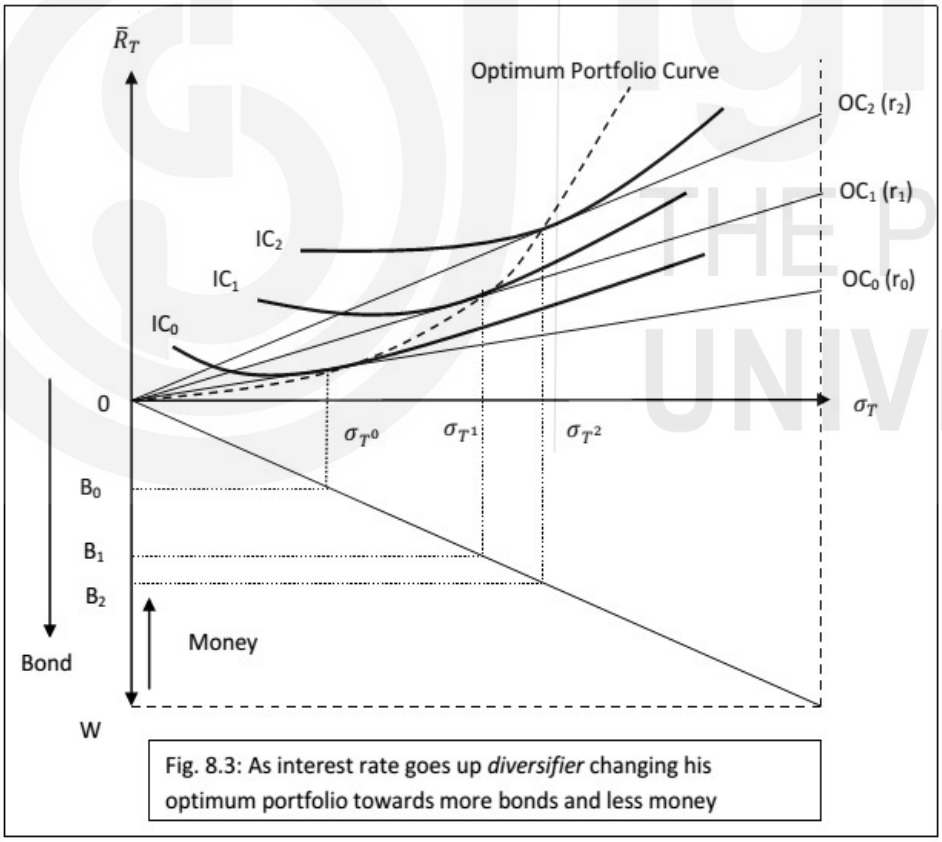

Fig. 8.3: As interest rate goes up *diversifier* changing his optimum portfolio towards more bonds and less money

8.3.3 Interest Rate Sensitivity of the Aggregate Money Demand

Aggregate Money Demand curve can be derived from the Fig. 8.3 by observing the changes in the investor's allocation of liquid wealth between bonds and money. As r increases by constant increments (r_0, r_1, r_2), the slope of the

opportunity locus lines increases and rotate upwards (OC_0, OC_1, OC_2) touching successively higher indifference curves (IC_0, IC_1, IC_2). Tracing out the successive tangency points between the utility curve and the opportunity locus we get the Optimum Portfolio Curve (dotted line). You should note that for successive equal increase in r we get smaller increments in the amount of wealth (fixed) put into bonds (B_0, B_1, B_2). Since W is fixed and W= B+M, we can also say conversely that, for continual equal increase in r the investor must decrease M progressively by smaller and smaller amounts.

EXAMPLE: For a risk averse investor, suppose W = 100. His portfolio allocation is given by the following table:

Rate of Interest	Bond holding (B)	Money Holding (M)	Real money Holding (M/P)
r_0	50	50	$50/P_0$
r_1	60	40	$40/P_0$
r_2	65	35	$35/P_0$
r_3	67	33	$33/P_0$

In the hypothetical example above, we assume that price level remains unchanged at P_0. We plot real money holding and rate of interest in Fig. 8.4. This gives us the *aggregate money demand curve*. Remember that we have assumed incometobeconstantatY_0.

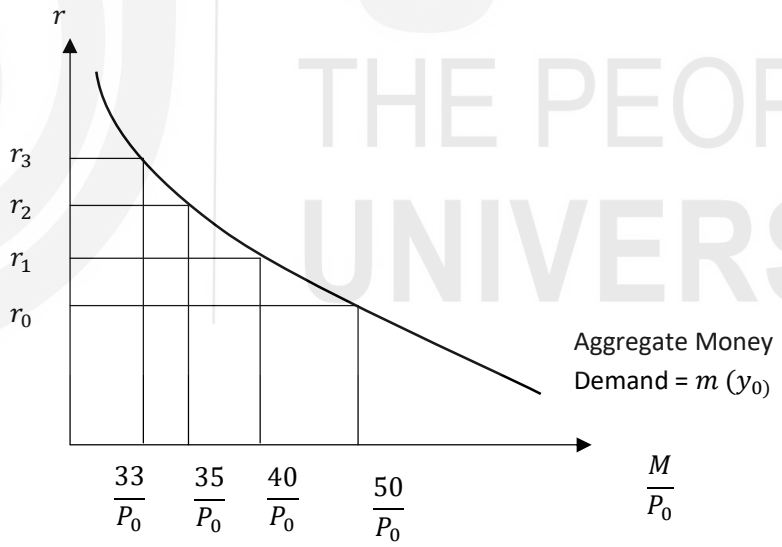

Fig. 8.4: Demand for Money Function

The demand for money function drawn in Fig. 8.4 is nothing but the speculative demand for money. It analyses the optimum allocation of fixed wealth into bond and money, depending upon the rate of interest, and expected risk and return on capital gain. In this model no reference has been made regarding the transaction demand for money.

8.3.4 Significance of the Probability Distribution of Capital Gains

Investor's estimates of σ_g of risk of bond holding are subjective. The standard deviation σ_g of the probability distribution of capital gain is influenced by the investor's perception, market experience, uncertainty, and measures of fiscal and monetary policy. The Central Bank's policy (such as open market operations) can influence investors' estimated risk. Tax rate on capital gain and interest earnings affect investor's calculation of estimated risk and return. Thus it is important to explore the impact of change in σ_g on the optimum allocation of investor's wealth.

An increase in σ_g influences the slope of both the OC line and the OQ line (see Fig. 8.2). While OC line will rotate downward, the OQ line will rotate upward. The logic is simple. When the risk of investing in bonds increases, investors like to reduce the total risk of entire bond holding (desire to reduce σ_T). The investor will cut down on B.

An increase in the capital gain $\bar{g}$ will have the same effect as the increase in interest rate. For any given rate of interest, an increase in capital gain would increase the investor's preference for bond and decrease his money demand. Thus, the money demand curve will shift downward.

Tobin's portfolio balance approach to explain speculative demand for money gives a more realistic analysis when investor's portfolio consists of both bonds and money

Check Your Progress 2

1) A bond worth Rs. 100 has a yield of Rs. 6. The price of the bond rose to Rs. 120. The bond is risky; higher the risk higher is the return. The average expected capital gain is 15% and the asset holder has a 66.7% chance that the actual capital gain will be between 11% and 19%. In this case an increase of one percentage point in the risk will buy the investor how much increase in the expected total return?

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2) Suppose there are two types of bonds in the market. Although both the types have the same average expected gain, one has a greater σ_g than the other. Which one will be preferred by the investor?

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8.4 FRIEDMAN'S APPROACH TO DEMAND FOR MONEY

Milton Friedman in his essay (1956), "The Quantity Theory of Money – A Restatement", reformulated the quantity theory of money. Friedman treated money as one type of asset. Economic agents such as households, firms and government want to hold certain portion of their wealth in the form of money. Thus, money is an asset or capital which has positive return. Hence Friedman's demand for money theory essentially a part of wealth theory. Friedman takes permanent income as a proxy for wealth.

8.4.1 Money Demand Function

Wealth can be held in five different forms: (i) Money, (ii) Bonds, (iii) Equities, (iv) Physical Goods, and (v) Human Capital. Each form of wealth has unique characteristics. Each form of wealth yields certain returns. The first four forms can be categorised as non-human wealth while the last one is human wealth. Non-human wealth can easily be converted into money. Human wealth (it refers to the income generating productive capacity of human beings such as education, skill or good health) can neither be liquidated easily nor can it be used as security to borrow money.

According to Friedman demand for money depends on the following variables:

(i) **Total wealth:** An individual's total stock of wealth is the most important determinant of his money demand. Greater the wealth of an individual, the more money he would demand for transaction and other purpose. Estimate of total wealth of an individual is seldom accurately available. Friedman used discounted value of permanent income (y_p) as an index of wealth. The permanent income is the aggregate expected yield from wealth during the agent's life time.

(ii) **The proportion of human to non-human wealth**: The proportion (w) in which the wealth (permanent income) of the agent is divided between these two forms of assets is an important factor in determining the money demand in real terms. Friedman in his *Permanent Income Hypothesis* suggested a relatively lower MPC out of human wealth. Due to this, although the ratio of human wealth to non-human wealth remains relevant, it does not play an important role in Friedman's theory.

(iii) **The expected rate of return on money and other financial assets:** Unlike other theories demand for money, Friedman takes broad definition of money. Thus, he includes time deposits along with the demand deposits and currency. So, money too has expected nominal return (R_m) like other forms of assets. As permanent income of an individual is stable, his wealth (which is surrogated by permanent income) is stable. Money and other financial assets are competing with each other to get their share out this fixed wealth. Thus, demand for money depends on the incentives for holding other assets relative to money ($\text{Bonds}: (\mathrm{R_b} - \mathrm{R_m})$, $\text{Equties}: (\mathrm{R_e} - \mathrm{R_m})$). If the return on financial assets (bonds and equities)

decreases vis-à-vis money, individual agent would want to hold more money.

(iv) **Price and expected inflation**: Rising price level due to inflation has two opposing effects. Inflation erodes the purchasing power of money (in nominal terms). In such situations, an individual will want to hold higher nominal money balances to keep his real money balances constant. Further, there is an increase in the relative return on non-human assets such as real estate, gold, unique art piece, etc. This will influence people to hold less money. Thus it will depend on the relative return $(\pi^e - R_m)$ of physical goods.

(v) **Other variables**: Variables such as taste and preference, expected economic instability (global financial crisis, phases of business cycle), and institutional factors (method of wage payment system, payments of bills) too affect the demand for money. All these factors are captured in the variable (z).

Friedman's demand for money function can be written in the following form:

$$\frac{M^d}{P} = \varphi\,(y_p, w,\ (R_b - R_m),\ (R_e - R_m),\ (\pi^e - R_m),\ z) \qquad \ldots (8.15)$$

In the above equation,

$\frac{M^d}{P}$ = Demand for real money balances

y_p = Real permanent income

w = ratio of human wealth to nonhuman wealth

R_m = Expected nominal return from money

R_b = Expected nominal return from bonds

R_e = Expected nominal return from equity

π^e = Expected rate of inflation = proxy for expected nominal return from non financial good

z = Any other variables which seem to have power to affect the uility derived from real money

The demand for real money balances, according to Friedman, increases when permanent income increases and declines when expected returns on bond, equities, or goods increases compared to the expected nominal return on money.

Friedman views that a change in the rate of interest in the economy would change the expected return on money as well as alternative forms of assets. Consequently, there is no change in the incentive terms ($R_b - R_m$, $R_e - R_m$, $\pi^e - R_m$) in the money demand function, and hence no change in money demand. Thus, money demand is insensitive to the rate of interest. This is in sharp contrast to Keynesian view. According to Keynes interest rate is an

important determinant of demand for money. This difference arises because of the difference in the definition of money considered by Keynes and friedman. Keynes takes a very narrow definition of money while Friedman takes a broad definition of money which includes time deposit (which is interest earning) along with the demand deposit. As the rate of interest increases, the demand for time deposit component of money increases and the demand for demand deposit and currency fall. So, the total effect of interest rate on money demand is negligible.

Friedman's money demand function stated in equation (8.15) can be approximated as

$$\frac{M^d}{P} = \varphi\,(Y_p) \qquad \ldots (8.16)$$

You should note that terms like *w* and *z* are being dropped due to their relative insignificance in determining the demand for money. Friedman's theory suggests that real permanent income is the only determinant of real money demand. Permanent income of an individual remains fairly stable over the time as it changes only due to certain unanticipated permanent changes in the income level. Thus, the second point in which Friedman differs from Keynes is that in Keynes' theory money demand is erratic and unstable due to the change in the expected interest rate. Whereas, Friedman's real money demand is highly stable as it is dependent on the stable variable 'permanent income'. It implies that the quantity of money demand can be predicted accurately by the demand for money function stated in equation (8.16).

8.4.2 Income Velocity of Money

According to Friedman money demand function, and therefore velocity of money, are highly predictable and stable. Stability of the money demand function and consequent predictability of the velocity of money can be derived from the relationship between the real current income (= actual measured income = y) and the real permanent income (y^p). This can be observed by converting the money demand function given at equation (8.16) into the following form:

$$V = \frac{y}{\frac{M^s}{P}} = \frac{y}{\frac{M^d}{P}} = \frac{y}{\varphi(y^p)} = \text{Velocity of Money} \qquad \ldots (8.17)$$

Since the relationship between the current income and the permanent income is fairly stable and predictable, velocity of money too is stable and predictable, although not constant. Friedman in his 'Permanent Income Hypothesis' defined real permanent income as follows:

$$y^p = \frac{r}{r+1} \sum_{j=0}^{\infty} \frac{y_{t+j}}{(1+r)^j} \qquad \ldots (8.18)$$

Here, $\mathrm{r} = \text{real rate of interest}$ & $\mathrm{t} = \text{time period}$. Thus, $\frac{r}{(r+1)} < 1$.

Therefore, real permanent income is less than current measured income. An implication of the above is that 'change in real permanent income is less than the change in current measured income'.

Friedman used this relationship to explain the pro-cyclical movement of the velocity of money. During the expansionary phase of a business cycle, the increase in the demand for money is less than the increase in income. This is due to the fact that the increase in permanent income is smaller relative to the increase in actual measured income (see equation (8.17)). Consequently, there is a rise in the velocity of money. During recession phase of business cycle, on the other hand, the decrease in the demand for money is less than that of income. This is due to the fact that the decline in permanent income is smaller relative to the decline in actual measured income. Consequently, there is a decline in the velocity of money during recession.

An implication of the above is that a given change in the nominal money supply will produce a predictable change in the aggregate spending. Thus, Friedman's demand for money is indeed a modern version of the quantity theory of money where money is the primary determinant of nominal aggregate spending.

8.4.3 Implications of Friedman's Theory of Money Demand

Friedman's theory of money demand has several interesting theoretical implications for the theory of money, study of business cycle, and conduct of monetary policies. It has received certain criticisms as well.

The insensitiveness of the demand for money to interest rate has received a lot of criticism. Friedman has been criticised for having a broad definition of money and including interest bearing M3 (along with M1 & M2) type of money supply which attracts rate of interest. Thus, an overall effect of a change in the rate of interest on money demand is negligible. Secondly, Friedman in his theory explained much of the cyclical fluctuations of income velocity of money by pointing out the usage of measured income and permanent income in calculating the velocity. The residual cyclical behaviour of the velocity only could be attributed to the change in the interest rates which is negligible and thus supports Friedman's idea of having demand for cash balances insensitive to the rate of interest.

Friedman considers the supply of money and the changes in the supply of money as given. He considered banks as producers of money. He ignored the possibility of any factor influencing the supply of money. However, decision on the supply of money depends on certain variables such as (i) deposits and withdrawals of currency by non-banking financial intermediaries, (ii) lending and borrowing by commercial banks form and to the Central Banks, and (iii) purchase and sale of securities by the Central Bank.

Check Your Progress 3

1) Point out the factors that determine the money demand in Friedman's modern quantity theory.

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2) What determines the velocity of money in Friedman's quantity theory of money?

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3) Suppose the real demand for money takes the functional form $\frac{M^d}{P} = 0.20 \times Y$. Use Friedman's implicit quantity theory of money equation and solve for income velocity of money.

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4) Suppose the real rate of interest is $r = 10\%$. Consider a *temporary* change in income such as $\Delta y_t = 1$ with $\Delta y_{t+j} = 0, j = 1,2,\ldots..$. How much will be the change in permanent income? If there has been a *permanent* change in income, $\Delta y_{t+j} = 1\ , j = 1,2, \ldots..$ how much do you think would be the change in permanent income?

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8.5 LET US SUM UP

The post-Keynesian theories of money demand mainly emphasized on either the transaction motive or the precautionary motive of holding cash balances. The medium of exchange function of money gave rise to the transaction models. Baumol (1952) and Tobin (1957) treated money as an inventory good which people would want to hold for transactions purpose when level of transactions is known and certain. Although alternative liquid assets are available with better

rate of return than money, there is certain transaction cost due to conversion of these assets into money. Such transaction cost justifies holding of money.

Friedman (1958) analysed money as a consumer good and demand for money as a direct extension of the demand for any consumer durable goods which enters the utility function of the consumers. Friedman treated money as an asset yielding a flow of services and have a broad range of opportunity cost variables. Friedman's stable demand for money is a function of permanent income of individual consumers.

8.6 ANSWERS/ HINTS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) If the online payments are being made through debit cards/ e-wallet, then it is as good as holding cash in hands. On the other hand, if it is made by credit cards, then payment for any month's credit card bill can be made by that month's salary as soon as that is disbursed at the beginning of the next month and rest of the salary amount can stay invested in bonds which does not need to be exchanged into money. So, depending upon financial infrastructure and attitude towards risk, the need for holding cash and exchanging bonds into money would lose its significance.

2) The optimum number of transactions for an individual is: $n = \sqrt{\frac{r.T.y}{2.b}}$.

   Price level = 1, real income Y/P = Rs.30000/Rs.1 = 30000

   T = 1 month = 30 days

   Real rate of interest 10% = 0.1

   Real brokerage cost = Nominal brokerage cost/price level = Rs. 5000/Rs. 1 = 5000

   Putting it in the formulae we get optimum number of transactions

   $= \sqrt{\frac{0.1\times30\times30000}{2\times5000}} = \sqrt{9} = 3.$

5) If there is a wave of credit card fraud then the transaction demand for money will initially increase. This means that LM curve will shift to the left and the rate of interest will rise. This may, ultimately, reduce transaction demand for money.

Check Your Progress 2

1) Here the percentage yield of bond is 6%. The market rate of return $r = \frac{Rs.6}{Rs.120} \times 100 = 5\%$

   $\bar{g}$ = average expected capital gain = 15%

σ_g = the standard deviation of return on a bond = 4% [The difference between 15% and 11% ; and 15% and 19%]

As per equation (8.14), the percentage increase in the total return from the bond due to one percentage point increase in the risk:

$$\frac{d\bar{R}_T}{d\sigma_T} = \frac{r + \bar{g}}{\sigma_g} = \frac{5\% + 15\%}{4\%} = 5\%$$

2) For both types of bonds, the average expected gains from bonds is the same, i.e., $\bar{g}$. However, one has higher risk/uncertainty (σ_g) than the other. Thus, there is 66.7% chance that the actual g, that the investor would receive will remain in the range, $\bar{g} \pm \sigma_g$. So where σ_g is higher, the spectrum of uncertainty increases, and this kind of bond would be less preferred.

Check Your Progress 3

1) In Friedman's theory, increases in permanent income increase the demand for money. Increases in the returns on bonds relative to money and the returns on equities relative to money decrease money demand. Increases in the returns on goods relative to the return on money, which is the expected rate of inflation relative to the return on money, decrease money demand.
2) Velocity is determined by the ratio of actual to permanent income. As actual income increases in an expansion, permanent income increases less rapidly. Thus, money demand increases less rapidly than income, and velocity rises (and vice versa for contractions). Interest rate does not affect velocity of money in Friedman's theory. This is due to the fact that relative returns on money and other assets are relatively constant.
3) $V = \frac{Y}{\frac{M^d}{P}} = \frac{Y}{0.20\,Y} = 5$
4) $\Delta y_p = \frac{0.10}{1+0.10}\Delta y_t = 0.09$ for the temporary change in the income

   $\Delta y_p = \frac{r}{1+r}.\frac{1+r}{r} = 1$ for permanent change in the income. Refer to equation 8.18 for details.

UNIT 9 FISCAL POLICY*

Structure

9.0 OBJECTIVES

After going through this Unit, you should be in a position to

- describe the effects of fiscal policy;
- identify the policy lags and their role;
- explain why there could be crowding-out of private investment;
- describe the components of government budget;
- define the various measures of budget deficit;
- appreciate the importance of debt-to-GDP ratio;
- derive the condition of debt sustainability; and
- explain the concept of Ricardian equivalence.

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9.1 INTRODUCTION

Policy makers always have certain goals in mind while framing policies. In the sphere of economics, these goals could be: (i) economic stability, (iii) acceleration in economic growth, (iii) increase in employment, (iv) reduction of poverty, and (v) better quality of life for people. Two prominent tools at the disposal of policy makers to achieve these goals are: (i) fiscal policy, and (ii) monetary policy. Fiscal policy refers to the use of public spending (i.e., government expenditure) and taxation to influence macroeconomic variables such as aggregate output and employment in an economy. Monetary policy refers primarily to the use of interest rate to influence macroeconomic variables. We will discuss about both these policies in the present course – fiscal policy in the present Unit and monetary policy in Unit 10.

In the aftermath of the Great Depression (1929-34), Keynes prescribed that the government should play an active role in the economy. About a decade back, during the global financial crisis of 2008-09, most countries resorted to fiscal stimulus packages to accelerate growth rate of the economy. Further, during the Covid-19 pandemic of 2020-21 fiscal policy played an important role. In India, for example, when there were phases of lock-down in most states due to the pandemic, the governments at the centre and the states came up with several fiscal measures to protect life and livelihood of people.

Governments have always tried to maintain public expenditure at a high level. In this pursuit government revenue has fallen short of government expenditure. Thus there has been a deficit budget of the government in most cases. Such deficit is funded usually by borrowing, which leads to public debt. In this Unit we will discuss about the sustainability of public expenditure in the presence of public debt.

9.2 EFFECTS OF FISCAL POLICY

The role of the government, particularly the fiscal aspect, has changed over time. Classical economists believed in the philosophy of ‘laissez faire’, which is a French term meaning ‘leave alone’ or ‘let you do’. According to this view, there should be minimal intervention from the government in business affairs. In fact, Adam Smith suggested that government should confine itself to three main duties, viz., (i) national defense, (ii) administration of justice (law and order), and (iii) establishing and maintaining certain public works (infrastructure, education, etc.). Keynesian economics, on the other hand, presents an altogether different view on the role of the government. Keynes believed that in case the economy is passing through bad times, it is the role of the government to intervene and help the economy to attain equilibrium. Thus the role of the government is much more than the maintenance of law and order, and defence. The government should enter into production of various goods and services. In fact, this point of view suited policy makers, and the size of the government kept on increasing.

Government is an important source of demand for goods and services. Through variation in government expenditure, the government can vary aggregate demand of the economy. Such variation in aggregate demand will lead to changes in aggregate output.

9.2.1 Counter-Cyclical Fiscal Measures

There are fluctuations in economic activity in an economy due to business cycles (see Unit 4). During recession there is a downturn in economic activities, while the economy may suffer from inflation during the expansionary phase. Government expenditure can be an important tool of countering business cycles. Keynes talked about pump-priming expenditure, i.e., a step taken by the government to increase public expenditure during and after recession. Public expenditure on infrastructure (better roads, railway network, uninterrupted power supply, etc.) would also act as a catalyst for private investment.

There are two main instruments of fiscal policy, viz., government expenditure and taxation. During recession, the government should increase its spending so as to compensate for the decline in aggregate demand. On the other hand, the government should decrease public spending when there is high inflation in the economy. Similarly, tax rates should be decreased during recession and increased during boom period.

You have already read about the effect of government expenditure on output, prices and interest rate. Apart from its effect on these three variables, fiscal policy influences two more variables in the long run: (i) redistribution of wealth, and (ii) growth of production capacity. Redistribution of wealth can be attained through the following three channels: (i) Taxation should be progressive in an economy. It means that tax rate is higher for people with higher income. As you know, people with higher income pay direct taxes (such as personal income tax) at a higher rate. (ii) Poor people are given various subsidies (such as old age pension, subsidized ration, etc.) to supplement their income. (iii) Government provides preferential treatment to certain sectors, which affects relative income of people (for example, free electricity or subsidized inputs for priority sectors). Such measures lead to redistribution of income and wealth in the long run.

Government produces certain goods and services, which are not necessarily ‘public goods’. The government operates hospitals, educational institutions, banks, water supply, etc. It also builds roads, railway tracks, power plants and several infrastructural projects. Further, government produces many goods such as steel, coal, heavy machineries, etc. In the long run, all these production activities enhance the production capacity of the economy.

9.2.2 Policy Lags

We mentioned above that the government can vary its spending to moderate the effect of business cycles. Thus Keynesian economics suggests a lot of discretionary power to the government.

The effect of variation in public investment to counter business cycles, however, may not be effective because of certain policy lags.

When certain economic problem comes up in an economy, it takes some time to recognize it. For example, suppose inflation in the economy is about to increase. Policy makers may not be in a position to recognize the problem immediately. They may think the price rise to be temporary (seasonality, supply shock, etc.) and assume that market forces will be able to rectify it. Further, policy makers have to take due approval before taking any action. For example, tax rates are usually changed during the annual budget presentation. Policy makers have recognized the problem but they have to wait for implementation of appropriate policy measure! Finally, when the government takes action, its effect will be visible only after some time. For example, if the government comes up with certain relief package to counter the recession, the economy will respond with a lag. When the effect of the higher government expenditure is visible, the economy may be moving towards high inflation. Thus, government may be taking certain action, which is not needed or which may be negating the objective of the government.

We generally observe four types of policy lags, viz., (i) information lag, (ii) decision lag, (iii) implementation lag, and (iii) effect lag.

Information Lag: The Central Statistical Office collects data on various economic variables periodically. You may have observed that we do not have data on many variables on a regular basis. On some of the variables (for example, prices) we have data on a weekly basis, while for others on a quarterly basis. Data on employment, investment, consumption, etc. are not available so frequently. You should note that it takes long to plan a survey, collect data and carry out statistical analysis. Thus there is an information lag in an economy.

Decision Lag: Even when the state of the economy is known, the government has to wait for some time to take a decision. Policy makers have to seek due approval before taking any action. For example, tax rates are usually changed during the annual budget presentation. Thus, there is a decision lag.

Implementation Lag: Implementation of government policies take time. To implement an investment project, for example, a lot of time is required. The procedures of placing order for machineries, recruiting employees and purchasing raw materials are time consuming. Therefore, even when the policy makers have recognized the problem and decided to carry out certain projects, they have to wait for implementation of the projects. This leads to implementation lag.

Effect Lag: There is a lag in realizing the effect of the policy decisions. Effects of certain government projects are visible immediately. In other cases it takes somewhat longer. Cash transfer to the saving account of farmers or poor people can have immediate effect. Reduction of poverty in a region due to setting up of certain industry however will take time.

Thus the effect of government policy needs to be evaluated on a case to case basis. In most cases, however, there is a lag in realizing the desired effects.

9.2.3 Automatic Stabilizers

Taxes are considered to be automatic stabilizers in an economy. As you may know, the government is not in a position to vary tax rates at times due to several factors – there could be resistance from people, policy makers have to wait till the parliament approves it, the government may not want to increase tax rates keeping forthcoming election in mind, etc. Even in those cases the tax revenue will have a stabilizing effect. Let us see how. Let us assume that the economy is experiencing rapid economic growth. It implies that more workers are employed, turnover of firms is growing, and income of people is growing. This leads to payment of higher taxes by individuals and firms, even if the government does not increase tax rates. Consequently, there is increase in tax revenue of the government. As government expenditure does not depend on the size of GDP, the government can go for a surplus budget, if needed. In times of recession, on the other hand, there is a dip in the level of employment, income of people and turnover of firms. During such times there is a decline in taxes paid by people and firms, even if the tax rates are unchanged. Thus, directs taxes such as income tax work as automatic stabilizers; they soften the impact of business cycles.

9.2.4 Expectations in Economics

Keynes recognized the importance of expectations in economics. However, he did not introduce expectations explicitly into his analysis. There are two reasons for the above: (i) Expectations are volatile and bringing it into analysis is difficult. (ii) Keynes focused his analysis on the short run – there may not be much change in expectations in the short run.

As you know from BECC 106: Intermediate Macroeconomics-I, expectations formation could be according to two important theories: adaptive expectations and rational expectations. In Unit 3 of BECC 106, we discussed the effects of fiscal policy. In Table 3.2 we presented the short run and long run impact of fiscal expansion (i.e., an increase in government expenditure and decrease in tax rates). As a result of expansionary fiscal policy, in the short run, there will be (i) an increase in output, (ii) price level will rise, and (iii) rate of interest will rise. In the long run, aggregate output will revert back to its natural level (i.e., potential output), while price level and interest rate will remain at higher levels. We assumed that expectations formation is according to adaptive expectations. Thus, there is a discrepancy between expected price and actual price in the short run. If we assume rational expectations, aggregate output will not increase. Under rational expectations, there is no difference between expected price level and actual price level even in the short run.

9.2.5 Crowding-Out of Private Investment

Keynes favoured fiscal policy measures, primarily government spending on public works. Most of the debate over economic policy at that time focused on the desirability of government spending on public works as a cure for unemployment. Those arguing against Keynes's view primarily drew attention towards the financing of the government expenditure. Many economists and

observers got distressed about the persistent increase in the budget deficit and they viewed it as harmful.

Suppose there is a tax cut. This will result in lower revenue of the government. Public expenditure, however, is likely to remain unchanged. The budget deficit needs to be financed by government borrowing. According to Keynesian point of view, a tax cut would increase disposable income of consumers. Higher disposable income will increase the demand for goods and services, which in turn will enhance consumption expenditure. Increased consumption expenditure will lead to increase in aggregate demand. An increase in aggregate demand will lead to an increase in output and employment.

Let us look into the neoclassical point of view. Due to the tax cut, there is an increase in disposable income of households. Part of this income would be spent on consumption (depending upon the value of the mpc), while the remaining part will be saved. Total saving of the households (private saving) will increase as a result of higher disposable income. Such increase in private saving, however, will be lower than the decrease in public saving. Therefore, there is a decrease in the desired aggregate saving of the economy. As aggregate saving falls short of aggregate investment, there is an increase in the real interest rate. This higher interest rate would *crowd out* the domestic private investment. Such crowding out of private investment will result in smaller stock of productive capital in the long run.

Check Your Progress 1

1. Explain why government expenditure should be counter-cyclical.

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2. What are policy lags and how do they affect fiscal policy?

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3. Explain why income tax can be considered as an automatic stabilizer in an economy.

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9.3 BUDGET DEFICIT

Budget is the annual financial statement of a government. It gives us the details of revenue and expenditure of the government. As you know, in the case of India, every year budget of the central government is presented before the Parliament for its approval. Similarly, budget of the state governments are presented before the respective state legislature. When we talk of public sector, it includes central, state and local governments.

9.3.1 Components of the Budget

The budget is prepared by the Finance Minister in consultation with economists, entrepreneurs, state governments, etc. There are two accounts in the budget: (i) revenue budget, and (ii) capital budget. The revenue budget includes revenue receipts or current receipts of the government and the expenditure that can be carried out from that receipt. The capital budget consists of capital receipts and capital expenditure. You should note that revenue budget consists of items that are recurring in nature and do not create any asset or liability for the government. Further, revenue receipts of the government are such receipts that are not required to be repaid. Transactions in the capital budget, on the other hand, create assets and liabilities for the government.

There are two sources of revenue receipts: (i) tax revenue, and (ii) non-tax revenue. Taxes are the most important source of revenue of the government (around 53 per cent of the total revenue and capital receipts). There are of two types of taxes, viz., direct tax and indirect tax. Direct taxes are levied on the incomes of individuals (such as personal income tax) and net income or profit of corporations (such as corporate income tax). Indirect taxes are levied on the purchase and sales of goods and services (such as Goods and Services Tax (GST)). Apart from taxes, the other sources of revenue receipts are fines and fees. There is a subtle difference between fee and tax. The government collects fee for rendering certain services. Taxes, on the other hand, are compulsory payments by individuals and firms to the government, for which there is no *quid pro quo* (that is, the government does not provide any service or return to the tax payer). The major source of capital receipts is borrowings by the government (about 36 per cent of total receipts).

On the expenditure side, there are three types of expenditure the government incurs: (i) government purchase of goods and services, (ii) transfer payments, and (iii) subsidies. The government produces goods and services, including capital goods. For such production, it has to employ labour, procure capital, and purchase intermediate inputs. Some of the expenses of the government are recurring in nature (for example, wages and salaries) while others are one time (for example, fighter planes). Transfer payments are unilateral payments to individuals, for which there is no quid pro quo (for example, old age pension), in the sense that the receiver does not pay anything in return to the government. Note that transfer payments are the opposite of taxes – in the case of taxes there

is a flow of money from individuals and firms to the government. In the case of 'transfer payments' the flow of funds from the government to the individual. 'Subsidies' are the supply of certain goods and services at a price that is lower than the market price. For example, the government provides food grains at subsidized prices to poor households. Another example of subsidies could be the supply of water to households at a much lower price than its cost of production. It implies that subsidies involve certain costs to the exchequer.

In the budget, government expenditure are placed under two categories: revenue expenditure and capital expenditure. The major heads of expenditure from revenue budget are wages and salaries, defence expenditure, transfers on account of interest payments, pensions and unemployment allowances. As mentioned earlier, revenue expenditure does not lead to creation of assets. Expenditure that results in an addition to the capital stock of the economy such as roads, buildings, factories, dams, etc. are referred to as capital expenditure.

9.3.2 Budget Deficit

We mentioned earlier that revenue receipts do not have to be repaid by the government while capital receipts have to be repaid. Thus in simple terms revenue receipts are the income while capital receipts are the debt for the government. In the context of budget, if the total expenditure (both revenue and capital) is equal to revenue receipts of the government, the budget is said to be *balanced*. If total expenditure is less than revenue receipts, it is called a *surplus budget*. If total expenditure, on the other hand, is more than revenue receipts, it is called a *deficit budget*.

You would have heard of three concepts of deficit, viz., fiscal deficit, revenue deficit and primary deficit during the talks that follow the presentation of the budget. Before we move forward, let us define these concepts.

Revenue Deficit: It shows the gap between revenue expenditure and revenue receipts of the government. It draws attention to the extent to which the government cannot meet its revenue expenditure from its revenue receipts. You should note that

Revenue Deficit = Revenue Receipts – Revenue Expenditure

Fiscal Deficit: It is the difference between total expenditure (both revenue and capital) and the revenue receipts. You should note that

Fiscal Deficit = Revenue Receipts – Total Expenditure (Revenue + Capital)

Fiscal deficit gives an estimate of the borrowing requirements of the government.

Primary Deficit: Interest payments (servicing of debt) constitute a large share of the revenue expenditure (about 25 per cent of revenue receipts). In this context, you should remember that interest payments are on the borrowings in the previous periods. Thus, to assess the fiscal health of an economy, we look at primary deficit. We obtain primary deficit by subtracting interest payments from fiscal deficit.

Primary Deficit = *Fiscal Deficit – Interest Payments*

= *Revenue Receipts – Total Expenditure – Interest Payments*

A part of the revenue expenditure is spent on payment of interest. This in fact reduces the debt burden of the country. Deficits and surplus, as well as taxes and expenditure, are flow variables. These variables are defined over a period of time. Public debt is a stock variable and it is defined at a point of time.

9.3.3 Impact of Budget Deficit

Fiscal deficit leads to borrowings by the government. Such borrowings over the years accumulate in the form of public debt. The government has to pay interests on existing public debt on a regular basis. If the level of public debt is high, interest payment also is high. If revenue budget is surplus, the government can repay part of its existing debt (so that there is a reduction in the level of public debt). On the other hand, if the revenue budget is deficit, there is an increase in public debt due to further borrowings. Servicing of public debt takes away a substantial part of revenue receipts. Thus, very little is left for productive use of public funds. Now you can understand why there is a clamour from every quarter – political leaders, researchers and general public – to reduce fiscal deficit. Fiscal deficit is often expressed as a percentage of GDP.

9.3.4 Financing of Budget Deficit

There are three sources of financing the budget deficit as mentioned below.

(i) **Borrowing from the Domestic Market**: The government issues bonds of certain maturity period to mobilise funds. Borrowing from the market leads to accumulation of public debt as mentioned earlier. The government can borrow from the domestic market or from the rest of the world. Borrowing from the domestic market does not lead to an increase in money supply. However, payment of interest and principal amount from revenue receipts is often a problem for the country. In this context the concept 'Debt-to-GDP ratio' is important. If debt-to-GDP ratio is high, a major part of revenue receipts has to be diverted towards servicing of public debt. In the case of India in 2019-20, for example, public debt (state and centre combined) as a percentage of GDP is about 76 percent.

(ii) **Borrowing from the Rest of the World**: External borrowing could be in the form of (i) soft loans from international organisations such as IMF and World Bank, (ii) borrowing from commercial markets, or (iii) deposits by international emigrants (for example, non-resident Indians). You should note that external borrowings lead to accumulation of foreign debt. Debt servicing (i.e., payment of interest as well principal amount) of such external debt has to be made from current account receipts. In this context, the concept 'debt-service ratio' is very important. Debt-service ratio is defined as the ratio of debt service to current account receipts of the country. Debt service ratio of India in 2019-20 was about 6.5 per cent.

(iii) **Monetisation of Deficit**: When the government borrows from the market, there is a decrease in money supply in the hands of people. In the case of monetisation of deficit, there is an increase in money supply in the economy. It is a two-step process where the government issues government bonds to cover its spending and the central bank purchases the bonds. The central bank holds the bonds until it matures. This process leaves the system with an increased supply of high powered money. Thus, monetisation of deficit can be inflationary. In view of the above, the FRBM Act, 2003 prescribes that the Reserve Bank of India should not buy government bonds, except under exceptional circumstances.

9.4 FISCAL SUSTAINABILITY

A government should be able to maintain its public finances (taxation, expenditure and debt) in such a manner that fiscal policy is credible and sustainable in the long run. The government should be in a position to estimate its future revenue and expenditure correctly. It should carry out the projects committed in the budget. Also it should not fail to repay its debt.

There is always a budget constraint for the government. While the scope of raising revenue receipts is limited, there is a demand from the public for an increase in public expenditure. This puts the government in a difficult position and the government usually operates with a deficit budget. Budget deficit is financed usually through public borrowing. The government repays part of the debt every year, but a deficit budget over the years leads to an escalation in public debt.

Deficit budget appears to be a soft option for the government. The government does not want to alienate its voters by increasing taxes. For several years during the 1980s and 1990s fiscal deficit of the Indian government remained very high. In order to bring in transparency in fiscal management, the government came up with the Fiscal Responsibility and Budget Management (FRBM) Act in 2003. The act prescribed that (i) revenue deficit should be eliminated completely, (ii) fiscal deficit should be brought down to 3 per cent of GDP, and (iii) debt-to-GDP ratio should be less than 60 per cent (40 per cent for centre and 20 per cent for states). These targets have not been fulfilled entirely and the targets have been revised over the years. However, the Act has been able to apply brakes on fiscal deficit and public debt in India.

9.4.1 Government Budget Constraint

Let us assume (for simplicity) that taxes (T_t) are the only source of public revenue. Let us assume that government expenditure (net of interest payments) in the current period is G_t. Suppose existing debt of the government is D_{t-1}. If the rate of interest on existing debt of the government is r, then interest payment during the current time period will be rD_{t-1}.

The net change in the stock of public debt in time period (t+1) will be

$$\Delta D_t = (G_t - T_t) + rD_{t-1} \quad ...(9.1)$$

The **government budget constraint** says that the net change in government debt $(D_t - D_{t-1}) = \Delta D_t$ during the year (t) is the sum of *primary deficit* and the interest payments during the year (t).

The debt in time period (t) will be

$$D_t = D_{t-1} + (G_t - T_t) + rD_{t-1} \quad ...(9.2)$$

We can re-arrange terms in (9.2) to obtain

$$D_t = (1 + r)D_t + (G_t - T_t) \quad ...(9.3)$$

Equation (9.3) implies the manner in which public debt will evolve over time. Remember that we add primary deficit, not fiscal deficit to existing debt (D_t). This is due to the fact that total government expenditure, by definition, includes interest payments as well. Recall that fiscal deficit takes into account government expenditure on interest payments also.

9.4.2 Debt Stabilization

As mentioned earlier, government has to pay interest on past debt and repay the principal amount. It is observed that the government does not repay all its debt at any point of time – it repays part of the debt every year. In the process, there is a change in the amount of public debt over the years. There is a regular increase in the GDP of the country, which leads to increase in revenue collection and therefore, the repayment capacity. The growth in public debt and the growth in GDP, however, need to be balanced. Fiscal sustainability suggests that the debt-to-GDP ratio should be at a manageable level and should not increase over time.

Let us define debt-to-GDP ratio as $d_t = \frac{D_t}{Y_t}$.

Let us divide both sides of equation (9.3) by Y_t so that we obtain

$$\frac{D_t}{Y_t} = (1 + r)\frac{D_{t-1}}{Y_t} + \frac{G_t - T_t}{Y_t} \quad ...(9.4)$$

We can rewrite D_{t-1}/Y_t as $(D_t/Y_{t-1})(Y_{t-1}/Y_t)$. In other words, we multiply the numerator and the denominator by Y_{t-1}.

$$\frac{D_t}{Y_t} = (1 + r)\left(\frac{Y_{t-1}}{Y_t}\right)\frac{D_{t-1}}{Y_{t-1}} + \frac{G_t - T_t}{Y_t} \quad ...(9.5)$$

Note that all the terms in equation (9.5) are now in terms of ratios to output, *Y*. To simplify the above equation, we assume that output growth is constant and we denote the growth rate of output by *g*, so Y_{t-1}/Y_t can be written as $1/(1 + g)$.

[Since $1/(1 + g) = \frac{1}{1+\frac{(Y_t - Y_{t-1})}{Y_{t-1}}} = = \frac{1}{\frac{Y_{t-1}+(Y_t - Y_{t-1})}{Y_{t-1}}} = \frac{Y_{t-1}}{Y_t}$]

Thus, equation (9.5) can be written as

$$\frac{D_t}{Y_t} = (1+r)/(1+g)\frac{D_{t-1}}{Y_{t-1}} + \frac{G_t - T_t}{Y_t} \quad ...(9.6)$$

Let us use the approximation $(1+r)/(1+g) = (1+r-g)$.

Thus we can write (9.6) as

$$\frac{D_t}{Y_t} = (1+r-g)\frac{D_{t-1}}{Y_{t-1}} + \frac{G_t - T_t}{Y_t} \quad ...(9.7)$$

Finally, we reorganize equation (9.7) to get

$$\frac{D_t}{Y_t} - \frac{D_{t-1}}{Y_{t-1}} = (r-g)\frac{D_{t-1}}{Y_{t-1}} + \frac{G_t - T_t}{Y_t}$$

$$(d_t - d_{t-1}) = (r-g)\, d_{t-1} + \frac{G_t - T_t}{Y_t} \quad ...(9.8)$$

From equation (9.8) we find that the change in the debt ratio over time (the left side of the equation) is equal to the sum of two terms, viz., (i) the difference between the real interest rate and the growth rate times the initial debt ratio, an (ii) primary deficit as a ratio of GDP. The second term is the ratio of the primary deficit to GDP. From equation (9.8) we find that the increase in the debt-to-GDP ratio will be larger if

(i) the rate of interest is higher,

(ii) growth rate of the economy is lower, and

(iii) the ratio of primary deficit to GDP is higher.

9.4.3 Implications of High Debt GDP Ratio

Suppose that large deficits have led to a high debt-to-GDP ratio. What should the government do then? Simply trying to stabilize the debt at this high level is not adequate. High debt-to-GDP ratio can lead to a situation of 'debt trap' – in order to repay the debt the country borrows further. Such situations make the conduct of fiscal policy extremely difficult.

Let us look at equation (9.8) more closely.

$$\frac{D_t}{Y_t} - \frac{D_{t-1}}{Y_{t-1}} = (r-g)\frac{D_{t-1}}{Y_{t-1}} + \frac{G_t - T_t}{Y_t} \quad ...(9.8)$$

Let us assume that a country has a very high debt-to-GDP ratio, say, 100%. Suppose the real interest rate is 3% and economic growth rate is 2%. Suppose the government is conscious of the difficult fiscal position and it is running a surplus budget with primary surplus of 1% of GDP. If we apply these figures in equation (9.8), The first term on the right hand side of equation (9.8) is (3% – 2%) times 100% = 1% of GDP. Since the government is running a primary surplus of 1% of GDP (i.e., $\frac{G_t - T_t}{Y_t}$ = 1% of GDP), there is stability in the debt-to-GDP ratio.

Let us consider another scenario. Suppose financial investors start to worry that the government may not be able to fully repay the debt. Further borrowing by the government is possible, only if the rate of interest rate is increased.

Any increase in interest rate, however, will make debt stabilisation more difficult. Suppose, for example, that the interest rate increases from 3% to, say, 5%. Then, just to stabilize the debt, the government needs to run a primary surplus of 3% (the right hand side of equation (9.8) is then equal to (5%–2%) × 100% = 3% of GDP.

Suppose the government indeed takes measures to increase the primary surplus to 3 per cent. This necessitates cuts in government expenditure. It may prove politically costly, as it may alienate voters. Further, decrease in government expenditure may lead to further decline in growth rate. Increase in interest rate and decrease in growth rate may require a still higher primary surplus. At some point, the government may be unable to increase the primary surplus further. Such a situation will lead to an increase in debt-to-GDP ratio. The result is a debt explosion. The lesson is clear. When a government inherits a high debt-to-GDP ratio, it should aim at decreasing it over time. Such an objective can be achieved through a combination of primary surplus, high growth rate, and low real interest rate.

Check Your Progress 2

1) Bring out the factors that cause an increase in the debt to GDP ratio.

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2) Explain why debt stabilisation is necessary for a government.

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9.5 RICARDIAN EQUIVALENCE PROPOSITION

A deficit budget allows a government to spend more than its revenue. In the process the government accumulates debt, which has to be repaid later. Such repayment has to be made by imposing higher taxes on individuals. Thus a deficit budget implies a trade-off between present consumption and future consumption on the part of the consumers.

While dealing with the inter-temporal consumption function in Units 5 and 6 we assumed that consumers are rational and forward looking. They take into account the future stream of income while deciding on the amount of current consumption. In this framework, the Keynesian consumption function is not realistic in the sense that there is no simple and stable relationship between current consumption and current income. In this section we will discuss how the budget deficit of the government influences consumption decision of people and aggregate output of the economy.

One extreme view is that neither fiscal deficit nor public debt has an effect on aggregate output. It implies that an increase in government expenditure may not have the desired effect of increase in aggregate demand and consequent increase in aggregate output. In other words, counter-cyclical measures by the government may be ineffective. This argument is known as the *Ricardian Equivalence Proposition*. The new classical economists (to be discussed in Unit 12) question the effectiveness of Keynesian fiscal measures on the ground of Ricardian equivalence. The Ricardian equivalence proposition is mainly associated with Robert Barro (1974).

The *neoclassical economists* criticized Keynesian fiscal policy on the ground that the latter ignored crowding out effect. An expansionary fiscal policy will lead to a rise in the interest rate (see Sub-Section 9.2.3). An increase in interest rate will adversely affect private investment. In an open economy the rise in interest rate will attract inflow of foreign capital which will lead to appreciation of the domestic currency. Such appreciation in value of domestic currency will adversely affect exports, thereby deteriorating the current account situation of the country (see Unit 12 of BECC 106).

New classical economists, led by Robert Barro, criticized Keynesian fiscal policy at another level. In fact, Barro brought forward the point of view put forth by David Ricardo in the early 20th century. Ricardo had argued that financing of government expenditure by taxes or by issuing bonds would have no impact upon aggregate demand if people were forward looking. According to Barro if expectations formation is according to rational expectations, fiscal policy would be ineffective.

Let us take an example. Suppose the country is passing through a recession and the government plans to increase its expenditure; the objective is to increase aggregate demand so that there is an increase in aggregate output. There are two options before the government: (i) increase tax rates so that revenue receipts increase; and (iii) maintain taxes at the existing rate (or, decrease it), but increase government expenditure so that there is a deficit budget. Let us look into the first option. Increase in taxes during recession will lead to reduction in consumption expenditure. Increase in revenue receipts will enable the government to increase public expenditure. The decline in consumption is compensated by increase in government expenditure. On the whole, aggregate demand will remain unchanged. Now let us look into the second option. The deficit budget entails increase in public debt. People are rational enough to expect that they have to pay higher taxes in future as the government starts repayment of the debt. Therefore, people will start saving from the very beginning and this will lead to a decrease in consumption expenditure. Thus, the increase in government expenditure is compensated by reduction consumption expenditure. On the whole, there is no change in aggregate demand. Note that both the policy options (increase in taxes or deficit financing) have equivalent impact on aggregate output.

The term Ricardian equivalence comes up for the above. According to the new classical view, reduction in tax rates does not make us richer.

Does the Ricardian equivalence proposition hold when the economy is passing through a boom period? Let us consider the case when the government resorts to a contractionary fiscal policy (there is a surplus budget; revenue is less than

expenditure). People expect that there would be a reduction in tax rates in future because of the surplus budget. They will not bother about current saving; they will increase consumption expenditure. Thus, in this case also, there would be no change in aggregate demand.

There are certain limitations of the Ricardian equivalence proposition.

Uncertainty: If the consumers expect with certainty that the current tax cut will lead to an increase in future tax, they would save most of the incremental income. Tax cut policies however are not accompanied by an announcement that taxes will be increased in future. There are some elements of uncertainty associated with future policy of the government. The more distant the repayment the repayment schedule of the government appears, the more uncertain is the future date of tax increase. Therefore, it is likely that consumers would ignore the possibility of tax increase in future and they would increase current consumption.

Selfishness: Consumers have a finite life time. They may expect that they will die before the future tax increase, if tax increase is expected to be in distant future. Usually people do not care much about the tax levied on the next generation after their death. In that case the Ricardian equivalence will not work.

Myopia: Ricardian equivalence is based on the assumption that people have complete information and perfect foresight. When the government borrows to pay for its current spending, rational consumers look into the increase in taxes in future. Such behavior on the part of consumers is rare. People suffer from myopia (short-sightedness) and they do not fully understand the mechanism of the government's debt management. Therefore, the current tax cut can make them think that their life time income has increased. Such perception is likely to increase current consumption.

Check Your Progress 3

1. What does Ricardian equaivalence mean?

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2. Explain why tax cuts by a government may not make us richer.

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9.6 LET US SUM UP

Policy makers need to consider several factors while framing fiscal policy. The extent of fiscal deficit is very important in this respect, as it adds to public debt. The debt-to-GDP ratio should not be very high. For stabilisation of public debt, economic growth rate should be greater than the rate of interest.

In this Unit we have explored the views of Keynes and new-classical economists on fiscal policy. Ricardian equivalence proposition suggests that fiscal policy may be ineffective.

9.7 ANSWERS/HINTS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) Government expenditure is an important component of aggregate demand. It can moderate the fluctuations in aggregate demand due to business cycle. See Section 9.2 for details.
2) There are four types of policy lags. Refer to Sub-Section 9.2.2.
3) Income tax collection varies with the changes in the level of economic activity in an economy. Refer to Sub-Section 9.2.3.

Check Your Progress 2

1) Three factors that influence debt-to-GDP ratio are: interest rate, growth rate and the ratio of primary deficit to GDP. For further details see Section 9.4.
2) High debt-to-GDP ratio necessitates larger interest payments. It may require cutting down on public expenditure. See Sub-Section 9.4.3 for details.

Check Your Progress 3

1) Ricardian equivalence proposition suggests that fiscal policy of a government may be ineffective. See Section 9.5 for details.
2) If expectations formation is according to rational expectations, tax cut may not increase consumption expenditure. Households may increase their saving so as pay higher taxes in future.

UNIT 10 MONETARY POLICY*

Structure

10.0 OBJECTIVES

After going through this unit, you will be able to

- discuss the underlying ideas behind the quantity theory of money;
- identify the various tools (or instruments) of conducting monetary policy;
- elucidate the objectives of monetary policy;
- explain why policy rules are better than discretionary policies;
- explain the Taylor rule on determination of interest rate;
- describe the usefulness of quantitative easing;
- identify the limitations of monetary policy.

10.1 INTRODUCTION

In Unit 6 of BECC 103: Introductory Macroeconomics we had a brief introduction to the objectives and instruments of monetary policy. In this context, we discussed about inflation targeting and quantitative easing. In the present Unit, we will recapitulate some of those issues and extend it further towards the policy formulation aspect. Monetary policy refers to the use of a set of

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instruments by the central bank to influence the level of money supply in an economy. There are two types of tools or instruments of monetary policy, viz., (i) quantitative, and (ii) qualitative. Quantitative instruments are also known as general instruments. They relate to the quantity or volume of money supply in the economy. Thus these policy instruments do not discriminate across sectors of the economy or social groups. The important tools in this category are a) interest rate, b) open market operations, c) cash reserve ratio, and d) statutory liquidity ratio. Qualitative instruments are also called selective tools. They are used for discriminating between different uses of credit. The important selective credit control instruments are a) selective credit controls, b) margin requirements, c) credit rationing, d) moral suasion, and e) direct actions. We have elaborated on all these instruments in Unit 6 of BECC 103.

Monetary policy as practiced by countries has evolved over time. These days, the main instrument at the disposal of central banks is the interest rate. You may have seen people in the business as well as bankers waiting for the announcement of monetary policy by the Reserve Bank of India (RBI). In an open economy, the challenges before the central bank are too many. In fact, in the modern era, financial stability has become an important consideration of the central banks.

Till the 1970s, it was believed that the central bank would be able to control the supply of money in the economy. Even then, there were economists who expressed doubts on the ability of the central bank to do so. However, during the period 1986-2006, there was stability in 'economic growth and inflation' in most developed countries. This period is often termed as the 'great moderation' as it was somehow believed that we have mastered the art of controlling the economy. Extreme economic volatility was thought to be a thing of the past, till the world encountered the global financial crisis during 2007-2009. Subsequent to the financial crisis, since 2010, many countries have resorted to 'protectionism', which has influenced globalisation adversely.

The importance of monetary policy worldwide has resulted in heads of the central banks (for example, Governor of RBI in the case of India) receiving importance. Most of the central banks are governed by their legal mandates, not just to control the level of inflation, but also maintain a lower level of unemployment. In fact, in earlier days (up to 1980) most central banks were pursuing multiple objectives including price stability, employment and economic growth. Since the 1980s, however, the focus has been more on inflation targeting.

This focus on inflation targeting to the exclusion of other priorities is usually ascribed to the Federal Reserve System of the United States (US) for its role played in the 1980s. In the aftermath of the oil crisis during the 1970s, United States was witness to an unprecedented inflation of sorts. Paul Volcker, the then President of the Federal Reserve System, administered a large hike in the interest rate. Even though the level of output contracted as a result of the increase in interest rate, the rate of inflation declined. It is in this context that inflation targeting gained acceptability in the policy circles of central banks. Volcker's disinflation strategy of hiking interest rate towards reducing price levels gained wide recognition. Since the 1980s, the focus among central bankers has been more on inflation targeting to the exclusion of the objective of employment

generation. You should note that the increase in interest rate in the United States resulted in a number of Latin American countries (such as Brazil, Argentina and Mexico) defaulting on their international debt obligations. Many Latin American countries had borrowed huge amounts during the 1960s and 1970s for industrialization of their countries. When the rate of interest increased during the 1980s these countries had to pay huge sums to service their debts. Students of economics and history would know that the international debt crisis in the 1980s had a harmful effect on the economic growth in Latin America. This had much to do with the disinflation strategy pursued by the United States and European Countries. In the recent years too, you would have noticed that developing economies witnessed capital flights (outflow of foreign capital) from financial markets in response to increases in interest rate by the developed economies.

10.2 QUANTITY THEORY OF MONEY

The lineage of the quantity theory of money (at times called classical quantity theory of money as it is based on classical assumptions) can be traced to the writings of the Scottish philosopher David Hume. He mentioned about the same in his classic work, Treatise of Human Nature. In his model of 'Price-Specie Flow Mechanism' in 1749, he developed an explanation of the functioning of the Gold Standard. Gold Standard, as you know, was a monetary system in which a country's currency had a fixed value in terms of gold. According to Hume, if a country had a positive balance of trade (means exports is greater than imports), gold would flow into the country. Thus, money supply would increase which would lead to inflation. Similarly, if the country had deficit in balance of trade, gold equivalent to the value of deficit would flow out of the country. If there is no counter measures by the government, money supply will decrease, which in turn will lead to decrease in price level.

Quantity theory of money was put forth in its current version by Irving Fisher in the early twentieth century as an equation of exchange. It is given as $MV = PY$, where M is the money supply, V is velocity of circulation of money, P is price level and Y is the level of output produced in the economy. The classical economists assumed that because of flexibility in prices and wage rate, there is full employment in the economy. Thus, Y is fixed at the full employment level, and V (the number of times a unit of money, say, a currency note, changes hand) is usually constant. Thus, any increase in money supply will increase the price level.

10.2.1 Neutrality of Money

According to the proponents of the classical economics, money is neutral in the sense that it affects monetary variables such as prices, wage rate and exchange rate. It does not affect real variables such as output and employment. Output is not affected by money supply as, by assumption, there is always full employment in the economy. Prices and wage rates are assumed to be flexible.

If supply of labour is more than demand for labour, wage rate will decline. On the other hand, if demand for labour is more than its supply, wage rate will increase. Similarly, prices are determined by the market forces such as supply and demand. Certain studies, based on empirical data, have established that

money is neutral in the long run. Thus, it could be a long run phenomenon. In the short run, however, neutrality of money does not get much support from empirical studies. Thus, in the short run, money may not be neutral.

An increase in money supply leads in the long run to a proportionate increase in the level of prices with no change in the level of allocation of resources or in the value of the output produced. As long as the rise in prices is fully anticipated, an increase in the total amount of money leads to a proportionate increase in all money prices. This would have no effect on any real variable in the long run. For a long period of time, the monetarist policies (inspired by the restatement of the quantity theory of money) continued to be of powerful influence in central banking circles. Milton Friedman once observed that inflation is always and everywhere a monetary phenomenon. In fact, till before the global financial crisis, the focus of the central banks has been to restrict the rate of growth of money supply. As per Friedman's postulate in this regard, money supply should grow only at the same rate of growth of nominal GDP.

In addition to neutrality of money, there is another concept called 'super neutrality of money'. Being a stronger proposition than the neutrality of money, it says that changes in the growth rate of money supply have no effect on real variables. Suppose money supply in a country is increasing at the rate of 3 per cent per annum. Suddenly, the central bank decides to increase it by 5 per cent per annum. Will it have any effect on output growth? Empirical results on this, however, are ambiguous.

10.2.2 Effect of Change in Interest Rate

By taking into account the expectations (see Units 4 and 5 of this course) about inflation rate and growth rate in the economy, the central bank sets the interest rate.

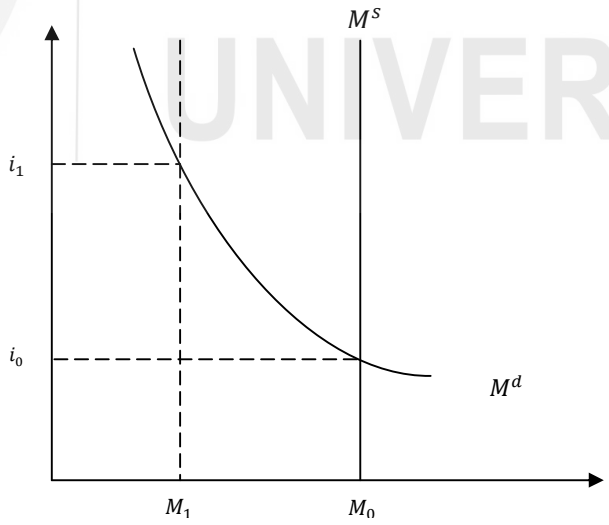

Fig. 10.1: Effect of Rise in Interest Rate

You may recall from the quantity theory of money that 'nominal interest rate = real interest rate + the expected rate of inflation'. Monetary authorities worldwide set the interest rates and let the money stock adjust to the demand. A policy

induced rise in the interest rate, say, from i_0 to i_1, results in the money stock contracting from M_0 to M_1 (see Fig.10.1).

How does this work? The increase in interest rate results in a reduction in investment spending as well as consumption spending. This results in a decrease in the level of income, and hence, there would be reduction of money demand (M^d). The stock of money supply (M^s) would adjust to the new money demand.

10.2.3 Monetary Transmission Mechanism

Let us assume that the central bank increases money supply. This will increase liquidity in the economy and interest rate will decrease. A decrease in interest rate can affect several macroeconomic variables in the economy. These effects are often called 'transmission channels' or 'transmission mechanisms'. Monetary transmission mechanism tells us how the effect of a monetary variable transmits or passes on to other variables. The important channels are as follows:

(i) Credit Channel: A decrease in interest rate will lead to an increase in the demand for credits. Those projects which were considered unviable earlier could now become viable because of the lower cost of capital. Households which did not take a loan from the bank because of higher interest rate may now think of taking a loan. Such actions would put purchasing power in the hands of firms and households. Firms and households would spend this additional money on various goods and services. As a result of the increase in demand, equilibrium output will increase (if the economy is operating below the equilibrium output level). Thus, the classical position that increases in money supply would lead to increases in price level only, may not be true.

(ii) Exchange Rate Channel: Apart from the credit channel, another channel of monetary transmission mechanism is through the 'exchange rate channel'. As interest rate is reduced, there will be outflow of capital – foreign investors will pull out their money to invest in other countries offering higher rate of interest. This will lead to shortage of foreign exchange and the domestic currency will depreciate. Due to the depreciation of the exchange rate, however, there will be an increase in the competitiveness of the exports. Simultaneously, imports will become costlier. The increase in net exports will lead to increase in aggregate demand, which in turn will lead to increase in equilibrium level of output. For this to happen, domestic price levels should not increase with depreciation. However, note that elasticity of demand for exports and imports should be greater than unity. Thus, the exchange rate channel works only if these conditions are fulfilled.

(iii) Cost of Capital: Yet another channel is through the cost of capital. As the interest rates are reduced, the ease of financing the purchase of shares increases. This leads to an increase in the price of shares (i.e., stock prices) of firms. In other words, the market value of the firm increases in comparison to the replacement cost. This encourages firms to expand

further by carrying out new investments. This results in an increase in the level of output. The same also has a spinoff effect in consumption expenditure.

As the value of shares increase, households stand to benefit in the form of increase in the value of the shares they possess. This results in a wealth effect enhancing the level of consumption expenditure.

These are some of the routes of monetary transmission mechanism. These channels, however, do not always work due to several reasons. In particular, when there is a large demand for liquidity in the economy, and the economy is in liquidity trap, monetary policy ceases to be effective. A monetary variable (money supply) affects a real variable (output) but this need not happen always. Even after the interest rate has been reduced, there need not necessarily be an increase in demand for credit from households and firms. For instance, firms may not increase the demand for money if the expectations about future earnings are uncertain. Similarly, households may not require additional money if incomes in the near future are not certain. Further, even when the central bank reduces interest rate, it is not necessary that the same will be passed on to the borrowers by the commercial banks. Commercial banks would be reluctant to do so, particularly when the banks have a large volume of non-performing assets (bad debts).

Check Your Progress 1

1. Outline the concept of neutrality of money.

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2. State the various channels of monetary transmission mechanism.

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10.3 RULES VERSUS DISCRETION

As you are aware, Keynesian economics prescribed an activist role for the government. When the economy is passing through a recession phase, the government should increase public investment. Increase in investment would lead to increase in aggregate demand, which in turn will increase aggregate output. On the other hand, if the economy is over-heated (economy is operating at the full employment level and aggregate demand is still on the increase), the

government should reduce public investment so that aggregate demand is stabilised. Thus, Keynesian economics visualizes that the government can moderate the effect of business cycles. Keynesian economics advises that the government should have a discretionary power so far as government spending is concerned.

Keynesian economics, proposed an activist role of the government. The new-classical economists, however, advocated that government policy should be on the basis of certain rules, and not by the discretion of the policy makers (We will learn about various schools of macroeconomic thought in Units 11 and 12 of this course).

10.3.1 Reputation and Credibility

The government policy should be credible in the sense that the government is committed to its policy measures. The credibility of an announced policy depends on two factors: (i) past experience regarding a government's ability to adhere to commitments, and (ii) expectations of people that the government will adhere to the policy. Investment decisions by firms and saving decisions by households are taken on the basis of credibility. In this context, you can observe that certain governments have built their reputations over the years regarding good governance.

A government optimizes on its objectives. Suppose, the government announces that it will give tax holidays (i.e., no taxes) for five years to certain sector, say, tourism. This will act as an incentive for firms to invest in the tourism sector. After two years, if the government thinks that investments have been made, and now the government can increase tax revenue by imposing taxes on the tourism sector. This leads to loss of credibility.

10.3.2 Monetary Policy Rule

In order to maintain stability in the economy, economists suggest certain 'policy rules'. In simple words, it means that government actions should be according to certain rules. Let us take an example from real life. You might have seen that there are illegal constructions on the fringes of cities.

These houses are constructed in clandestine manner. These house owners subsequently plead before the government to legalise these constructions. Before elections, political parties compete with one another to promise that if they come to power, they will regularize these illegal constructions. Similarly, political parties often promise to waive agricultural loans after coming to power. Such promises work as incentives for people to go for houses in illegal colonies. Similarly, people take agricultural loans and do not repay with a hope that the government will waive it. Suppose there is a law of the land that under no

circumstances, illegal construction will be regularized or loan will be waived. Such rules will work as disincentives for people against such behaviour.

Let us take an example from economics. Under an agreement between the central government and RBI, the RBI will have to maintain inflation rate in India at 4 per cent per annum, with an allowable range of 2 per cent to 6 per cent. Thus, RBI will take such measures that inflation rate does not go beyond the 2 per cent to 6 per cent range.

Thus 'monetary policy rule' can be seen as a reaction function of the government. It is a mathematical function that describes how the central bank decides interest rate in response to certain macroeconomic variables. As you know, higher interest rate discourages investment; thus slows down economic growth. If inflation rate is high, interest rate should be high. If actual growth rate is higher than potential growth rate, interest rate should high. We will discuss the Taylor rule, which is a specific case of monetary policy rule, later in this Unit.

Check Your Progress 2

1. Elaborate on the need for policy rules.

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2. What is the importance of credibility and reputation for an economy?

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10.4 LOSS FUNCTION

The main objective of monetary policy is inflation targeting but control of inflation should not be at the cost of economic growth and employment. You are aware of the concept of 'natural rate of unemployment'. It says that a small fraction of the labour force is usually unemployed as they are in the process of changing job. The potential output of a country takes into consideration such natural rate of unemployment.

Let us assume that y_e and π^T are output at natural rate of unemployment and targeted rate of inflation respectively. We assume that the economic welfare of the country is the maximum when the economy is operating at y_e and π^T. It implies that the economy is at a 'point of bliss' when it achieves (y_e, π^T) and any

deviation from the same would reduce welfare. Suppose actual output and inflation are y and π respectively. Thus, if targeted inflation is 4 per cent and actual inflation is 2 per cent the deviation is $(\pi - \pi^T) = (2 - 4) = -2$ per cent. There is a loss of welfare if inflation is higher than 4 per cent or lower than 4 per cent. Thus, the central bank would like to minimize the function $(\pi - \pi^T)^2$. Similarly, the central bank would like to avoid deviation in actual output (y) from potential output (y_e). Thus it will minimize the function $(y - y_e)^2$.

If we combine both the terms, we obtain a *loss function* of the central bank, given by

$$L = (y - y_e)^2 + (\pi - \pi^T)^2 \quad \ldots(10.1)$$

The central bank would minimize the loss in welfare by minimizing equation (10.1) arising out of deviations in actual output and actual inflation from respective targets. In equation (10.1) we give equal emphasis on output gap $(y - y_e)$ and deviation in inflation $(\pi - \pi^T)$. Many a times, a central bank gives unequal weightage to output (which represents employment) and inflation. For that purpose we re-formulate (10.1) as

$$L = (y - y_e)^2 + \beta(\pi - \pi^T)^2 \quad \ldots(10.2)$$

In (10.2), if $\beta = 1$, we have a situation same as (10.1). If $\beta > 1$, the central bank puts more emphasis on maintaining inflation target (i.e. it perceives a greater loss if inflation deviates from its target). Such an approach is considered as 'inflation-averse'. On the other hand, if $\beta < 1$, the central bank perceives that there is greater loss of welfare if people remain unemployed. This type of a position by the central bank is termed as 'unemployment-averse'.

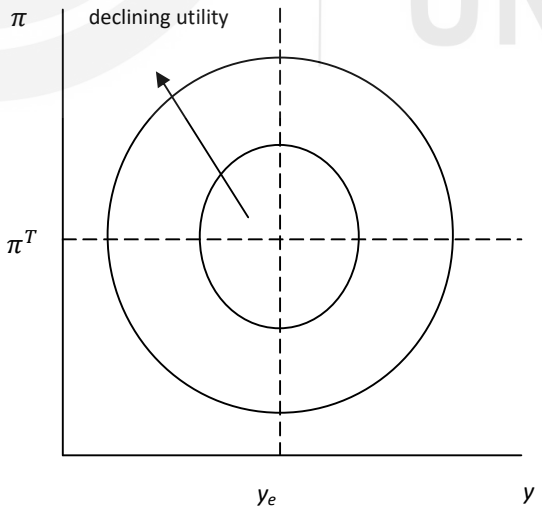

Fig. 10.2: Balanced Approach (β = 1)

We depict the loss function diagrammatically through the 'loss circles'. These circles are quite similar to the indifference curve you have studied in microeconomics.

Let us take output on the x-axis and inflation on the y-axis (see Fig. 10.2). The bliss point is given by the inter-section of the lines representing the point (y_e, π^T).

Let us consider the first quadrant of Fig. 10.2 (top right segment of the diagram) where we consider position deviations in output and employment ($y > y_e$; $\pi > \pi^T$). If the economy deviates from the bliss point, there is a loss of welfare. If the approach of the central bank is balanced (i.e., $\beta = 1$) there is equal emphasis on unemployment and inflation. An implication of the above is that an 1 per cent deviation in actual output from potential output means the same amount of welfare loss as 1 per cent deviation in actual inflation from target inflation. Both the evils can be represented by an indifference curve (concave to the origin), indicating various combinations of inflation deviation and output gap. In the second quadrant, we consider the situation where actual output is less than potential output ($y < y_e$) and actual inflation is more than target inflation ($\pi > \pi^T$). Since this also involves a loss of economic welfare for the country, we represent it by an indifference curve. You can develop a similar logic and find that the indifference curve in this case is actually a circle! We call it the 'loss circle'. Following the manner in which we have drawn a loss circle for 1 per cent deviation in both output and inflation, we can draw another loss circle for 2 per cent deviation. Thus, we can draw a series of concentric loss circles, with (y_e, π^T) at the centre. It looks like a bull's-eye; the objective of the central bank is to hit the bull's-eye; and deviation away from the bull's-eye implies declining utility for the economy.

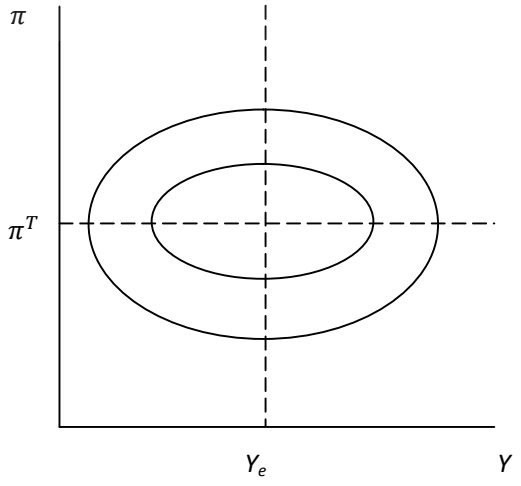

Fig. 10.3: Inflation-Averse (β >1)

The shape of the loss circles would depend on the approach of the central bank towards inflation and unemployment. In Fig. 10.2 we have depicted perfect circles because the central bank is equally concerned about deviation from output and inflation ($\beta = 1$).

In case the central bank is inflation-averse (i.e., perceives inflation to be a greater concern than unemployment), then it would require smaller deviation in inflation than in unemployment for certain loss of welfare. In this case, the loss circles would be like ellipsoid (as shown in Fig. 10.3). Here the central bank would trade off a small rise in inflation with large fall in unemployment.

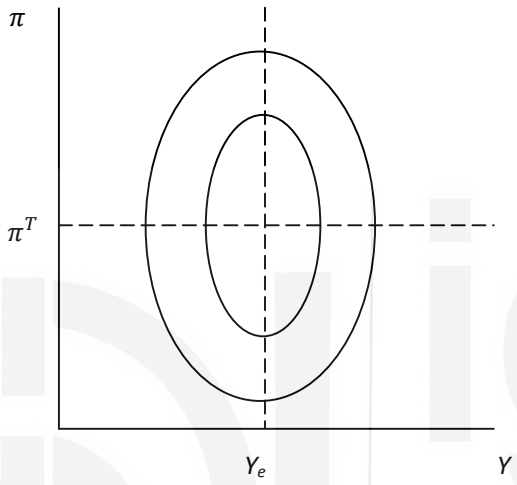

Fig. 10.4: Unemployment-Averse (β <1)

In case the central bank is unemployment-averse (i.e., perceives unemployment to be a greater concern than inflation), then it would trade off a small decline in unemployment for a large rise in inflation. In this case, the loss circles would be like ellipsoid as in Fig. 10.4.

10.4.1 Taylor Rule

Taylor rule of interest rate setting sets the inflation rate at a higher level compared to the benchmark interest rate. This is in case inflation is expected to be higher than the targeted inflation rate and output is expected to be higher than the output at the natural rate of employment.

On the other hand, in case, inflation is lower than the targeted level of inflation or output is lower than at the natural rate of employment, the level of interest rate is set at a lower level compared to the benchmark interest rate.

The guiding principle of interest rate determination among central bankers worldwide has been the Taylor rule. In simple terms, it recommends changes in interest rates from its benchmark rate on the basis of the deviation from the natural rate of employment and targeted rate of inflation. As inflation exceeds targeted rate of inflation, the interest rate is increased. Likewise, if output is above the full employment level, the level of interest rate is increased. The

interest rate is decreased if inflation is lower than the targeted level of inflation, or output is lower than the targeted level of output. Therefore, there are no limits to using interest rates for controlling inflation and output, in general, but it is different during periods of deflation and unemployment. In fact, in the aftermath of the global financial crisis, as per the Taylor equation, the rates of interest had to be reduced to negative nominal rates, which was unsustainable.

We can write the Taylor rule of interest rate setting it as

$$i_t = i' + \gamma_1(\pi - \pi^T) + \gamma_2(y - y_e) \quad \ldots(10.3)$$

where

i_t is operating target interest rate (the rate decided) for short-term;

i' is existing interest rate (benchmark interest rate);

$(\pi - \pi^T)$ is the gap of inflation from the inflation target;

$(y - y_e)$ is the output gap ; and

γ_1 and γ_2 are parameters of the model representing the weights assigned to unemployment and inflation.

If there is a positive output gap (actual output is more than full capacity output) in the economy, the central bank should raise interest rate according to equation (10.3). On the other hand, if output gap is negative (actual output is less than full capacity output), there is spare capacity in the economy and interest rate should be reduced. If actual inflation rate (π) is higher than target inflation rate (π^*), the central bank should raise interest rate. On the other hand, if actual inflation rate is lower than target inflation rate, the central bank would decrease interest rate.

Suppose, for an economy the following information is given:

$\gamma_1 = 0.5, \gamma_2 = 0.5,\ \pi^T = 0.04$, and $i' = 0.02$

The Taylor rule will become

$$r = 0.02 + 0.5(\pi - 0.04) + 0.5(y - y_e) \quad \ldots(10.4)$$

By applying equation (10.4), the central bank can determine interest rate.

10.5 QUANTITATIVE EASING

When the rates of interest are very close to zero, the economy enters the liquidity trap region where monetary policy is completely ineffective. People are willing to hold whatever amount of money is supplied to them. In such a scenario, a different strategy has to be adopted by the central bank to boost economic activity. Money is directly pumped into the financial system through a process known as 'quantitative easing', which is also known as *asset purchase scheme*. The central bank starts purchasing asset-backed securities.

Quantitative easing is incorrectly referred to as money printing since no hard cash is actually printed. Instead of printing money, the central bank creates electronic or digital money which is used for purchase of bonds. The central bank issues credit to the central bank's reserves to buy bonds. As a result, commercial banks get more than what they require as reserves. Commercial banks make a profit by lending out the excess reserves.

With quantitative easing, there is an increase in demand for bonds or safe assets. The market price of these bonds increases. Banks and financial institutions have more funds resulting in increased lending, higher business investment, and a boost to economic activity. When the economy recovers, the central bank sells these assets and sterilizes the cash it receives from the sales. So there is no additional money remaining in the system.

Hence, the goal of quantitative easing is to inject liquidity into the banking system, so that banks are able to lend money to boost economic activity. It is a deliberate expansion of the central bank's balance sheet and the economy's monetary base. However, there is a danger of increased inflation through this process.

You may be aware of the global financial crisis of 2007-08. During that time, a cut in interest rates was implemented by many central banks such as Federal Reserve, European Central Bank, Bank of Japan and Bank of England. Such measures were coupled with practices of unconventional monetary policies, i.e., purchases of bonds. In the aftermath of the global financial crisis, there has been large scale purchase of assets on the part of central banks worldwide.

10.6 LIMITS TO MONETARY POLICY

As per the Taylor rule of setting interest rates, in case the economy is on an inflationary mode or if the level of output exceeds the potential output, the interest rate should be increased from the benchmark interest rate. But, when it comes to level of inflation lower than the target rate of inflation, or levels of output lower than the potential output, the central bank has to reduce the interest rate in comparison to the benchmark rate. Interest rate setting is not that simple at times.

This is because interest rate in developed economies is much lower than that in developing economies. As per the Taylor rule of interest rate setting, the central bank may not be in a position to decrease the benchmark rate further if it is close to zero or in the negative zone. In Japan, for example, interest rate has been in the negative zone since 2016 (current rate on interest, as of May 2021, in Japan is (–) 0.10 per cent per annum). After the global financial crisis of 2007-2009, many countries went through such situations of zero interest rate. This suggests that there are limits to monetary policy but expansionary stimulus (through fiscal spending and unconventional purchases of bonds), i.e., quantitative easing can help in such situations.

Check Your Progress 2

1. Explain the concept of loss function.

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2. Describe the loss function for an inflation-averse economy through diagrams.

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3. State the Taylor rule for determination of the interest rate in an economy.

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10.7 LET US SUM UP

In this unit we discussed the quantity theory of money. In this context we dealt with the concept of neutrality of money in the short run and the long run. The unit has briefly discussed the Taylor rule which describes how, for each one-percent increase in inflation, the central bank tends to raise the nominal interest rate to stabilize the economy. In a liquidity trap like situation, monetary policy instruments may not work. The central bank can adopt quantitative easing which injects liquidity into the banking system lowering the lending rates of banks.

10.10 ANSWER/ HINTS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) The quantity theory of money states that there is a direct relationship between the quantity of money in an economy and the level of prices. Thus money should be neutral. However, money is not neutral in the short run. See Section 10.2 for details.

2) It is the link between monetary policy and aggregate demand. There are various channels of transmission mechanism. See Section 10.2 for details.

Check Your Progress 2

1) See Section 10.3 for details.

2) Refer to Section 10.3.1 and answer.

Check Your Progress 3

1) Refer to equation (10.1) and explain.

2) Refer to Fig. 10.3 and explain.

3) Refer to equation (10.3) and explain.

UNIT 11 EVOLUTION OF MACROECONOMIC THOUGHT- I*

Structure

11.0 OBJECTIVES

After going through this unit you should be in a position to

- explain the salient features of various schools of macroeconomic thought;
- locate the context for various concepts which you have learned through the previous units on macroeconomics;
- recapitulate the Classical and Keynesian theories; and
- appreciate how empirical evidences on macroeconomic variables lead to development of new theories.

11.1 INTRODUCTION

By now you must have perceived that macroeconomic theory has evolved over time in response to changes in macroeconomic environment. Initially, during the nineteenth and early twentieth century, there was almost a consensus among economists that an economy could run smoothly without much fluctuation in

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income, output and employment. This called for minimum government intervention in economic variables such as price, wage and interest rate.

It was suggested that determination of the level of these variables should be left to the market forces (such as supply and demand). These classical ideas were based on flexibility of prices and wages. Occurrence of the Great Depression (1929-1933), which witnessed a massive decline in income, output, employment and price level during the 1930s, led to the search for new explanations of the contemporary events. John Maynard Keynes, in sharp contrast to prevailing ideas, put forth the logic that prices and wages are not flexible; rather they are sticky. He prescribed that government should actively intervene in the market to counter the recessionary condition. His prescription was so radical from conventional thinking, and was so convincing, that it was termed as 'Keynesian Revolution'.

Among economists there is no agreement on how adjustments in prices, wages, output, etc. take place in an economy. During the 1970s there were certain economic developments in major countries of the world (rising prices, falling employment, ineffectiveness of Keynesian prescription) led to exploration of fresh ideas on how an economy works. Robert E. Lucas revived the classical ideas that there should not be government interventions in the market as they are ineffective. The logic was so convincing that many people term it to be counter-revolution to Keynesian ideas.

There are also differences in views on the sources of economic fluctuations (business cycles). Basically there are two important schools of thought: Classical and Keynesian. The term 'classical' was coined by John Maynard Keynes to reflect the ideas presented by economists prior to him. Prominent among classical economists are Adam Smith, David Ricardo, Thomas Malthus and John Stuart Mill. The classical and Keynesian economists differ on many issues such as: i) the relative roles played by supply and demand in determination of output, employment and prices, ii) the flexibility of prices and wage rate in the economy, and iii) the dichotomy between real sector and monetary sector. The mainstay of classical economics has been the basic assumption that 'supply creates its own demand'; often referred to as 'Say's law', named after J. B. Say. The Keynesian economists rule out such a possibility, particularly during periods of recession.

11.2 VARIOUS SCHOOLS OF MACROECONOMIC THOUGHT

Schools of macroeconomic thought are closely associated with the economic history of the world. As mentioned in the previous section, Keynesian theory came into existence as a response to the Great Depression. Further developments in the world economy led newer ideas and newer schools of thought. In fact, macroeconomics as a specialised branch of economics did not exist prior to

Keynesian economics. The classical economists explained macroeconomic phenomena through microeconomic tools of analysis. As we will see later, revival of classical economics, in the form of new-classical economics, emphasised on micro-foundations of economics. As you know, Keynesian economics ignored 'micro-foundations of macroeconomics'.

11.2.1 Economic Theory

Let us begin with the concept 'theory'. Theories are developed to understand, explain and predict certain 'phenomenon'. As you know, phenomenon means certain observable event. In microeconomics, you have theory of firm and theory of consumer behaviour. Theory of firm helps you in explaining how a firm will behave, if some economic variables (such as output price, wage rate or market structure) change. Similarly, theory of consumer behaviour helps you in explaining the behaviour of households (household decisions such as what commodity to buy, how much quantity to buy, how to maximise utility, etc.). It helps us in predicting the nature of changes a household will undertake; when there are changes in output price and household income level.

In macroeconomics we develop theories to understand, explain and predict macroeconomic phenomenon. Let us take a concrete example. Suppose, there is an oil crisis (that is, there is a sudden and unexpected rise in crude oil prices). The world economy will react to it in certain ways. The oil-exporting countries will have increased inflow of income. On the other hand, petroleum-importing countries will experience a rise in their cost of production. Macroeconomic theory should enable us to explain the situation and suggest policy measures to be undertaken by governments.

Thus economic theory is a set of explanations to economic events that have changed our understanding of issues and thinking process. If we look at the history of economic thought, we can see that economic theories have been a reflection of social, historical and political developments. The development of new ideas and the abandonment of old has often been in response to major economic phenomena.

Often we come across another concept: hypothesis. A 'hypothesis' is a tentative statement based on logic and rationality. When a hypothesis is tested repeated number of times, and gets confirmed, it becomes a theory. It does not mean that a theory cannot be proved to be wrong. There are several instances in economic history, when new a new theory has overturned an existing theory. As you will see in this Unit, Keynesian ideas led to the fall down of classical theory during 1930s. The world economic developments during 1970s led to the revival of classical theory in the form of 'new-classical theory'. During the 1980s, the Keynesian economists compensated for some of the shortcomings of Keynesian

theory, as pointed out by new-classical economists. As a result, a new school of thought, 'new-Keynesian economics' was born.

11.2.2 Important Schools of Macroeconomic Thought

Some of the earliest ideas in macroeconomics, known today as **classical theory** emerged in the 18th and 19th centuries with the dominance of a new economic and social system called capitalism. The classical theorists attempted to understand and explain the enormous increase in the wealth of the societies witnessed at that time.

The ideas of these economists dominated till the Great Depression of the 1930s. These economists argued that economies possess strong self-correcting properties on account of flexible prices. These ensure that there is no deficiency of aggregate demand and the economy produces at its full employment level. Over time, some of the ideas of old classical economics were refined and modern, 'scientific' **neoclassical theory** evolved with a foundation in utility theory and emphasis on marginalism. Mathematical rigour became the natural form of expression. With Alfred Marshall, theory of firm, symmetric to the theory of consumer, evolved. Neoclassical theory is the basis of contemporary microeconomic theory but the automatic, self-adjusting nature of the market based on flexible prices, reiterated the conclusion that the economy would produce at the full employment level of employment and output. The belief in the automatic, self-adjusting nature of the market also implied that government intervention in the market be minimal and limited to enforcing contracts between the economic agents.

The Great Depression of the 1930s belied the faith in self-adjustment of markets. A worldwide phenomenon, Great Depression affected all the major capitalist countries. More than one fourth of the labour force became unemployed. Depressions could not be explained by classical/ neo-classical theory. It was in this context that John Maynard Keynes came up with the theory known today as **Keynesian theory**. According to this theory, unemployment was the result of deficiency in aggregate demand which in turn was the consequence of inadequate investment. Keynesian theory advocated government policy in order to stimulate demand and thereby increase employment.

After this, there was an attempt to integrate the two sets of ideas in what is called the '**neoclassical synthesis**'. Subsequently, especially after 1970s, there was a spread of **Monetarism, New Classical** and **New Keynesian models.** However, these, along with more contemporary economic theories will be discussed in the next unit.

Simultaneously with the development of mainstream economic theories as outlined above, there was also an evolution of **Institutionalist Economics** on one hand and **Marxist economics** on the other. These traditions rejected the mainstream theory almost entirely. These ideas evolved in the period after the

Second World War, independently from neoclassical or/ and Keynesian economics. During the 1950s some economists (Harrod, Domar, Kaldor) extended Keynesian from short-run to long-run. In the long-run, because of large-scale investments, there is an increase in production capacity. This leads to economic growth. These economists are known as **Post-Keynesians** and their central concern has been economic growth. We conclude this section by saying that the neoclassical growth model of Solow was in response to Post-Keynesian economics.

11.3 CLASSICAL THEORY

The usage of the term *classical theory* is attributed to John Maynard Keynes, who used it to refer to all economists who wrote prior to 1930s. Yet another categorisation distinguishes between two periods: (i) *classical period* which refers to work of Adam Smith, David Ricardo, John Stuart Mill, J. B. Say and others (18^{th} and 19^{th} centuries), and (ii) *neoclassical period* dominated by Alfred Marshall, A. C. Pigou and others (20^{th} century).

Classical economics emerged as a critique of the ideas of 'mercantilism'. Mercantilists believed that wealth of nations depended on the amount of bullion (gold and silver) with it. They pursued policies of maximisation of exports and minimisation of imports through imposition of tariffs and subsidies. It promoted imperialism in the world. Classical economists emphasised that 'wealth of nations' depended on real factors and money was considered merely as a medium of exchange. You should note that Adam Smith's book is called *Wealth of Nations* (1776).

The classical economists assumed that wages and prices are fully flexible which results in full employment level of output. Also, aggregate production would generate sufficient aggregate demand and thereby Say's Law is satisfied. According to J. B. Say, 'supply creates its own demand'. In this theory, level of aggregate output is constant at the full employment level; money supply determines only the price level. Classical economists stressed upon the self-adjusting tendencies of the economy. Since the economy returns to its full employment output level automatically, the classical economists disliked government intervention in economic policies. The basic tenets of classical theory can be understood with the help of production function, labour market and capital market. The 'quantity theory of money' explains the determination of price level.

11.3.1 Output and Employment

In Unit 9 of BECC 103, we have discussed classical theory in details; here we recapitulate some of that briefly. The classical economists assume that firms and workers (i) are optimisers, (ii) have perfect knowledge, and (iii) operate under

perfectly competitive conditions. Wages and prices are completely flexible. For profit maximising firms, demand for labour is given by equating the product price to the ratio of Wages to Marginal Product of Labour. Price (P) is equal to its marginal revenue (MR) received from sale of one unit of output and W/MPN is the marginal cost of producing an additional unit of output. The labour demand curve in terms of real wage (W/P) is nothing but the Marginal Product of Labour (MPN). This gives a negatively sloping demand curve for labour.

$$N_d = f(W/P) \quad \ldots (11.1)$$

Supply of labour is based on the assumption of utility maximising individual labourers and depends positively on real wage (W/P).

$$N_s = g(W/P) \quad \ldots (11.2)$$

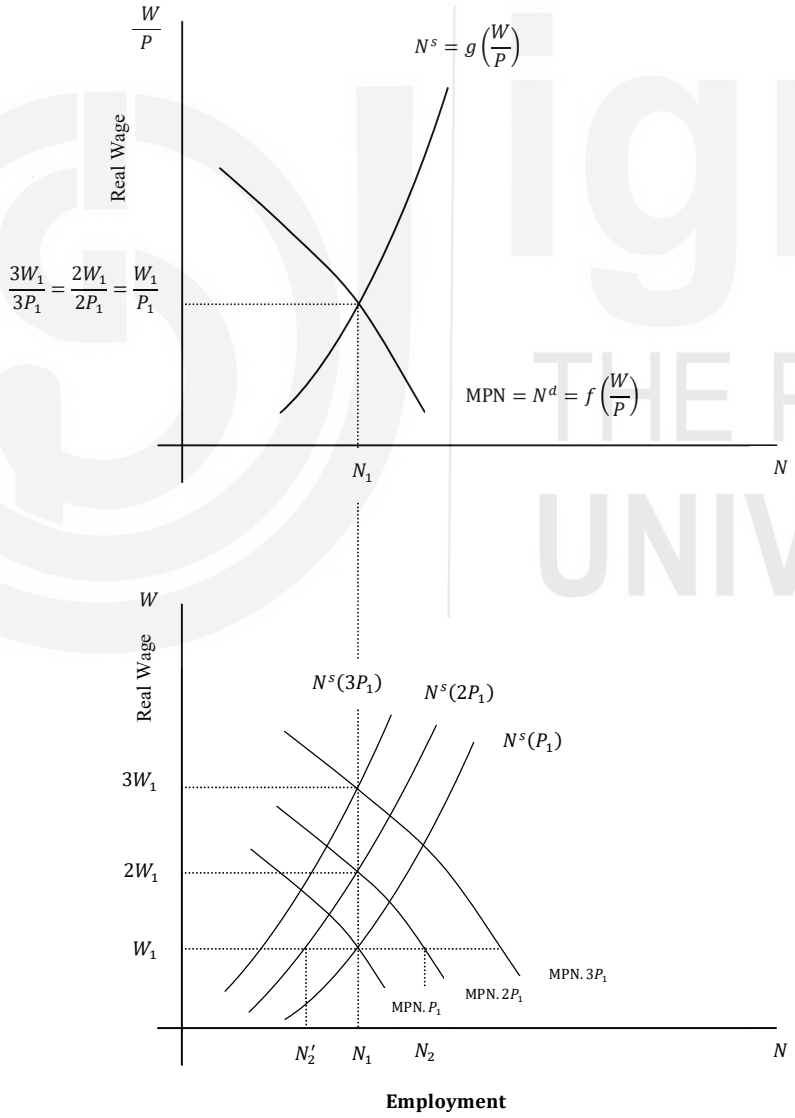

Fig. 11.1: Labour Supply and Demand Functions

Given the assumption of full flexibility of wages and prices, the labour market is in equilibrium at full employment of labour. Labour market clears (i.e., supply of labour is equal to demand for labour) and there is no 'involuntary unemployment' (See Fig. 11.1).

In the upper panel of Fig. 11.1 we present labour supply and labour demand as functions of real wage $\left(\frac{W}{P}\right)$. In the lower panel of Fig. 11.1, we present labour supply and labour demand as functions of money wage. AS price level increases from P_1 to P_2 and then to P_3, real wage can be maintained at the same level if nominal wage increase to 2W and 3W respectively. If there is an in output prices, but no increase in wage rate, labour supply will decrease.

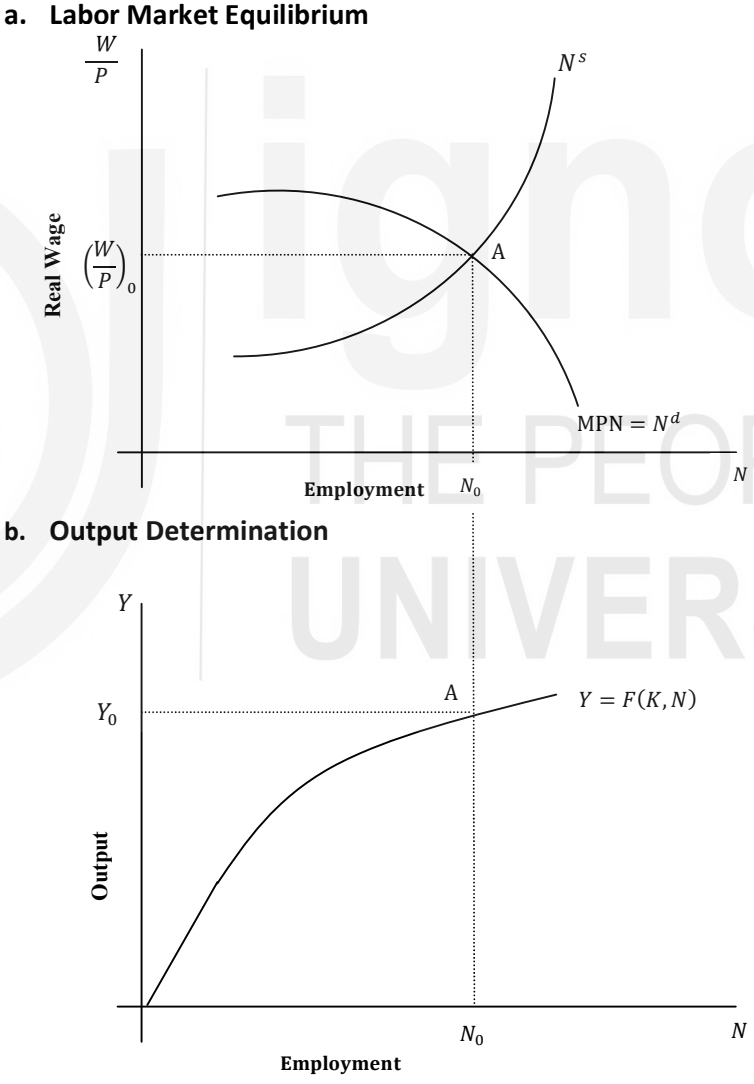

Fig. 11.2: Equilibrium Output and Employment

The full employment of labour translates into full employment level of output given some production function such as $Y = (\overline{K}, N)$. This gives a perfectly inelastic Aggregate Supply (AS) curve at full employment level of output.

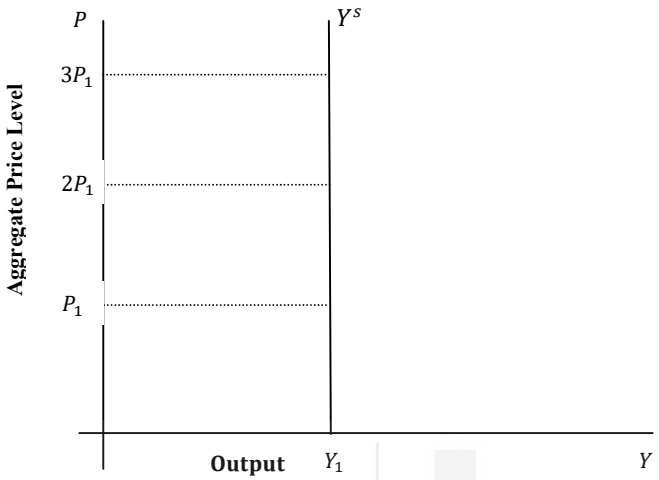

Fig. 11.3: Classical Aggregate Supply Curve

11.3.2 Quantity Theory of Money and Price Level

Classical theorists believed that money is demanded for its function as a medium of exchange. Thus total stock of money in the economy (Money Supply times the Velocity of circulation) equals the nominal value of transactions or the nominal value of income or output in the economy.

$$MV \equiv PY \qquad \ldots(11.3)$$

It follows from (11.3) that if velocity of circulation is predetermined ($V = \bar{V}$) and output level is fixed at the full employment level of output ($Y = \bar{Y}$), then the Price level (P) is proportional to the exogenously given money supply.

$$P = (\bar{V}/\bar{Y}) \times M \qquad \ldots(11.4)$$

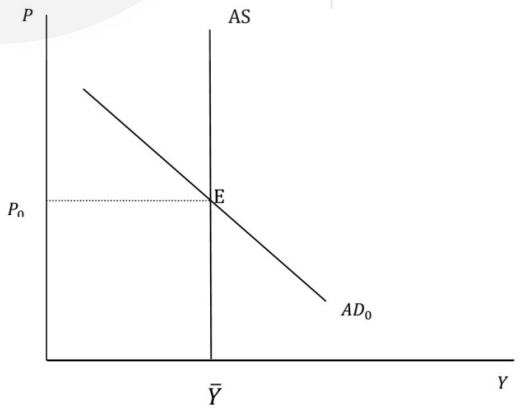

Fig. 11.4: Equilibrium Output and Prices

Thus, the labour market and production function determines the output level while money supply determines the price level in the classical scheme of things.

Quantity theory of money equation also gives the Aggregate Demand Curve (see Fig. 11.4).

11.3.3 Say's Law

Classical economists assumed that saving (that is, the supply of loanable funds) depends positively on the rate of interest. On the other hand, investment (that is, the demand for loanable funds) depends inversely on rate of interest. Full flexibility of the rate of interest ensures that loanable funds market (that is, the capital market) always clears so that saving equals investment (or saving equals investment plus government deficit) (see Fig. 11.5).

Thus, changes in the rate of interest ensure that changes in the composition of aggregate demand do not affect aggregate demand. Aggregate demand would always equal the aggregate level of production and output.

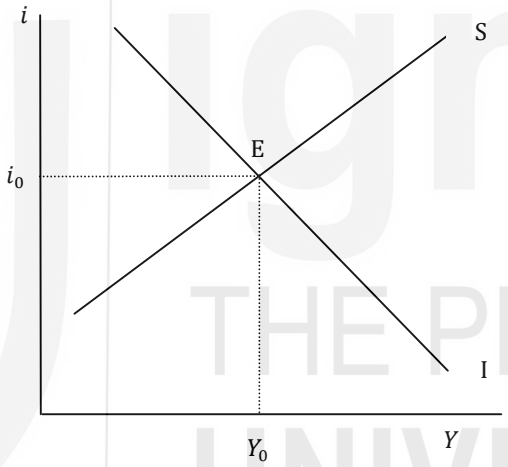

Fig. 11.5: Equilibrium in the Capital Market

11.3.4 Policy Prescriptions

Flexibility of prices results in self-adjustment of markets in the economy. Flexibility of money wages and flexibility of interest rates ensure that changes in aggregate demand do not impact output. The supply side (population, technology, capital formation) determines real output and employment. Money supply determines only the nominal variables such as prices. This leads to a dichotomy between the real and the nominal parts of the economy, referred to as the *classical dichotomy*. This also results in 'neutrality of money' whereby money does not impact any real variable. According to classical economists, government should not intervene in the economy as it has a tendency to operate at the full employment output level.

Check Your Progress 1

1) Explain why the classical economists ruled out the possibility of deficiency of demand.

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2) How does a decrease in the demand for money affects the levels of output and prices in the classical theory?

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3) In the classical model, explain the impact of expansionary fiscal policy (use appropriate diagram to illustrate your answer).

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11.4 KEYNESIAN THEORY

Classical Theory, with its belief in the self-adjusting markets could not explain the Great Depression which hit most of the developed economies in the 1930s. In fact, the capitalist world saw many crises even in the 19th century but the situation grew worse in the 20th century, culminating in the Great Depression of the 1930s. Stock markets crashed, thousands of banks failed, businessmen cut back investment and production, and millions of workers became unemployed. The entire world was witnessing one of the worst economic calamities.

It is in this context that John Maynard Keynes wrote *The General Theory of Employment, Interest and Money* which became the basis for Keynesian economics. According to Keynes, high unemployment was a result of low *aggregate demand* which in turn was a consequence of low investment. Further, Keynes believed that nominal wages would not be completely flexible (i.e., it would be rigid). As a result, full employment would not be ensured in the economy. It implies that *aggregate supply* will not be at the full employment level always. When we place aggregate supply (AS) and aggregate demand (AD) together, we obtain the equilibrium level of output and prices.

11.4.1 Aggregate Demand

In Keynesian theory, goods and the money markets are interlinked. In the goods market, consumption (and saving) is predominantly determined by current disposable income. This is the first major departure from the classical theory where saving (and therefore consumption) was a function of rate of interest. Keynesian consumption function can be shown as in equation (4.5) where c is the marginal propensity to consume (MPC), Y_d is the current disposable income.

$C = \overline{C} + cY_d$ where $c \leq 1$ …(11.5)

Investment is a negative function of rate of interest but the investment function depends on profitability of investment or what Keynes called the 'animal spirits'. Keynes believed that investment was a highly variable component of aggregate demand.

Investment is given by $I = \overline{I} - bi$ …(11.6)

Taking Government spending (G) as exogenously given and net exports denoted by NX, the equilibrium in the **goods market** can be shown by the following equations:

$Y = C + I + G$ and $Y = C + I + G + NX$ for closed and open economies respectively. …(11.7)

Another major departure from classical theory is the determination of the rate of interest. According to Keynes, rate of interest is determined in the **money market,** by the demand for money and supply of money. The supply of money is given by the monetary authorities and can be regarded as exogenously given. The demand for money is governed by three motives: (i) transactions, (ii) precautionary, and (iii) speculative. As in earlier theories of money demand, transaction demand and precautionary demand for money depend positively on the real volume of transactions or the level of real income.

Keynes' contribution lay in theorising about the speculative motive for holding money, which makes money demand depend on expectations about future interest rate. A very high interest rate (higher than normal) results in very few people holding money for speculative purposes. A low interest rate (lower than normal), however, leads to expectations that the interest rate will rise. Thus, it leads to an increase in the demand for money. This gives a money demand function which is inversely related to rate of interest. Keynes talked about the possible existence of *liquidity trap* at very low rates of interest.

Money demand can be expressed as $L = kY - hi$ and the equilibrium in the money market is at that rate of interest where money demand (in real terms) equals real money supply.

$\overline{M} / P = kY - hi$ …(11.8)

Thus, in Keynesian scheme of things, the equilibrium values of interest rate and income has to be determined simultaneously since the goods and the money markets are interlinked.

11.4.2 The IS-LM Framework

The IS-LM model given by Hicks and Hansen is a common macroeconomic tool often used to show the simultaneous equilibriums in the goods and the money markets. The IS-LM model helps us in derivation of the Keynesian demand curve.

The IS curve shows the combination of rate of interest (*i*) and income (Y) at which goods market is in equilibrium (see, Fig. 11.6). The LM curve shows the combination of *i* and Y at which money market is in equilibrium (See, Fig. 11.7). The intersection of the two curves gives the equilibrium levels of *i* and Y in the economy.

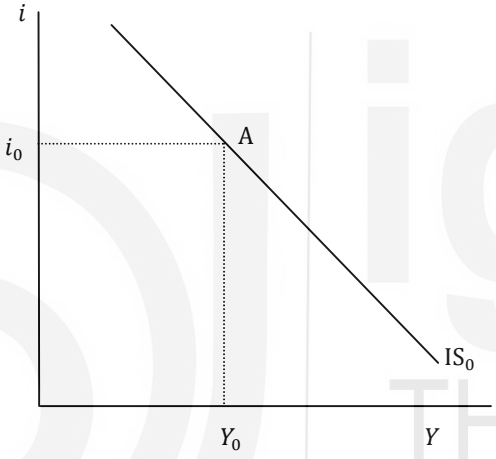

Fig.: 11.6: IS Curve

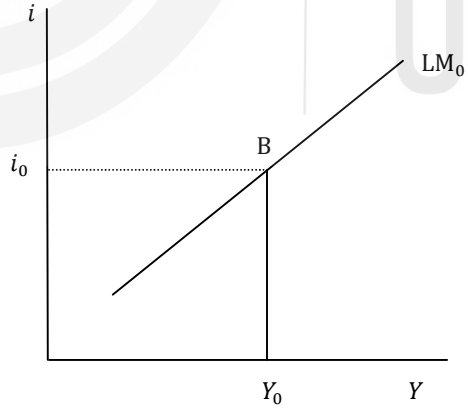

Fig. 11.7: LM Curve

The equation for the IS curve is:

$$Y = \alpha A - \alpha b i \quad \ldots(11.9)$$

where, $\alpha = \frac{1}{1-c}$ (also known as the autonomous spending multiplier); $A = \overline{C} + \overline{I}$ (autonomous spending in a model of closed economy and no government); b is

the responsiveness of Investment spending to the rate of interest and i is the rate of interest.

Equation (11.8) given earlier is the equation of the LM curve:

$$\overline{M} / P = kY - hi$$

In the above equation, the real money supply is given on the LHS and the money demand (in real terms) is on the RHS. The responsiveness of money demand to income is given by parameter k and the responsiveness of money demand to rate of interest is given by parameter h. A situation of liquidity trap makes money demand infinitely elastic to rate of interest. The corresponding LM curve becomes flat at that rate of interest (see Fig. 11.8).

Fig. 11.8: LM Curve under Liquidity Trap

Recall that in the classical model, equilibrium output in the economy is always at the full employment level. If there is any deviation from this equilibrium, there is instantaneous adjustment through flexible prices and wage rate. In the Keynesian model, equilibrium in the economy could be at any level of output. Thus there could be equilibrium in the economy while there is large scale unemployment. Thus, the equilibrium rate of interest may be such that the corresponding output level is not at the full employment level. Thus full employment is not guaranteed under Keynesian theory.

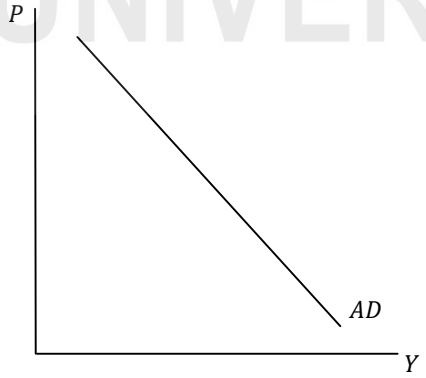

Fig. 11.9: Aggregate Demand Curve in Keynesian Model

Aggregate Demand (AD) curve is given by the simultaneous equilibrium of both the goods and the money markets (see Fig. 11.9). The AD curve has been derived from the IS-LM model in Unit 2 of BECC 106.

11.4.3 Aggregate Supply

Unlike the classical theory, Keynes held a contractual view of the labour market. Wages are usually determined by a contract between the employers (firms) and the workers (labour). Based on his observation of the Great Depression years, Keynes believed that wages do not adjust quickly enough to clear the labour market. While classical economists believed in the full flexibility of money wages, Keynesian theory offers a number of explanations for rigidity in wages. In fact rigidity (that is, lack of flexibility) of wages has become a crucial point of distinction among economists in the present scenario. Economists owing allegiance to classical theory (i.e., new-classical economists) assume perfect competition in the market, and flexibilities in prices and wage rate. On the other hand, new-Keynesian economists assume imperfect competition in the market, and rigidities in wages and prices.

Rigidity of wages makes wage rate vary inversely with unemployment and therefore directly with employment and income. The Aggregate Supply (AS) curve shows the prices at which different levels of output are supplied. The price charged by firms depends on the costs of production. It implies that as wages rise with increasing output levels (falling unemployment). Consequently, prices rise with the increase in the level of output. Thus Keynesian Aggregate Supply (AS) curve shows a positive relationship between the prices and output (unlike the vertical AS curve of classical theory based on full flexibility of wages). In case we assume wages to be completely rigid, we get a completely flat AS curve. Keynes actually dealt with the short-run. During the recession phase of business cycle, there is high level of unemployment in economy, due to which there is no increase in wage rate due increase in the AD in the short-run. Thus we obtain a flat (perfectly elastic) AS curve, which is often referred to as the Keynesian AS curve.

These supply curves started being referred to as short-run AS curve (SRAS) in the course of later developments in economic thought. In the medium run, however, the AS curve is upward sloping (see Unit 2 of BECC 106).

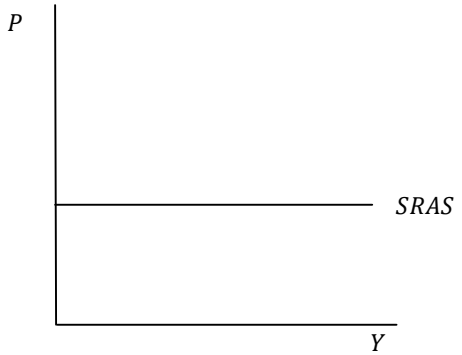

Fig. 11.10: Keynesian AS Curve

11.4.4 Phillips Curve

The classical economists believed money is neutral in the sense that changes in money supply do not influence real variables such as output and employment (classical dichotomy discussed earlier). According to them, an increase in money supply results in an increase in prices only. Keynes believed that monetary variables have real implications. An increase in money supply results in a decrease in interest rate, which leads to an increase in the level of investment. An increase in the level of investment leads to manifold increase in output through the investment multiplier.

Keynes however could not provide a theoretical relationship between monetary and real variables in an economy. Much after the publication of the General Theory, an inverse relationship between inflation and unemployment was established. It is known as the Phillips Curve (see Unit 6 of BECC 106), as the empirical relation was first shown by A W Phillips in 1958. Later development in macroeconomic theory distinguished between the short-run Phillips Curve (SRPC) and the long-run Phillips Curve (LRPC). This will be further discussed in Unit 12. For the time being it is sufficient to say that less than full flexibility of money wages lies behind both SRAS and SRPC. The SRPC is the basis for policy trade-off between inflation and unemployment. Keynesian economists argued that it was more important to reduce unemployment, even at the cost of some inflation.

11.4.5 Policy Prescriptions

Equilibrium output and price level are determined by the intersection of AD and AS curves. As stated earlier, there is no reason for the output to be at the full employment level. According to Keynes, if private spending does not suffice to create enough demand so as to result in full employment, the government needs to intervene and create demand through higher government spending. The demand can also be increased by using expansionary monetary policy to lower the interest rate and stimulate investment spending. However, monetary policy may not be able to lower the interest rate sufficiently in case the preference for liquidity is very high (monetary policy is ineffective under conditions of liquidity trap). Keynes laid particular emphasis on the use of fiscal policy to alleviate unemployment and increase output. According to Keynesian economists, government spending should be counter-cyclical. When there is inflationary pressure in the economy the government should cut down on public expenditure and it should go for a surplus budget. On the other hand, when there is recession, government should increase public spending. Thus Keynesian economics prescribes an activist role for the government. It found widespread acceptance among policy makers. Its popularity can be gauged from the fact that during the 1950s and 1960s most economists were Keynesian.

Check Your Progress 2

1) Assume an economy where money supply is infinitely responsive to the rate of interest. Also assume that the economy is at less than full employment level of output. Use the IS-LM framework to show the impact of fiscal policy and monetary policy in such a situation.

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2) Assume an economy where investment is not responsive to the rate of interest at all. Draw a corresponding IS curve and AD curve. Suggest a policy which can be employed to increase equilibrium level of output.

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3) Discuss the impact of fall in real money demand in Keynesian theory.

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11.5 LET US SUM UP

In this unit, we saw how the classical and Keynesian theories reach different conclusions, based on the assumptions they make. Assuming full flexibility of wages and prices, classical economists conclude that the economy is always in equilibrium at the full employment level of output. Capital market (or, the market for loanable funds) ensures that there is no deficiency of demand. The traditional quantity theory gives the level of prices. According to classical theory, government intervention in the economy cannot impact output levels. Thus, classical economists suggested minimum government intervention in the economy.

Keynes gave a diametrically opposite theory. According to Keynesian theory, equilibrium income is that level of income which is equal to aggregate demand.

This can be lower than full employment level of income. AD is based on simultaneous equilibrium of the goods and the money markets. Further, unlike classical theory, Keynesian theory assumes that wages are rigid. This gives an upward sloping Aggregate Supply Curve or a trade-off between inflation and unemployment in terms of Phillips Curve. Keynesian theory emphasises on using expansionary fiscal policy in order to increase employment and output in the economy.

11.6 ANSWERS/HINTS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

a) See section 11.2.3. Full flexibility of the rate of interest in the loanable funds market ensures that saving equals investment, and output produced is always demanded.

b) A fall in money demand leads to arise in price level. A fall in money demand leads to excess supply of money ($MV=PY$) which leads to a rise in price level, at given output levels.

c) Expansionary fiscal policy shifts the demand for loanable funds curve to the right (parallel to the original curve with an increase in G financed by borrowings). This raises the rate of interest and crowds-out private investment. Finally, equilibrium output remains the same but the composition of output changes such that G replaces I. Go through Fig. 11.5 for further details.

Check your progress 2

a) Liquidity trap situation. Monetary policy is completely ineffective since an increase in money supply cannot reduce interest and thus raise investment. Expansionary fiscal policy will shift the IS curve to the right and increase incomes by multiplier times increase in government spending.

b) IS curve will be vertical and so will the AD curve be. An investment subsidy or increase in government expenditure can increase output.

c) Fall in real money demand implies excess money supply; this reduces rate of interest, increases investment and thus increases output.

UNIT 12 EVOLUTION OF MACROECONOMIC THOUGHT - II*

Structure

12.0 OBJECTIVES

After going through this Unit you should be in a position to

- bring out the basic tenets of various schools of macroeconomic thought;
- contrast between the New Classical and the New Keynesian schools;
- explain how the New Classical ideas are rooted in Classical ideas;
- explain how the Keynesian views are reinforced by the New Keynesians; and
- highlight contemporary research areas in macroeconomics.

12.1 INTRODUCTION

In Unit 11 we discussed the Classical and the Keynesian theories in some detail. While classical economic theory suggested minimal government intervention in the economy, the Keynesian theory prescribed government intervention. The Keynesian economic theory laid emphasis on the use of fiscal policy for attaining economic goals. In 1955, Paul A Samuelson provided '**neoclassical synthesis**'; an integration of Keynesian with classical/ neoclassical economics. He spoke of a mixed economy, with both the market and the government.

Keynesian ideas had influenced government policy right from the time of Second World War till the 1960s. Battling the effect of the Great Depression, governments took it upon themselves to stimulate spending and aggregate

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demand in the economy. The 1950s and 1960s saw high rates of growth in the developed capitalist countries. By the end of 1960s, however, signals of serious crisis in Keynesian economics started coming up. Simultaneous occurrence of unemployment and inflation became commonplace resulting in 'stagflation' throughout the 1970s. The trade-off suggested by Keynesian economics did not work.

Many countries began to feel the pinch of fiscal crisis as a result of high government expenditure. The situation was made worse by the OPEC oil embargo of 1973, popularly known as the 'oil shock'. Keynesian prescriptions did not seem to be working any more. The situation could not be explained convincingly by Keynesian economics or Samuelson's neoclassical synthesis. Over time, the solution was sought in re-establishing market freedom and letting go of the state stimulus for enhancing aggregate demand. Also, inflation was sought to be controlled by making wages more flexible so that with a reduced demand for labour, wages fall and consequently cost of production as well as prices fall. This opened the door for spread of the ideas of Milton Friedman, commonly known as **Monetarism.** In some ways, this was a resurgence of classical ideas. By this time, the idea of expectations (price expectations) was introduced explicitly in macroeconomics.

After the 1970s, the world of macroeconomics became bifurcated between two prominent schools of thought: (i) **New Classical**, and (ii) **New Keynesian**. Both these schools based their theories on micro-foundations and intelligent, utility-maximising individuals. The new classical theory (like the original classical theory) argues that government intervention is ineffective in changing the level of output. The 1980s and 1990s saw further development of this School and business cycles were sought to be explained by individuals' rational responses to technological shocks as in the *Real Business Cycle* model.

As the ideas of the new classical economists were developing, economists following the tradition of Samuelson recognised the importance of imperfections in the economy. Known as new Keynesians, these economists argued that even though rational individuals maximised utility, sub-optimal outcomes can result on account of imperfections in the economy. Hence the new Keynesian models argue in favour of government intervention in the economy (like the original Keynesian theory). More recently**, Dynamic Stochastic General Equilibrium (DSGE) Models** have come up which combine features of both new classical theory and new Keynesian theory.

12.2 NEOCLASSICAL SYNTHESIS

With the coming of Keynesian theory, it seemed that the classical/ neoclassical and Keynesian ideas were irreconcilable. However, in 1955, Paul A. Samuelson integrated Keynesian and Classical ideas in the form of '**neoclassical synthesis**.

Over time, tools such as IS-LM and Phillips Curve were used to show that economy exhibits Keynesian characteristics in the short run but in the long run, classical/ neo-classical results were reached.

Milton Friedman and Edmund Phelps introduced the idea of adaptive expectations about prices. In this framework, expectations did not change in the short run, thus giving rise to an upward sloping Aggregate Supply (SRAS) curve. Labour demand was considered to be a negative function of real wages (W/P); labour supply was a positive function of expected real wages (W/P^e). In a contractual labour market, as long as expected prices remained unchanged, nominal wages demanded by the workers (to keep real wages constant) also remained unchanged.

This gave less than full flexibility of wages. However, in the medium run or the long run (the usage is more a matter of taste), expectations about prices (P^e) get revised, leading to a revision of money wages. This leads to a shift in the SRAS curve so as to give a vertical Aggregate Supply (LRAS) curve in the long run (see Fig. 12.1). In the long run, expected price level is equal to the actual price level.

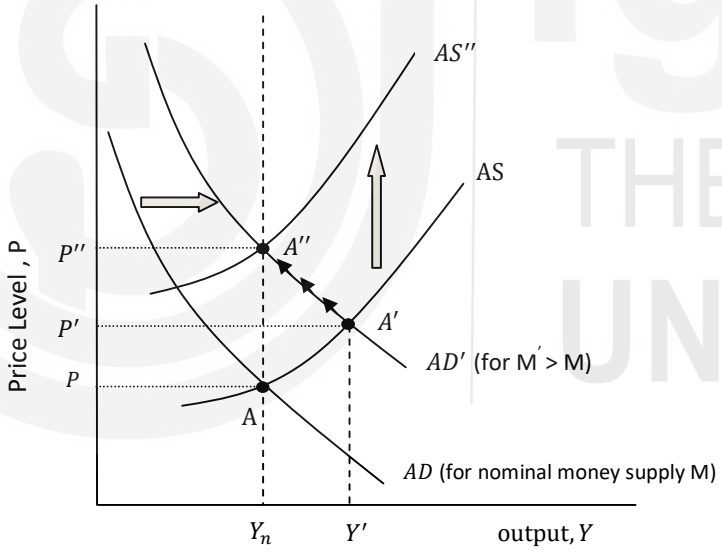

Fig. 12.1: Long-Run Aggregate Supply Curve

In terms of expectations-augmented Phillips Curve; in the short run, due to labour contracts does fail to anticipate further inflation, and therefore, they fail to specify increases in nominal wages needed to keep real wages constant. This leads to a SRPC which shows an inverse relationship between the rate of inflation and unemployment rate. In the long run, the Phillips Curve (LRPC) is vertical at 'natural rate of unemployment' (see Fig. 12.2). The concept of the natural rate of unemployment was first introduced by Milton Friedman and Edmund Phelps in the 1960s.

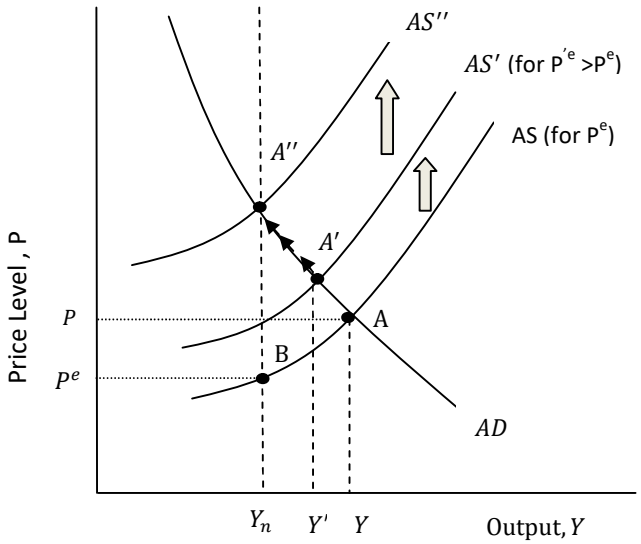

Fig. 12.2: Long-Run Phillips Curve

Thus, any kind of demand shock leads to a Keynesian kind of equilibrium in the short run (when P^e is constant) and equilibrium at the 'natural rate of output' in the long run. In the long run, output changes only on account of supply side factors (which change the natural rate of output itself) as in classical theory. Also the inflation –unemployment trade off can only be exploited in the short run. The adjustment of prices and output in the short and the long run can be seen in Fig. 12.1 and Fig. 12.2.

Check Your Progress 1

1) Assume that the economy starts in the long run at natural rate of output. By using the AS-AD framework show the impact of a contractionary fiscal policy on output and prices in the short run and in the long run.

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2) Assume that the economy is operating at the natural rate of output. Using AS-AD framework, explain the impact of a contractionary fiscal policy on investment in the short run and in the medium run.

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12.3 MONETARISM

Keynesian theory faced the first serious challenge in the mid-1950s on account of the work done by Milton Friedman and his followers. In contrast to Keynes' recommendations, Friedman laid much greater emphasis on monetary policy rather than on fiscal policy. Not surprisingly, Friedman is known as the father of 'monetarism'. In 1956, Friedman reformulated the quantity theory of money and achieved results which were close to the results of the traditional Quantity Theory. Demand for money was found to be stable and hence, changes in money supply were held to be responsible for fluctuations in output.

Monetarists believe that changes in income are predominantly explained by monetary policy. According to them, fiscal policy may be useful but only in the short run and that too for controlling inflation. In fact, monetarists explained the Great Depression in terms of laxity of Federal Reserve Bank. They argued that if the Federal Reserve Bank had intervened with open market operations (by purchasing bonds and securities, so that there is an increase in money supply) the severity of the Great Depression would have been much lesser.

Monetarists also challenge the Keynesian inflation-unemployment trade-off. According to them, Phillips Curve is vertical in the long run (at the natural rate of unemployment) and hence, it is ineffective to try and maintain unemployment below the natural rate. Instead, government should focus on monetary policy to maintain price stability. The policy suggestions made by the Monetarists became the new orthodoxy during the 1970s as the capitalist economies faced a combination of inflation and unemployment which could not be convincingly explained by Keynesian theory.

During the 1980s, macroeconomic theory got bifurcated into two major schools of thought, viz., new classical economics and new Keynesian economics. This bifurcation continues till date. Both the camps are based on rigorous micro foundations for macroeconomics. In other words, the starting point for both the schools of thought is the behaviour of the individual economic agent (such as households and firms).

It is important to understand that both the schools attempt to provide different explanations for the underlying economic reality. While new classical theory attempts to explain business cycles or fluctuations in output through imperfect information or through real shocks (see RBC), new Keynesian theory explains the same phenomena through real and nominal rigidities of wages and prices.

12.4 NEW CLASSICAL ECONOMICS

The new classical theory revived the classical ideas through newer tools of analysis.

12.4.1 Salient Features of New Classical Theory

The important features of new classical economics are as follows:

(i) **Lucas Critique:** As mentioned in the previous Unit, the decades of 1950s and 1960s were the heyday of Keynesian economics. Policy makers believed that they have mastered the art of policy-making and they have wide range of policy options. Stagflation during the 1970s however shattered such optimism. Robert Lucas criticised Keynesian models on the ground that these models lack micro-foundations. These are highly aggregative models. The parameters of these models change when there is a change in policy. Thus, forecasts based on past data does not hold good for these aggregative models.

(ii) **Micro-foundations of Macroeconomics:** Lucas suggested that all macroeconomic models should be based on micro-foundations. Utility function of households and production function of firms should be integrated in macroeconomic models. Let us elaborate a bit on this. There are two types of trade-off before households. One, trade-off between consumption and saving; less consumption means more saving. More saving means more of future income. Thus, the choice between consumption and saving today is the same as the choice between present consumption and future consumption in a temporal framework. Households optimise on their consumption and saving over time (i.e., inter-temporal optimisation) given the level of future expected income and the real interest rate. Two, trade-off between work and leisure. Since time in a day is limited, more hours of work means less time for leisure. If more time is devoted to work, more is the stream of income. Similarly, firms optimise their production decisions over time on the basis of production function. Firms take into account expected rate of inflation and output gaps in their production decision.

(iii) **Continuous Market Clearing:** New classical economists assume that wages are and prices are flexible. Thus there is equality between supply and demand; and markets clear always. New classical economics rules out the possibility of market imperfections.

(iv) **Rational Expectations:** New classical theory assumes rational expectations on the part of economic agents. Economic agents take into account all available information in formation of expectations about economic variables such as prices, inflation and wages. As a result, there is no systematic error in forecast, and in the long run actual value of a variable is equal to the expected value of the variable.

12.4.2 Major Inferences on Policy

(i) **No Trade-Off between Inflation and Unemployment**: New classical theory rules out the possibility of trade-off between inflation and unemployment, even in the short-run. Economic agents update their expectations on economic variables, and there is no systematic

discrepancy between actual value of a variable and its expected value. For example, workers expect inflation rate correctly and they take into account such inflation rate while entering into contracts with employers. Thus there is no lag between price increase and wage increase. As a result, LRPC is vertical.

(ii) **Policy Ineffectiveness Proposition**: Based on the assumption of rational expectations, new classical theory predicts that government policy measures become ineffective. Economic agents anticipate the implications of government measures, and their decision-making is influenced by such expectations. According to new classical economists, economic policy is effective only if it is unexpected.

(iii) **Aggregate Supply Hypothesis**: The AS curve, according to new classical economists is vertical, as in the case of classical theory. The short run AS curve, however, is upward sloping. Workers allocate their time between work and leisure. If the current real wage rate is higher than normal wage rate, they devote more time towards work, cutting down on leisure. On the other hand, when the real wage rate is lower than normal wage rate, there is a disincentive for work; they spend more time on leisure with the hope that they work more in the future. This leads to a decline in production. Thus output is directly proportional to wage rate. Since prices are directly proportional to wage rate, the SRAS is upward-sloping. The LRAS curve, however, is vertical.

12.4.3 Certain New Classical Models

Now let us discuss some of the new classical models, which explain business cycles on the basis of incorrect information. Although workers and firms are acting as desired, they are doing so on the basis of incorrect information. '*Fooling models*' given by Friedman, Phelps and Lucas fall in this category. Another set of new classical models, called the *Real Business Cycle Model*, sets utility maximising individuals in a context where demand problems no longer exist. Business cycles are explained by individuals' rational responses to technological shocks and other supply shocks.

i) Friedman and Phelps Models

Although the actions of firms and workers are voluntary and markets clear continuously, business cycles occur when economic agents 'incorrectly' perceive the price level ($P \neq P^e$). Friedman and Phelps (both are Nobel Prize winners), during the 1960s, talked about expectations being 'adaptive'. This implies that expectational errors can happen in the short run, but sooner or later they would be corrected and the economy will reach the natural rate of output. This means that as soon as expectations get revised and $P = P^e$, the economy reaches the natural rate of unemployment. Friedman's model is sometimes called the '*natural rate*'

model. There exists a vertical AS curve and a vertical Phillips Curve at the natural rate of output or unemployment.

Both Friedman and Phelps based their models on *adaptive expectations*, but there is a subtle difference between the two. Friedman's model is asymmetric in which firms know the actual price level but the workers are 'fooled'. In Phelps' model, both workers and firms are equally 'fooled' – both sides perceive the rise in aggregate price level as an increase in relative prices for their industry and hence choose to supply more. There are versions of Phelps' models where the firms are fooled but workers are not; or where workers are isolated from the economy-wide information.

There are certain limitations of these models. First, there is no reason to assume that one set of agents is 'fooled' while the other is not. Second, information about wages and prices is known fairly well in the modern world. Third, the entire explanation of business cycles is based on gaps in information, ignorance and fooling.

ii) Lucas Model

Robert E. Lucas, another Nobel Prize winner, introduced *rational expectations* in macroeconomics. This meant that along with maximising utility, economic agents never make consistent mistakes. Thus, these individuals could be 'fooled' once, but not twice. Also, the utility maximising decisions pertain to the future as well. Hence people make best forecasts they can, with available information.

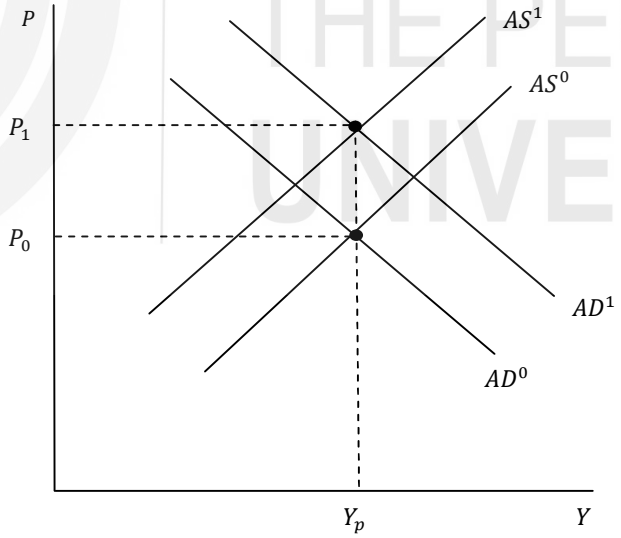

Fig. 12.3: Effect of Anticipated Increase in Money Supply

An implication of rational expectations is that any policy measure taken by the government, whether fiscal or monetary, would be factored in by rational individuals before taking a decision about supply. For example, a monetary expansion meant to stimulate the economy, immediately increases expectations about prices as rational individuals anticipate the impact of policy on wages and

prices. Thus, there is no impact of expansionist monetary policy on employment and real output. This is also known as the *Policy Ineffectiveness Proposition*, as discussed earlier. Anticipated policy is ineffective vis-à-vis output. With a shift in the AD curve from AD^0 to AD^1, there is an immediate shift in the AS curve (from AS^0 to AS^1), so that the new curves intersect at the natural rate of output or potential output (Y_p) (see Fig. 12.3).

You may recall the situation of *Ricardian Equivalence* where the government borrows to finance its deficit budget. Such a policy may not lead to higher output as rational economic agents anticipate the implications of government policy. They expect that government will increase taxes in future to repay the debt and increase their saving. As a result, there is no increase in aggregate demand; and therefore output. According to Lucas, only unanticipated policy or a 'price surprise' can result in output changes.

Like the other fooling models, Lucas also explains the observed output fluctuations because of information gaps. Business cycles are explained through a set of 'signal extraction problem' where the economic agents may perceive the signal of price change incorrectly and therefore change the level of output supplied by them.

The above model can be expressed using the following Lucas supply curve:

$$Y_t = Y_p + \beta(P_t - P_t^e) \quad \ldots (12.1)$$

Here, output in period *t*, (Y_t) differs from potential output (Y_p) only when expected prices (P^e) differ from actual prices (P).

The problem with the Lucas model is similar to other 'fooling' models, i.e., information lags are too short to provide a convincing explanation of business cycles.

12.4.4 Real Business Cycle Model

Prominent economists associated with these models are Nobel Prize winners, Finn E. Kydland and Edward C. Prescott, who put forward these models during the 1980s and 1990s. The real business cycle (RBC) models explain the fluctuations in output in terms of the real shocks to the economy. Economic agents respond to real (supply) shocks rather than monetary (demand) shocks. According to RBC models the fluctuations in output are fluctuations in natural rate of output itself. Prices and wages are fully flexible (as in classical theory) and with a shift in the AS curve, there is a change in the natural rate of output (i.e., potential output). The supply shocks can be of various types: (i) changes in technology, (ii) changes in weather, (iii) new sources of raw materials, and (iv) changes in raw material prices. The supply shocks are assumed to be highly persistent, thus explaining the length of business cycle.

In Fig. 12.4 upper panel we depict production function F_0 which is for normal times. When there is an adverse supply shock (say, drought), there is a downward

shift in the production function to F_1. In the lower panel of Fig. 12.4 we depict equilibrium in the labour market. The supply curve of labour is N_0^S and the demand curve for labour is N_0^d during normal times. Equilibrium is at point B with employment level N_0. The corresponding level of equilibrium output is Y_0 (see upper panel of Fig. 12.4).

Now let us assume that there is an adverse supply shock. There is no change in the supply curve of labour, but there is a downward shift in the demand curve for labour from N_0^d to N_1^d. Due to the adverse shock, equilibrium is at point V with equilibrium employment level at N_1. The corresponding level of output will be Y_1. Thus, due to the adverse supply shock there is a recession in the economy.

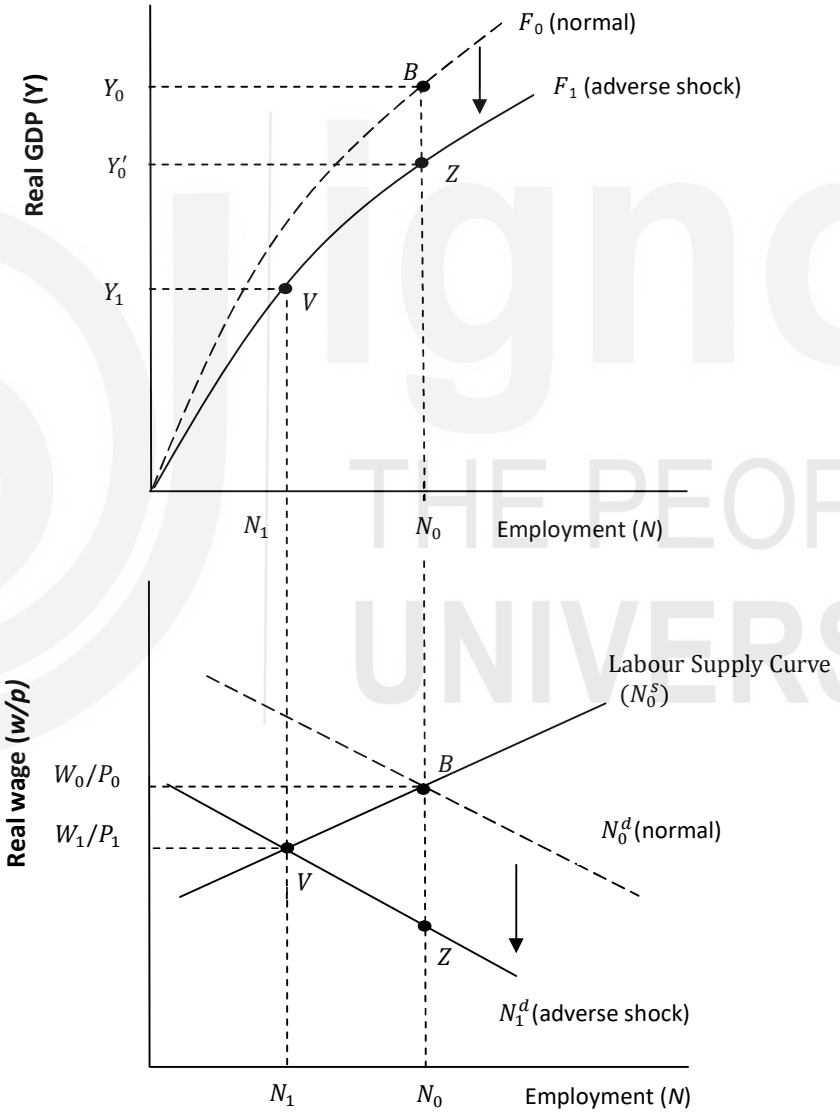

Fig. 12.4: Effect of an Adverse Supply Shock

In Fig. 12.4 we have taken an upward sloping supply curve of labour. Let us assume that the supply curve of labour is vertical at N_0. Due to the adverse shock

equilibrium is at point Z. There is no decrease in employment (it remains at N_0); adjustment takes place through a decline in real wage. In that case, equilibrium out would be Y_0'.

The RBC models have been criticised on various counts. As far as technology is concerned, there is always advancement in technology over time, not a decline in technology. The RBC models have failed to give convincing examples of negative shocks, except for the rise in oil prices. Also RBC models cannot show how the impact of a shock on the output is magnified (as in Keynesian multiplier).

Lastly, if the business cycles occur due to shifts in the aggregate supply, then a fall in output would be accompanied by a rise in prices. However, this is not always the case during recessions and depressions.

Check Your Progress 2

1) Let there be a boom in the economy in which output (Y) rises above natural rate of output (Y_p). According to Lucas' model, does this require price surprise? Explain.

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2) Bring out the central ideas of real business cycle models.

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12.5 NEW KEYNESIAN ECONOMICS

At the same time, when new classical ideas were spreading, some followers of Samuelson's tradition discarded the conventional IS-LM framework and developed the '*New Keynesian*' models. The new Keynesian models are also based on rational, utility-maximising individuals like the new classical models. Thus, new Keynesian economists present the Keynesian ideas by using some of the new classical tools of analysis such as micro-foundations and rational expectations. There is a basic difference between new classical theory and new Keynesian theory, however. New classical economists assume that there is perfect competition in the economy because of which prices and wages are fully flexible. New Keynesian economists believe that there are imperfections and asymmetric information in the economy because of which there are rigidities in

prices and wages (it means that these variables do not adjust to desired levels instantaneously).

With the emphasis on microeconomics of market imperfections, new Keynesian models are able to arrive at the traditional Keynesian results. Even when rational individuals are maximising their utility under these conditions, the macroeconomic results can be sub-optimal. Prices do not adjust rapidly enough to clear the markets (due to rational behaviour of individual economic agents) and therefore these models (along with original Keynesian model) are termed as a *non-market clearing* models.

The imperfect conditions could be on account of several factors: (i) market power of the firms, (ii) nominal or real rigidity of wages and prices, and (iii) asymmetric information. In such a theoretical framework, fluctuations in aggregate demand create fluctuations in output and employment. In terms of AD and SRAS, a demand shock shifts the AD curve, but the SRAS curve is unable to shift due to maximising behaviour of rational individuals. This leads to changes in output and business cycles. The source of price or wage rigidity (due to which SRAS cannot shift quickly or adequately) can be traced to several factors as described below.

(i) Menu Costs: A reason for price rigidity is that it is costly to change prices. You would have noticed that vegetable prices change every day, but the cost of food in a restaurant does not change that frequently. The menu card remains the same – because it costs more to print the menu card again than to bear the loss due to increase in marginal cost. New Keynesian economists generalise the above idea for all firms in an economy. According to new Keynesians, menu costs could be small for a firm, but for the economy as a whole, menu costs could have large effects. In the case of menu costs, in response to a fall in demand by a monopolistic firm, the firm may choose not to cut price if gain in profits from cutting price is less than the menu cost of cutting price.

(ii) Sticky Marginal Cost: Even when menu costs do not exist, sticky marginal cost can result in no change in prices but a change in output. Now fluctuations in output are explained through sticky or rigid marginal costs. In response to a fall in demand faced by a monopolistic firm, the firm experiences a reduction in its marginal revenue. However, its marginal cost may not fall sufficiently for the firm to maintain the same level of output as before the decline in demand. In such a case, the output will fall.

New Keynesian economists offered a variety of reasons for sticky marginal cost or why the firms may rationally expect marginal cost to move differently from marginal revenue. The labour contracts may be fixed for a long time resulting in nominal wage rigidity and sticky marginal cost for the period of the contract. In such cases, nominal wages are fixed in advance and cannot be changed during the contract. Secondly, marginal costs depend on the raw material prices and in case of multiple buyer-supplier relationships, a rational firm may prefer not to

reduce prices until the chain of input suppliers reduce their prices. It is also possible that changes in demand (and therefore marginal revenue) are due to local factors but the costs depend on many other factors. In this case also, a firm may rationally expect marginal revenue to move differently from marginal cost. In all such situations, rational workers and firms take decisions which are privately advantageous for them, but still result in loss of output and employment.

(iii) Staggered Prices: Firms do not set their prices at the same time; it is staggered over a period of time. When there is a change in money supply and aggregate demand some firms may be changing their prices immediately while others wait for some time. This results in a slowing down of changes in price level in the economy.

(iv) Coordination Failure: During the recession phase, many people are willing to work but do not find employment. Inventories of firms keep on increasing as there is a demand deficiency. People go hungry while stock of food is large. Some new Keynesian economists therefore think that business cycle could be due to coordination failure. We have mentioned earlier that prices and wages do not converge to their equilibrium level instantaneously. According to new Keynesian better coordination among firms in decision-making could reduce business fluctuations. Some of the new Keynesian models suggest there are multiple equilibria in an economy. If firms fail to coordinate, the economy may end up with a less efficient (low level) equilibrium.

A major problem with the new Keynesian models is that they suggest too many reasons for stickiness or rigidity in wages and prices. Business cycles are observed even in industries which do not have labour unions and fixed wage contracts.

12.6 DYNAMIC STOCHASTIC GENERAL EQUILIBRIUM (DSGE) MODELS

In recent years, new classicals and new Keynesians have come closer and common models have evolved. New classical economists continue to assume perfect competition with flexible wages and prices. New Keynesian economists include market power and other imperfections resulting in 'sticky' wages and prices.

In recent years a new set of models, called dynamic stochastic general equilibrium models, have come up in recent years. As the name suggests, these are 'general equilibrium models' in the sense that it pertains to the whole economy. The word 'dynamic' reflects the idea that these are inter-temporal models and economic agents optimise on their decision-variables over time. Thus it involves the issue of dynamic optimisation. As you know, the economy receives various types of shocks, viz., demand shocks, supply shocks and policy

shocks, which are exogenous. These shocks are assumed to be random in nature; thus these models are stochastic.

In simple DSGE models there three inter-related blocks (set of equations), viz., (i) a demand block, (ii) a supply block, and (iii) a monetary policy equation (recall policy rules discussed in Unit 10). The equations included in these blocks are derived from micro-foundations.

In DGSE models, passage of time is explicitly considered (dynamic), random variables are included (stochastic), and they provide an explanation for the entire economy and not merely a part of the economy (general equilibrium). Simple versions of DSGE models are based on equations representing i) rational expectations theory of consumption (IS curve of DSGE model), ii) a version of the Phillips Curve in which expectations about inflation are formed rationally but actual inflation depends on expected future inflation and output gap (Stabilisation Policy (SP) curve), and iii) a version of the Taylor Rule which indicates monetary policy. Both demand and supply shocks are allowed to create business cycles.

The DSGE models have been quite useful in policy analysis. Several issues can be analysed through DSGE models. Macroeconomic policies have several implications, as you can imagine. A particular policy measure can be beneficial in certain aspects while being adverse in some other directions. We cite a couple of examples; you can think of many others. First, the impact of currency depreciation in economy – when currency depreciation takes place, exports become cheaper so that demand for domestic goods increases. In case the external debt is high, the country will end up repaying higher amount and servicing the debt. Further, if imports are inelastic (crude oil imports by India, for example), depreciation may lead to balance of payments problem. Second, the impact of an increase in nominal interest rate on inflation – higher interest rate implies tightening of monetary policy, thereby reducing aggregate demand, output and inflation. Higher interest rate however would mean higher cost of borrowing, higher cost of production and higher prices. Which one will be stronger? The DGSE model can help us in deciding the net impact.

Check Your Progress 3

1) Give a brief account of the sources of business cycles according to new Keynesian economics.

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2) Bring out the salient features of dynamic stochastic general equilibrium models.

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12.7 LET US SUM UP

In this Unit we have discussed the development of macroeconomic thought after the Keynesian theory. Neoclassical synthesis tried to combine classical and Keynesian ideas in the framework of IS-LM equations. Monetarism provided the first serious challenge to Keynesian theory. The economic crisis faced by many countries during the 1970s could not be explained by Keynesian theory. This prompted economists to explore newer macroeconomic models. Introduction of the role of expectations changed the subject matter of macroeconomics completely. New classical theory revived the classical ideas and offered policy prescriptions totally opposite to Keynesian theory. During the 1980s, a new school of thought called new Keynesian theory attempted to revive Keynesian ideas.

Both new classical models and new Keynesian models are based on maximising microeconomic behaviour of rational individuals in an inter-temporal framework. Differences in assumptions about the market imperfection, however, give us quite contrasting results. By assuming perfect competition the new classical economists could come out with that are close to original classical theory. The new Keynesian economists challenge the assumption of perfect competition. By assuming market imperfection they could revive some of the Keynesian ideas. In the end, we gave some preliminary ideas on contemporary DSGE models.

12.8 ANSWERS/ HINTS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) A contractionary fiscal policy shifts the AD curve to the left. The short run result (given by the intersection of new AD and original SRAS) is output lower than natural rate of output and prices lower than expected prices ($Y \prec Y_n$ and $P \prec P^e$). In the long run, on account of adaptive expectations, expectations about prices get revised downward and SRAS shifts down. Once again, $Y \prec Y_n$ and $P \prec P^e$ (the equilibrium given by new SRAS and new AD) but the gap between Y and Y_n is reduced. With continuous downward revision of expected prices, SAS keeps shifting

down, till SAS intersects new AD at Y_n and P equals P^e. This is the long run equilibrium.

2) Contractionary fiscal policy implies reduction in government investment. In the short run, this leads to fall in Y and P. In the long run, Y is back at Y_n but P falls. However, composition of output changes in the long run and investment rises as Government expenditure falls (a reduction in P, increases real money supply, reduces interest rate and thus increases investment).

Check Your Progress 2

1) Yes it does. See the policy ineffective proposition in Sub-Section 12.4.3(ii).
2) The real business cycle models argue that business cycles are due to supply shocks to an economy. These shocks could due changes in several factors such as productivity, weather, input prices, etc. Real business cycle models are rooted in new classical theory. However, they are often placed under a distinct category as they emphasise on real factors. New classical models, generally, emphasise on monetary shocks or demand shocks to the economy.

Check Your Progress 3

1) The new Keynesian theory ascribes various reasons for the occurrence of business cycles in an economy, viz., menu costs, sticky marginal cost, staggered prices and coordination failure. Go through Section 12.5 for details.
2) Go through Section 12.6 and answer.

GLOSSARY

Accelerator : The accelerator effect in economics is a positive effect on private fixed investment of the growth of the market economy (change in GDP).

Asymmetric Information : It refers to a concept where one party in a transaction has more information than the other. For example, when an old car is being sold, the seller has more information about the car than the buyer.

Adaptive Expectations : Adaptive expectations is a theoretical concept that deals with formulation of expectations for future on the basis of experiences and events in the recent past. According to adaptive expectations hypothesis, the following equation will be true: $Y_t^e - Y_{t-1}^e = \alpha(Y_{t-1} - Y_{t-1}^e)$, where Y_t^e is the value of expected income in time period t, Y_{t-1} is the actual income in time period t-1, and α is a coefficient and its value is positive but less than one.

Balanced Growth Path : A situation where each variable of the model- output per worker and capital per worker, all grows at the rate of technological progress.

Bonds : A bond is a fixed income instrument. Bonds traditionally accrue a fixed interest rate (coupon) to the bond holder. Bonds with variable or floating interest rates are also common.

Brokerage : It is a fee charged by a broker to execute transactions or provide specialized services.

Bank Rate : It refers to the rate at which the central bank lends funds to commercial banks.

Consumption Goods : It refers to goods which are produced for the express purpose of satisfying human wants and preferences.

Capital Goods : It refers to goods which we may think of as commodities that are produced for the purpose of producing other commodities.

Constant Returns to Scale : When the output increases exactly in proportion to an increase in all the inputs or factors of production, it is called constant returns to scale. In the Cobb Douglas Production Function, $Q = AL^{\alpha}K^{\beta}$, if $\alpha+\beta = 1$ there will be constant returns to scale.

Cross-Sectional Budget Studies : In cross-sectional budget studies, certain sample households are taken and data pertaining to a particular point of time on their income, consumption expenditure, saving, etc. are studied.

Consumption Smoothing : Individuals avoid volatility in their consumption level during their life time. Thus they transfer their income from periods of high income to periods of low income. In other words, they smoothen their consumption over time.

Capital Gain : Profit made by selling capital assets (stocks, bonds, real estate, etc.) at higher price than its purchase price.

Cyclical Movement : It refers to the periodical movement of macroeconomic variables through four discrete phases expansionary, boom, down swing and trough.

Cash Reserve Ratio (CRR) : This is the fraction of total deposits which the banks are required to hold with the RBI. It is a certain fraction of their demand and time liabilities in the form of cash balances.

Crowding Out Effect : Due to a tax cut, there is an increase in disposable income of households. Private saving will increase as a result of higher disposable income. Such increase in private saving, however, will be lower than the decrease in public saving. Therefore, there is a decrease in the desired aggregate saving of the economy. As aggregate saving falls short of aggregate investment, there is an increase in the real interest rate. This higher interest rate would *crowd out* the domestic private investment.

Debt Financing : The debt is a stock variable, which is measured at a specific point of time and it is the accumulation of all prior deficits. Public debt is financed by selling government bonds and treasury bills. Banks, Pension Funds and individuals buy those sovereign bonds in return for an interest rate on bonds. In some circumstances public debt can be financed by the Central Bank buying those bonds and printing more money to pay it to the government.

Distributive Lag Models : In a regression model, we include explanatory variables to explain the variation in the explained or dependent variable. In distributive lag models, we include lagged values of the explanatory variables also in addition to current values of the explanatory variables.

Dividend : It refers to the returns on the shares or equities. It is a distribution of profits by a public limited company to its shareholders.

Depreciation : It refers to the loss of value due to wear and tear of fixed capital assets.

Demand Shock : A demand shock is a surprise event that shifts the aggregate demand curve. A negative demand shock could be a global pandemic. A positive demand shock could be a stimulus package by the government or an increase in money supply.

Debt Stabilization : It means changing the taxes or spending so that the debt remains constant from then on.

Economic Agents : These are groups of transactors, which indulge in economic activities like production/ income generation/ addition to capital stock. Economic agents can be classified into producers, households, capital sector, rest of the world, and government.

Equity : In the context of stock market investments, equity refers to the shares in a company's ownership. In simpler terms, it is the total amount of money that a shareholder is eligible to receive if all of a company's debts are paid off and its assets liquidated. When an individual invests in a company's equities, (s)he becomes its partial owner.

Full Employment Output : It is the capacity output or potential output that an economy can produce, when there is full employment of resources.

Flexibility in Wages and Prices : It is one of the basic assumptions of classical economics. According to this assumption, there are instantaneous changes in wage rate and price level as results of changes in supply and demand conditions in the economy.

Fiscal Deficit : It is defined as the difference between total expenditure (both revenue and capital) and the revenue receipts. Fiscal Deficit = Revenue Receipts – Total Expenditure

Fiscal Sustainability : It refers to the ability of a government to sustain its current spending, tax and other policies in the long run without threatening government solvency or defaulting on some of its liabilities or promised expenditures.

Goods Market Equilibrium : When AD and AS interact with each other. All points on the IS curve reflects equilibrium in the goods market.

High-powered Money : M0 is known as monetary base or central bank money or high-powered money.

Incremental Capital-Output Ratio : ICOR indicates the additional unit of capital or investment needed to produce an additional unit of output.

Inter-temporal Choice	:	It is a process of choice in which the decision maker makes decision about what to and how much to do over various periods of time. Today's choice has a direct impact on future's opportunity.
IS-LM Model	:	In Keynesian macroeconomic model the equilibrium in the economy is achieved at the output level and interest rate, where IS and LM curves intersect. The IS curve shows the equilibrium in the real sector while the LM curve shows the equilibrium in the monetary sector of the economy.
Knife-Edge Equilibrium	:	A state in which a slight deviation of actual growth rate from warranted growth rate leads the economy drift farther away from the steady state growth path.
Lagrangian	:	The *Lagrangian function* combines the function being optimized with the functions describing the constraints into a single equation. Solving the Lagrangian function allows us to optimize the variable we choose, subject to the constraints we cannot change.
Liquidity	:	Liquidity refers to the ease with which an asset, or security, can be converted into ready cash without affecting its market price. Cash is the most liquid form of assets.
Mercantilism	:	It is school of thought that prescribed tariffs and subsidies in such a manner that the country's economic power improves. It led to imperialism. It was prevalent mostly in Europe during the 16th to 18th century.
Mortgage Rate	:	It refers to the interest rate charged on home loan.
Monetary Transmission Mechanism	:	It is the link between monetary policy and aggregate demand. This process suggests how monetary policy affect asset prices and general economic conditions (which influence the aggregate demand, interest rates, and amounts of money and credit) in order to influence overall economic performance in a desired direction.
Monetization of Deficit	:	It is a two-step process where the government issues government bonds to cover its spending and the central bank purchases the bonds. The central bank holds the bonds until it matures. This process leaves the system with an increased supply of money.
Narrow Money	:	M1 is also known as 'narrow money'.
Net Indirect Taxes	:	It is the difference between indirect taxes and subsidies.

Net National Disposable Income (NNDP) : It is the total income at the disposal of a country by way of factor income as well as transfer incomes from the rest of the world. It is identical to NNP at market price plus net current transfers from abroad.

Non-departmental Enterprises : These are the government enterprises for which autonomous corporations are set up. The goods or services produced by these enterprises are sold for a price. They are the profit making enterprises set up in the public sector.

Output-Technology Ratio : It refers to the ratio of output per worker to technology. It is given by $\bar{y} = \frac{y}{A} = \frac{Y}{AL}$.

Open Market Operations : It refers to sale/purchase of government securities by the central bank to/from the general public and banks.

Price Rigidity : It indicates the Keynesian view that prices are not flexible; they are sticky. It challenges the classical view that prices change to the equilibrium level instantaneously.

Portfolio : It refers to a collection of investments such as stocks, bonds, commodities, cash and cash equivalents.

Precautionary Motive : It refers to the desire of an individual to hold cash in order to be able to deal effectively with unexpected events that require cash outlay.

Permanent Income : It refers to the long-term average expected income which remains steady throughout life of the consumer.

Price Rigidity : Keynes countered the classical economists on the assumption of flexible prices. According to Keynesian economics, there are many factors that lead to rigidity in prices. Menu cost is one such example.

Phillips Curve : It describes the relationship between inflation and unemployment. In the short run it is found to be downward sloping. In the long-run it is vertical.

Public Good : Two criteria distinguish public goods from private goods, non-rivalry and non-excludability. Consumption of public good (for example, oxygen in the atmosphere) is non-rival. Your consumption of the public good does not reduce the availability of the good for others. Further, no one can be excluded from consumption of the public good.

Primary Deficit : It is obtained by subtracting interest payments from fiscal deficit. Primary Deficit = Fiscal Deficit – Interest Payments

Quantity Theory of Money : The quantity theory of money states that there is a direct relationship between the quantity of money in an economy and the level of prices of goods and services sold.

Ricardian Equivalence : It is a proposition that government spending whether by current taxes or by future taxes will have the same impact. According to this proposition deficit financing through borrowing may not lead to increases in output, as people are forward looking and rational.

Reverse Repo Rate : Rate at which the commercial banks can deposit their excess liquidity with the central bank, by purchasing securities.

Steady Growth Rate : It is consistent with the concept of equilibrium growth. In steady state growth all variables, such as output, population, capital stock, saving, investment, and technological progress, either grow at constant exponential rate, or are constant.

Steady State : A steady state is a situation in which the economy's output per worker, y, consumption per worker c and capital stock per worker k are constant.

Stochastic Variable : It indicates a randomly determined process; having a random probability distribution. A stochastic variable can assume both positive and negative values, but its average value would be zero.

Stock Market : It is also called stock exchange. It refers to the aggregation of buyers and sellers of stocks, which represent ownership claims on businesses.

Shares : A share is an indivisible unit of capital, expressing the ownership relationship between the company and the shareholder.

Speculation : Speculation involves trading a financial instrument involving high risk, in expectation of significant returns.

Statutory Liquidity Ratio (SLR) : Is the fraction of total deposits which the banks are required to hold with them. It is a certain fraction of their demand and time liabilities in the form of government securities.

Signal Extraction Problem : Robert Lucas argues that producers face a signal extraction problem in their decision-making. They increase supply in response to an increase in the price of their product. They do not perceive that it is a general increase in prices, not an increase in relative prices.

Supply Shock : A supply shock is a surprise event that shifts the aggregate supply curve. It could be either negative or positive. Examples of supply shock are changes in weather, technology, input prices, etc.

Transaction Motive : It refers to the desire of an economic agent to hold adequate cash in hand, or in bank account (demand deposit), to meet the financial obligation of daily needs.

Total Factor Productivity : Total factor productivity (TFP) is a measure of productivity calculated by dividing economy-wide total production by the weighted average of inputs, i.e., labor and capital.

Taylor Rule : The rule describes how, for each one-percent increase in inflation, the central bank tends to raise the nominal interest rate by more than one percentage point.

Velocity of Money : It is a measure of the number of times an average unit of currency is used to purchase goods and services within stipulated time period. It is usually measured as the ratio of GDP and country's M1 or M2 money aggregate.

Risk : It is defined in financial terms as the probability that an outcome or investment's actual gains will differ from an expected outcome or return.

Rational Expectations : Rational expectations hypothesis is an improvement over the adaptive expectations hypothesis. It argues that people will use all available information related to the determination of the expected value of any variable. It also says that people use their human rationality, available information and their experience to predict the future value of any economic variable.

Ricardian Equivalence Proposition : The new classical economists question the effectiveness of Keynesian fiscal measures on the ground of Ricardian equivalence. Ricardo had argued that financing of government expenditure by taxes or by issuing bonds would have no impact upon aggregate demand if people were forward looking. According to Barro if expectations formation is according to rational expectations, fiscal policy would be ineffective.

Warranted Growth Rate : It refers to that growth rate of the economy when it is working at full capacity. It is also known as Full-capacity growth rate.

Wage Rigidity : It refers to rigidity or stickiness in wage rate. According to Keynes wage rate do not reach equilibrium level instantaneously due to several reasons including employment contracts.

SOME USEFUL BOOKS

Abel Andrew B, Ben Bernanke, and Dean Croushore, 2017, *Macroeconomics*, Ninth Edition, Pearson Education

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