The Harrod Model

Prof. R.F. Harrod tries to show in his model how steady (i.e. equilibrium) growth may occur in the economy. Once the ~~disequilibrium~~ steady growth rate is interrupted and the economy falls into disequilibrium, cumulative forces tend to perpetuate this divergence thereby leading to either secular deflation or secular inflation.

The Harrod model is based upon three distinct rates of growth. Firstly there is the actual growth rate represented by G which is determined by the saving ratio and the capital-output ratio. It shows short-run cyclical variations in the rate of growth. Secondly, there is the warranted growth rate represented by Gw which is full capacity growth rate of income of an economy. Lastly, there is the natural growth rate represented by Gn which is regarded as 'the welfare optimum' by Harrod. It may all be called the potential or the full employment rate of growth.

The Actual growth rate: In Harrodian model the first fundamental equation is

$$GC = s$$

where G is the ~~st~~ rate of growth of output in a given period of time and can be expressed as $\Delta Y/Y$. C is the net addition to capital and ' is defined as the ratio of investment to the increase in income, i.e., $I/\Delta Y$ and s is the average propensity to save, i.e., S/Y. Substituting these ratios in the above equation we get:

$$\frac{\Delta Y}{Y} \times \frac{I}{\Delta Y} = \frac{S}{Y} \quad \text{or} \quad \frac{I}{Y} = \frac{S}{Y} \quad \text{or} \quad I = S$$

The equation simply a re-statement of the truism that expost (actual) savings equal expost investment.

The above relationship is disclosed by the behaviour of income. Whereas S depends on Y, I depends on the increment in income (ΔY), the latter is nothing but the acceleration principles.

The Warranted Rate of Growth: The warranted rate of growth is according to Harrod, the rate "at which producers will be content with what they are doing." It is the "entrepreneurial equilibrium" it is the line of advance which, if achieved, will satisfy profit takers that they have done the right thing. Thus this growth rate is primarily related to the behaviour of businessmen. At the warranted rate of growth, demand is high enough for businessmen to sell what they have produced and they will continue to produce at the same percentage rate of growth. Thus, it is the path on which the supply and demand for goods and services will remain in equilibrium, given the propensity to save. The equation for the warranted rate is

$$G_w = s$$

where G_w is the "warrante rate of growth" or the full capacity rate of growth income which will fully utilize a growing stock of capital that will satisfy the entrepreneurs with the amount of investment actually made. It is value of $\frac{\Delta Y}{Y}$ Or, the 'capital requirements', denotes the amount

of capital needed to maintain the warranted rate of growth. It is the value of $1/\Delta Y$ or C. S is the same as in the first equation, i.e., S/Y.

The equation, therefore, states that if the economy is to advance at the steady rate of Gw that will fully utilize its capacity income must grow at the rate of S/Cr per year, i.e. $Gw = S/Cr$

If income grows at the warranted rate, the capital stock of the economy will be fully utilised and entrepreneurs will be willing to continue to invest the amount of saving generated at full potential income. Gw is therefore a self-sustaining rate of growth and if the economy continues to grow at this rate it will follow the equilibrium path.

Genesis of Long-run Disequilibria: Full employment growth, the actual growth rate of G must equal Gw, the warranted rate of growth that would give steady advance to the economy and C (the actual capital goods) must equal Cr (the required capital goods for steady growth).

If G and Gw are not equal, then ~~economy~~ economy will be in disequilibrium. For example if G exceeds Gw, then C will be less than Cr. When $G > Gw$, shortages results. Such a situation leads to secular inflation because actual income grows at a faster rate than that allowed by the growth in the productive capacity of the economy. It will further lead to a deficiency of capital goods, the actual amount of ~~cap~~ capital goods being less than the required capital goods ($C < Cr$). Under this circumstances, desired investment would be greater

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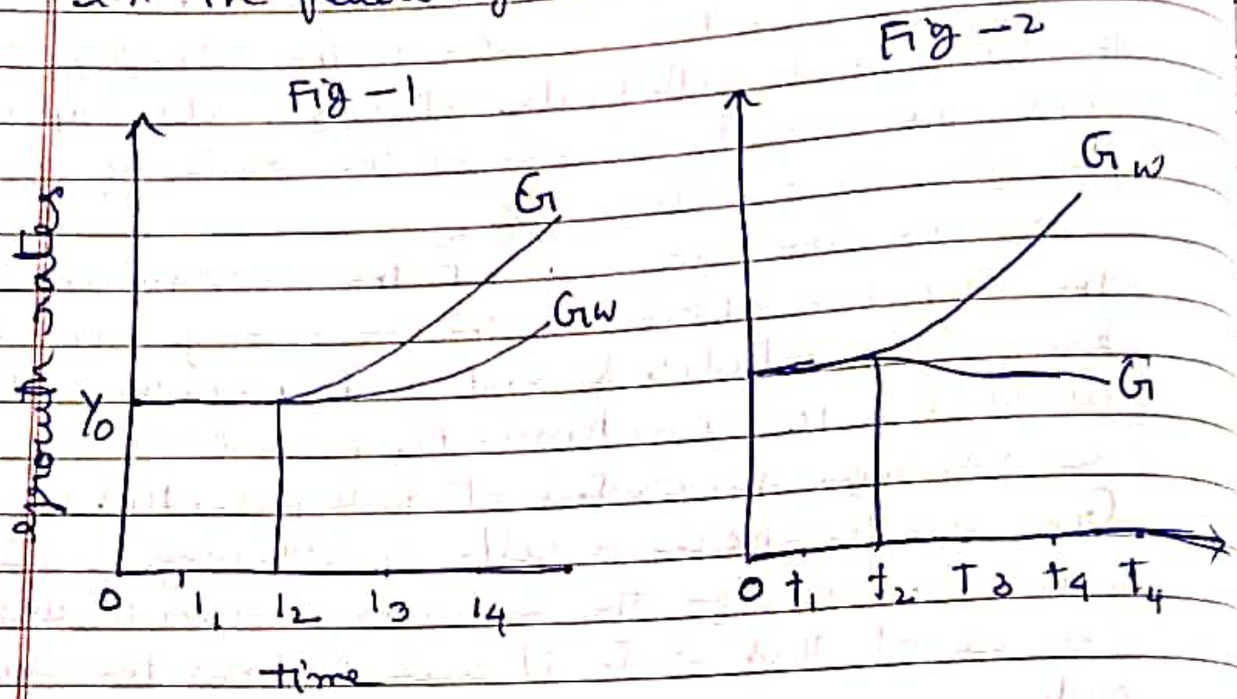
then saving and aggregate production would fall short of aggregate demand. There would be chronic inflation. This is illustrated in the following diagram → Fig-1



In Fig-1, the growth rates of income are taken on the vertical axis and time on the horizontal axis. Starting from the initial full employment level of income Y_0, the actual growth rate G follows the warranted growth path G_w upto point E through period t_2. But from t_2 onwards, G_r deviates from G_w and is higher than the latter. In subsequent periods, the deviation between the two becomes larger and larger.

If on the other hand G_r is less than G_w, then C is greater than C_r. Such a situation leads to secular depression because actual income grows more slowly than what is required by the productive ~~actual income~~ capacity of the economy leading to an excess of capital goods ($C > C_r$). This means that desired investment is less than saving and that the aggregate demand

falls short of aggregate supply. The result is fall in output, employment and income. There would thus be ~~error~~ chronic depression. This is explained in Fig - 2 when from period t_2 onwards G falls bellow Gw and the two continue to deviate further away.

Harrods states that once G departs from Gw, it will depart further and further away from equilibrium. Thus the equilibrium between G and Gw is a knife-edge ~~equilibrium~~ equilibrium. For once it is disturbed, it is not self correcting. It follows that one of the major tasks of public policy is to bring G and Gw together in order to maintain long-run stability. For this purpose Harrod introduces his third concept of the natural rate of growth.

The Natural Rate of Growth: The natural rate of growth depends on the macro variables like population, technology, natural resources and capital equipment. In other words, it is the rate of increase in output at full employment as determined by a growing population and the rate of technological progress. The equation for the natural rate of growth is

$$G_n = C_r = \alpha \neq s$$

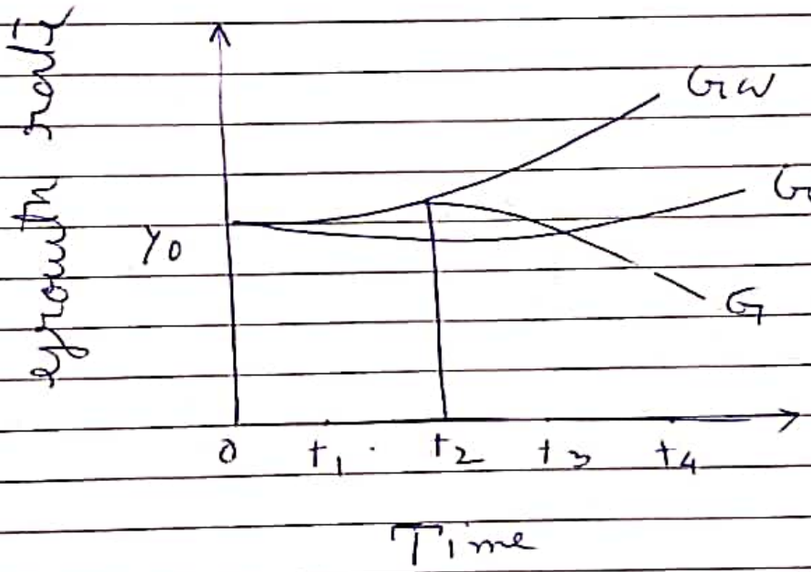
Here G_n is the natural or full employment rate of growth.

Divergence of G, Gw and Gn:

Now for full employment equilibrium growth $G_n = G_w = G$. But this is a knife-edge balance. For once there is any

divergence between natural, warranted and actual rates of growth conditions of secular stagnation or inflation would be generated in the economy. If $G > G_w$, investment increases faster than saving and income rises faster than G_w. If $G < G_w$ saving increases faster than investment and rise of income is less than G_w. Thus Harrod points out that if $G_w > G_n$ secular stagnation will develop. In such a situation G_w is also greater than G because the upper limit to the actual rate is set by the natural rate as shown in Fig - 3.

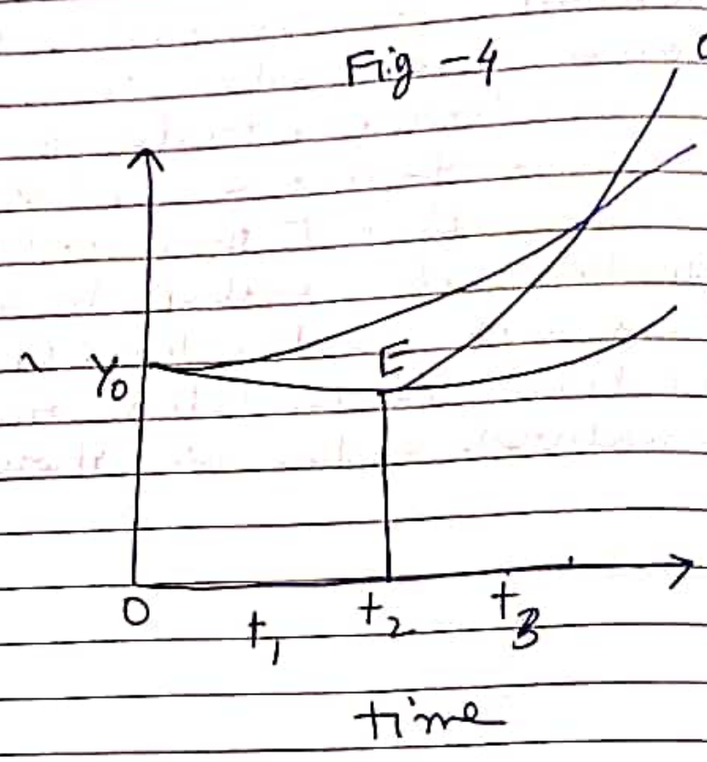
Fig - 3



When G_w exceeds G_n, $C > C_r$ and there is an excess of capital goods due to a shortage of labour. The shortage of labour keeps the rate of increase in output to a level less than G_w. Machines become idle and there is excess capacity. This further dampens investment, output employment and income. Thus the economy will be in the grip of chronic depression. Under such conditions saving is a vice

If Gw < Gn, Gw is also less than G as shown in Fig -4

Fig -4



The tendency is for secular inflation to develop in the economy. When Gw is less than Gn, C<Cr. There is a shortage of capital goods and labour is plentiful. Profits are high since desired investment is greater than realised investment and the businessmen have a tendency to increase their capital stock. This will lead to secular inflation. In such a situation saving is a virtue for it permits the warranted rate to increase.

The ~~rigidity~~ instability in Harrod's model is due to the rigidity of its basic assumptions. They are a fixed production function, a fixed saving ratio, and a fixed growth rate of

labour force. Economists have attempted to relieve this rigidity by permitting capital and labour substitution in the production function, by making the saving ratio a function of the profit rate and the growth rate of labour force as a variable in the growth process.

The policy implications of the model are that saving is a virtue in any inflationary gap economy and vice in a deflationary gap economy. Thus in an advanced economy, saving (S) has to be modified moved up or down as the situation demands.

Similarities of the two models:

The Domar Model	The Harrod model
$\delta = \frac{\Delta Y}{I}$ $\quad \frac{\Delta I}{I} = \alpha\delta$	$G_r C_r = s$ $\quad G_r = \frac{\Delta Y}{Y}$
$\alpha = \frac{\Delta S}{\Delta Y}$ $\quad \frac{\Delta I}{I} = \frac{\Delta Y}{I} \times \frac{\Delta S}{\Delta Y}$	or $\frac{\Delta Y}{Y} \times \frac{I}{\Delta Y} = \frac{S}{Y}$ $\quad C_r = \frac{I}{\Delta Y}$
$\frac{\Delta I}{I} = \frac{\Delta S}{I}$	$= \frac{I}{Y} = \frac{S}{Y}$
$\Delta I = \Delta S$	$\therefore S = \frac{S}{Y}$
	or $I = S$

Given the capital-output ratio, as long as the average propensity to save equal to the marginal propensity to save, the equality of saving and investment fulfils

the conditions of equilibrium rate of growth.

Harrod's G_W is the same as Domar's $\alpha\delta$. But in reality, Domar's rate of growth $r = \alpha s$ is Harrod's G_W, and Domar's $r = \alpha\delta$ is Harrod's natural growth rate. In Domar's model s is the annual production capacity of newly created capital which is greater than δ which is the potential social advantage productivity of investment. It is the lack of labour and other factors of production which reduces Domar's growth rate from $r = \alpha s$ to $r = \alpha\delta$. Since labour is involved in δ therefore Domar's potential growth rate resembles Harrod's natural rate.

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Points of Differences of the two models:

1. Domar assigns a key role to investment in the process of growth and emphasises on its dual character. But Harrod regards the level of income as the most important factors in the growth process. Whereas Domar forges a link between demand and supply of investment. Harrod, on the other hand, equates demand and supply of saving.

2. Domar model is based on one growth rate $r = \alpha\delta$. But Harrod uses three distinct rates of growth: the actual rate (G), the warranted rate (Gw) and the natural rate (Gn).

3. Domar uses the reciprocal of marginal capital - output ratio, while Harrod uses the marginal capital - output ratio. In this sense Domar's $\delta = \frac{1}{Cr}$ of Harrod.

4. Domar gives expression to the multiplier but Harrod uses the accelerator about which Domar appears to say nothing.

5. The formal identity of Harrod's Gw equation and Domar's equation is maintained by Domar's assumption that $\frac{\Delta I}{I} = \frac{\Delta Y}{Y}$. But Harrod does make such assumptions. In Harrod's equilibrium equation Gw, there is neither any explicit or implicit reference to ΔI or I. It is however

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in his basic equation $G_r = s/c$ that there is an implicit reference to I_{t-1} since C is defined as $I/\Delta Y$. But there is no explicit or implicit reference to ΔI.

6. For Harrod the business cycle is an integral part of the path of growth and for Domar it is not so, but is accommodated in his model by allowing δ (average productivity of investment) to fluctuate.

Limitations of Harrod-Domar Model:

1. The propensity to save (α or s) and the capital-output ratio (σ) (δ) are assumed to be constant. In actuality, they are likely to change in the long run and thus modify the requirements for steady growth. A steady rate of growth can, however, be maintained without this assumption.

2. The assumption that labour and capital are used in fixed proportions is untenable. Generally, labour can be substituted for capital and the economy can move more smoothly towards a path of steady growth. In fact, unlike Harrod's model, this path is not so unstable that the economy should experience ~~chron~~ chronic inflation or unemployment if G_r does not coincide with G_w.

3. The two models fails to consider changes in the general price level. Price changes always occur over time and may stabilize otherwise unstable situations.

4. The assumption that there are no changes in interest rates is irrelevant to the analysis. Interest rates change and affect investment. A reduction in interest rates during periods of over-production can make capital-intensive processes more profitable by increasing the demand for capital and thereby reduce excess supplies of goods.

5. This model neglects the entrepreneurial behaviour which actually determines the warranted growth rate in the economy. This makes the concept of the warranted growth rate unrealistic.

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