Both Harrod and Domar are interested in finding out the rate of income growth necessary to keep a dynamic economy in the path of equilibrium from year to year. The main point of their analysis is that assuming initially a full employment equilibrium level of income, the maintenance of this equilibrium requires that the volume of spending generated by investment must be sufficient to absorb the increased output made possible by investment. If the marginal propensity to save is given then the more the capital is accumulated, and the higher the national income already is, the greater must be the absolute volume of net investment. Thus, if full employment is to be maintained, the absolute amount of net investment must ever expand. This requires continuous growth in real national income. Capital formation, if not accompanied by an increase in income, would result in unemployed capital and labour. Therefore, national income must grow in order to avoid excess capital goods and unemployed labour It is also necessary that the volume of real income and output should increase at the same rate when productive capacity of the capital stock is increasing. If real income does not expand, the creation of new capital equipment will result in either of the following :

(1) The new capital would remain unused.

(2) The new capital will be used at the expense of previously constructed capital.

(3) The new capital would be substituted for labour.

On the basis of the above analysis, it can be said that capital formation, if not accompanied by increased income, would result in unemployed capital and labour. Adequate growth in income is required to avoid excess of capital goods or unemployed labour. Thus, employment in the long run is a function of the rate of growth of investment and income. If unemployment should be removed and long run disequilibrium to be avoided, income should grow at a rate sufficient to ensure full capacity utilisation of growing capital stock. Both Harrod and Domar try to find out the rate of growth of income necessary to keep a dynamic economy in the path of equilibrium. This required rate of income growth may be called 'the warranted rate of growth' or 'the full capacity growth rate.'

Domar constructs his model around the question : since investment increases productive capacity and also creates income, what should be the rate of increase investment in order to make the increase in income equal to that of productive capacity so that full-employment is maintained ?[1] The model is based on the following assumptions :

(1) an initial full employment level of income has already been reached ;

(2) there is absence of government interference and foreign aid ;

(3) there are no lags in adjustment ;

(4) the marginal and average propensities to save are equal ;

(5) the propensity to save and capital coefficient are constant.

Domar tries to set up an equation, one side of which represents the increase of productive capacity and the other side that of income and the solution of which will yield the required rate of growth.

Let investment in the economy increase at an annual rate of I, and let productive capacity per dollar of newly created capital be equal to S. Thus the productive capacity of I dollars invested will be equal to IS. But it is just possible that the operation of new capital may take place, to some extent, at the expense of previously constructed capital and hence the productive capacity of of the economy will not increase by IS dollars per year but by a smaller amount indicated by $I\sigma$. The symbol σ (sigma) indicates the potential social average productivity of investment. The propensity to save is represented by α and its reciprocal $1/\alpha$ is the multiplier. Now the increase in income will be multiplier $(1/\alpha)$ times the increase in investment (I) :

$$\Delta y = \frac{1}{\alpha}(\Delta I) \qquad \ldots(1)$$

if the economy initially is in full employment equilibrium so that national income is equal to productive capacity. Now national income and productive capacity must increase at the same rate. In other words, increase in national income must be equal to increase in productive capacity, *i.e.*

$$\frac{1}{\alpha}(\Delta I) = I\sigma \qquad \ldots(2)$$

The left of the equation shows the demand side of the equation *i.e.*, annual increase in income while the right side shows the

[1] Domar, *op. cit.*, 86–89.

supply side, *i.e.*, the increase in productive capacity.

Solving the equation by multiplying by α and dividing by I, we get the following :

$$\frac{\Delta I}{I} = \alpha\sigma \qquad \ldots(3)$$

The left side of this equation shows the absolute increase in investment divided by the volume of investment. In other words, it is the annual percentage rate of growth in investment. Thus the maintenance of full employment requires that investment should grow at the annual rate of $\alpha\ \sigma$. Assuming that income is a constant multiple of investment, we can say that the income must also grow at the same annual relative rate of $\alpha\ \sigma$. In other words, it can be said that investment and real income must grow at a constant annual percentage rate equal to the product of propensity to save and the average productivity of investment.[1]

This can be illustrated with the help of a numerical example. Suppose $\alpha = 25$ per cent per year, $\alpha = 12$ per cent, $y = \$150$ billion per year. If full employment is to be maintained, an amount equal to $150 \times \frac{12}{100}$ *i.e.*, \$ 18 billion must be invested. This investment will raise the productive capacity by the amount invested times α, *i.e.* by

$$150 \times \frac{12}{100} \times \frac{25}{100} = \$\ 4{\cdot}5 \text{ billion.}$$

If unused capacity is to be avoided, national income will have to rise by \$ 4·5 billion. The relative rise in income will be equal to absolute increase divided by the income itself, *i.e.*

$$\frac{150 \times \frac{12}{100} \times \frac{25}{100}}{150} = \frac{12}{100} \times \frac{25}{100} = \alpha\ \sigma = 3 \text{ p.c.}$$

This shows that the income must grow at a rate of 3 per cent per annum if full employment is to be maintained without creating unused production capacity.

Thus, according to Domar, the economy faces a serious dilemma : If sufficient investment is not forthcoming today, unemployment will be here today; but, if enough is invested today, still more will be needed tomorrow inorder to increase demand so that the expanded capacity can be utilised and excessive capital accumulation avoided tomorrow. Otherwise, the excessive capital accumulation will lead to a fall in investment, and hence a depression the day after tomorrow. The economy must, so to speak, run faster to stay in the same place; otherwise it will slip downwards. In his concluding remarks, Prof. Domar observes that 'investment of today must always exceed saving of yesterday.' A mere absence of hoarding will not do. An injection of new money must take place every day. Moreover, this injection must proceed, in absolute terms, at an accelerated rate. The economy

[1] *Ibid.*, 91–92.

must continuously expand.

Prof. Domar also tries to find out whether sufficient investment will actually be forthcoming to allow the required increase in the income. He is optimistic and observes that there is no inescapable necessity for the capitalist machine to run down. But, at the same time, he does not believe in the automatic tendency for capitalism to keep moving 'onwards and upwards'. With the help of his model he demonstrates that certain special conditions are necessary for continuous expansion of the economy.

HARROD'S MODEL

To a large extent Harrod's model of economic growth is a dynamic extension of the Keynesian analysis. Like Domar he is also concerned with the conditions of steady growth and indicates the nature of possible paths along which the economy might advance. He starts with two basic assumptions :

(1) the net savings of the community during any period of time is a constant proportion of the income received during that period.

(2) the entrepreneurs' desire to undertake investment depends on how quickly output is increasing *i.e.*, on the rate of increase in output in the previous years.

On the basis of these two assumptions, the behaviour of income as a response to entrepreneural decisions relating to investment is derived.

Since savings or investment formed a fixed proportion of income and since increase in investment depends on the rate of increase in income, it follows that the entrepreneurs will be satisfied with actual investment only if income is increasing correspondingly. If the rate of increase in income is too high, the entrepreneurs will find actual investment less than what is desirable, while if increase in income is not high enough, actual investment will be found excessive. The rate of growth of income, which is just sufficient to make the entrepreneurs satisfied with the actual investment, can be called 'warranted rate of growth.' The actual problem is to find out the determinants of this rate of growth of income.

Harrod speaks of three types of rates of growth :

(*i*) the actual rate of growth (G)

(*ii*) the warranted rate of growth (Gw)

(*iii*) the full employment or natural rate of growth (Gn).

According to him 'warranted rate of growth' (Gw) is the rate of growth which, if executed, will leave entrepreneurs in a state of mind in which they are prepared to carry on a similar advance. The natural rate of growth (Gn) represents the trend in production with full employment and no inflation. It is the rate of advance

which the increase of population and technological improvements allow. It has no relation to *Gw*. *Gn* sets a limit to the maximum average value of *G* over a long period.

Harrod starts with the fundamental equation,

$$GC=S \qquad \ldots(1)$$

This equation represents the fundamental truism that ex-post investment is equal to ex-post savings. In the equation *G* stands for the rate of growth of income; *C* stands for the increase in capital during the period divided by the increase in output in the period; *S* is savings expressed as a proportion of income. Since *G* can be expressed as $\Delta Y/Y$; *C* as $I/\Delta Y$ and *S* as S/Y, by substituting these in the above equation we get :

$$\frac{\Delta Y}{Y} \times \frac{I}{\Delta Y} = \frac{S}{Y}$$

or

$$\frac{I}{Y} = \frac{S}{Y}$$

$$\therefore \quad I=S$$

The second fundamental equation is :

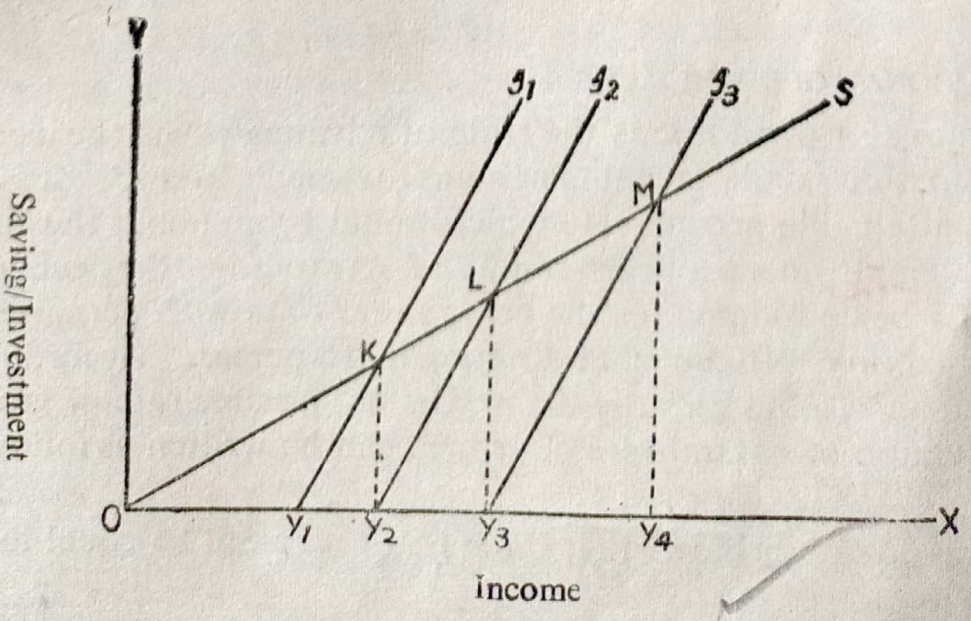
$$Gw\ Cr=S \qquad \ldots(2)$$

The equation represents the equilibrium conditions for a steady growth. In the equation, *Gw* stands for 'warranted rate of growth', *i.e.*, the rate of growth which satisfies the entrepreneurs; *Cr* is the 'capital requirement' or the capital coefficient required for sustaining the warranted rate of growth; S is the marginal propensity to save.

From the above equation we can derive,

$$Gw=S/Cr$$

According to this equation, if full capacity utilisation is to be maintained, income must grow at the annual rate of S/Cr *i.e.* at a rate equal to $\frac{\text{marginal propensity to save}}{\text{capital-output ratio}}$



This equation represents equilibrium conditions for a steady growth. In other words, if income grows at the warranted rate, the capital stock of the economy will be fully utilised and it will be on steady path of growth. The entrepreneurs wlll be willing to invest the amount of savings generated at full potential income. This rate of growth will be self-sustaining. The growth path of such an economy can be illustrated with the help of the above diagram.

The horizontal axis OX represents income and vertical axis OY represents saving and investment. OS is the savings function. The saving-investment equilibrium in the current period is attained when the level of income is OY_2. At this point the level of income in the current period is higher than that of the previous period by an amount $Y_1 Y_2$. Thus the warranted rate of growth will be Y_1Y_2/OY_2. In the succeeding period OY_2 becomes the income of the previous period and the investment function shifts from Y_1I_1 to Y_2I_2. The new saving-investment equilibrium will be at the point L where investment function Y_2I_2 intersects the savings function OS. Y_2I_2 has been shown parallel to Y_1I_1 which means that Cr (capital-output ratio) remains constant. The new saving-investment equilibrium at L raises income to OY_3. As a consequence, the investment function shifts to Y_3I_3 and the new saving investment equilibrium will be at point M which will raise the income to a still higher level to OY_4. In this way the economy will continue to grow as a consequence of higher and higher level of saving-investment, which is itself the result of increase in income.

But this expansion cannot go on indefinitely and may be restricted by the availability of labour and natural resources in the country. In other words, Gw is not the maximum rate of growth attainable by an economy. For this purpose Harrod introduces the concept of national rate of growth (Gn), which is the maximum rate of growth allowed by the growth of population, technological improvements, natural resources and capital equipment.

THE NATIONAL GROWTH RATE

National growth rate is the 'rate of advance which the increase in population and techological improvement allow.' It is the highest attainable growth rate which would bring about the fullest possible employment of the resources existing in the economy. This may be considered as the ceiling rate of growth permitted by the availability of labour and national resources. According to Mrs. Joan Robinson, it is the maximum feasible rate of growth. The equation of natural rate of growth can be written as follows :

$$Gn\ Cr = S \qquad \ldots(3)$$

This equation shows that Gn may or may not be equal to Gw.

If Gn exceeds Gw then G can also exceed Gw. Whenever G exceeds Gw there will be a tendency for a boom to develop and if it falls below Gw cyclical depression is likely to occur. Thus saving is a virtue and beneficial so long as Gw is below Gn.

Thus for attaining equilibrium rate at full employment of all existing resources, the following condition must be satisfied.

$$Gn = Gw = G$$

Any deviation from this position will cause cyclical fluctuations in the economy.

DIVERGENCE AMONG G, Gw AND Gn

For attaining full employment equilibrium it is necessary that actual growth rate (G), warranted growth rate (Gw) and natural growth rate (Gn) are equal to each other. But this is a knife edge balance and is not easy to establish. Divergence among G, Gw and Gn is a possibility and this sort of divergence is likely to involve the economy into conditions of secular stagnation or inflation. If $G > Gw$, investment in the economy will increase faster than saving and the rate of growth of income will be faster than Gw. On the other hand, if $G < Gw$, saving will increase faster than investment and the rate of growth of income will be lesser than Gw. According to Harrod, if $Gw > Gn$, *i.e.*, if warranted growth rate exceeds the natural growth rate, conditions of secular stagnation will develop. Under this condition Gw will also be greater than G because the upper limit to actual growth rate is set by natural growth rate (Gn). On the other hand, if $Gw < Gn$, Gw will also be less than G and a tendency of secular inflation will develop in the economy. Under this condition there will be a shortage of capital goods while labour will be plentiful. Profits will be high since desired investment is greater than realised investment. Businessmen will have a tendency to increase their capital stock. This will create conditions of secular inflation. Both these situations can be illustrated by diagrams.[1]

Like Keynes, Harrod also contemplates a world in which the propensity to save tends to exceed the inducement to invest, and in which there will be persistent tendency towards cyclical deflation and chronic stagnation. But unlike Keynes, he emphasises :

(*a*) the danger of productive capacity outruns the effective demand,

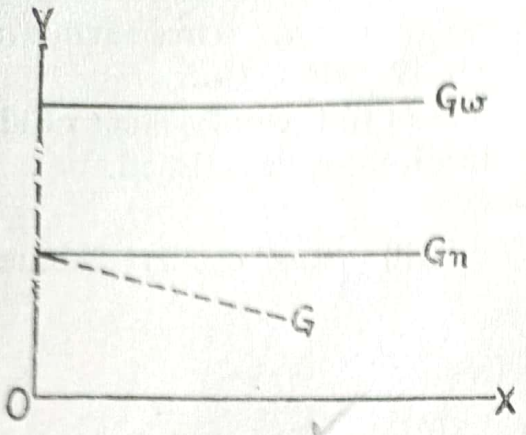
(*b*) the predominant role of induced investment, and

(*c*) the instability of the 'progressive equilibrium.'[2]

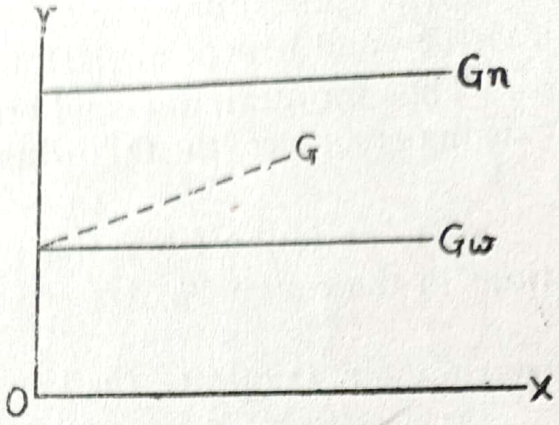
[1] Jhingan, *The Economics of Development and Planning.*

[2] K. K. Kurihara, *The Keynesian Theory of Economic Development* ,64.

$Gw > Gn \rightarrow$ Secular Stagnation



$Gw < Gn \rightarrow$ Secular Inflation



LIMITATIONS OF HARROD-DOMAR MODELS

Harrod-Domar models of growth have generally been criticised on the following grounds :

(1) These growth models are based on the unrealistic assumptions that propensity to save and capital-output ratio remain constant. In reality both of them are likely to change over a long period. Changes in these ratios will definitely alter the requirements of steady growth. If these changes are in a particular direction, the requirements of steady growth may not be so strict as indicated by these models. Prof. Domar himself feels that 'this assumption is not necessary for the argument, and the whole problem can be easily reworked with variable α and σ.

(2) Harrow-Domar analysis starts with presumption of fixed proportion between labour and capital. In reality different factors of production can be substituted for each other to some extent. The possibility of such substitution makes the conditions of steady growth less rigid.

(3) The models are deficient because they do not consider the possibility of price changes facilitating steady growth. Price changes do occur and they can exercise an important influence on the growth process. A small degree of price flexibility may help in stabilising a highly unstable situation.

(4) Harrod-Domar models are highly aggregative in their character and do not consider the structural features of growth by breaking the various aggregates into their components. Harmonious growth of various sectors of the economy may be very important for attaining steady growth. This possibility has not been considered by these models.

(5) Another shortcoming of these models is that they do not consider the possibility of government undertaking the programme of development. Such a change in government policy will alter considerably the requirements of steady growth in an economy.