The Harrod Model

Harrod's model can be considered as a pioneering model which attempted to identify the drivers of GDP growth in a formal way. It also sought to answer the following important questions:

- How can steady growth be achieved in an economy with fixed coefficients of production and a fixed saving-income ratio?
- How can the steady growth rate be maintained? Or what are the conditions for maintaining steady uninterrupted growth?
- How do the natural factors put a ceiling on the growth rate?

Basic Assumptions of the model

(i) The average propensity to save (APS) and marginal propensity to save (MPS) are equal to each other, that is, APS = MPS or written in symbols,
$S = sY$, or $s = S/Y = \Delta S/\Delta Y$ (a fixed fraction of national income is always saved).

(ii) Both (a) capital-labour ratio and (b) capital-output ratio are given constants. This amounts to assuming that the law of constant returns operates in the economy because of the rigidity of the coefficients of production.

(iii) Income, investment, savings are all defined in the net sense, i.e., they are considered over and above the depreciation. Thus, depreciation rates are not included in these variables.

(iv) Equilibrium requires that saving and investment are equal in ex-ante as well as in ex-post sense i.e., there is equality between accounting as well as planned saving and investment.

(v) Labour force grows at an exogenously given rate n.

AS we shall soon see, the model suggests that the economy's rate of growth depends on:

- The level of **national saving** (S)
- The **productivity of capital investment** (this is given by the **capital-output ratio (COR), or, under a slightly different framework used by A.K.Sen, the incremental capital-output ratio(ICOR)**)

The Capital-Output Ratio (COR)

- For example, if Rs. 100 worth of capital equipment produces each Re. 10 of annual output, a capital-output ratio of 10 to 1 exists. A 3 to 1 capital-output ratio indicates that only Rs. 30 of capital is required to produce each RS. 10 of output annually.
- If the capital-output ratio is low, an economy can produce more output from the same amount of capital. If the capital-output ratio is high, then it needs a lot of capital for production, and it will not get as much value of output for the same amount of capital.

The Incremental Capital-Output Ratio (ICOR)

Instead of C/Y, we write: ΔC/ΔY, that is, we take the marginal values. But the basic logic outlined above (high productivity implies low COR) is true here also, that is, high productivity implies low ICOR.

Thus, ***when capital productivity is high, then COR (and also the ICOR) will be lower***

Basic Harrod-Domar model says:

Rate of growth of GDP = Savings ratio / COR, or Growth of GDP = Savings ratio / ICOR

Let us see how. We shall take the ICOR approach.

Define: v= ΔC/ΔY where v is our ICOR. Now, change in capital stock is nothing but investment (be careful about stock and flow concepts). So, I = ΔC, and hence, v can be rewritten as I/ΔY

But, I = S (assumed)

Or, I = sY

Therefore, v = sY/ΔY

Or, ΔY/Y = s/v

That is, **Growth of GDP = Savings ratio / ICOR**

Numerical examples:

- If the savings rate is 10% and the incremental capital output ratio is 2, then a country would grow at 5% per year.
- If the savings rate is 8% and the capital output ratio is 4, then the country would grow at 2% per year.

Based on the model therefore the rate of growth in an economy can be increased in one of two ways:

- **Increased level of savings** in the economy (i.e. gross national savings as a % of GDP)
- **Reducing the capital output ratio** (i.e. increasing the quality / productivity of capital inputs)

Harrod calls s/v the warranted rate of growth. This is because, if this growth rate is reached, the economy is in dynamic equilibrium. In other words, investment expenditure creates exactly the same amount of additional demand (through the multiplier process) as the output that the additional capital stock can produce.

Unfortunately, Harrod's model gives us an unstable growth path. Any departure from the equilibrium growth path (called the 'warranted growth' rate by Harrod) will lead the economy further and further away

from equilibrium. This is because – as A.K. Sen has expressed it – the producers get wrong signals from the market. When they produce less than the warranted output, the expansion in demand is even less than the expanded capacity. Hence, they find sales dropping, and instead of thinking that they have produced too little, they tend to think that they have produced too much. As a result, they plan to grow at an even lower rate.

Similarly, when the firms produce expand more than the warranted rate, they find demand outpacing supply, and instead of thinking that they have produced too much, they tend to think that they have produced too little. Thus, they try to grow at an even faster pace.

This happens because of the double-edged nature of the investment expenditure. On the one hand, it raises demand though the multiplier process, and on the other hand, it raises productive capacity. The economy must always keep a fine balance between the rise in demand and the rise in productive capacity. In Harrod's model, if this balance is lost in any period, the economy deviates further and further away from the warranted growth path.

Introducing Population Growth

As mentioned earlier, it is assumed that population (labour force) grows at the constant rate n (exogenously determined). Now, with fixed coefficients of production, capital and labour always have to be mixed in a certain ratio. So, unless investment (and capital stock) grows at the same rate n, a problem arises. If the warranted rate is g (= s/v), where (g > n) and output and capital grow at the warranted rate, the economy runs into the full employment barrier sooner or later. This is because, in the long run, it will be found that the society is short of adequate labour force to optimally utilize the capital stock. As a result, the economy cannot grow at the warranted rate any more, and a departure occurs.

If, on the other hand, g < n, we shall have chronic unemployment as labour force will not be fully employed (labour expands at a faster rate than capital).

So, only if the warranted rate (s/v) is exactly equal to n (which is never guaranteed as n is completely exogenous), we shall have steady growth, which is sustainable, given the country's (a) savings propensity, (b) ICOR and (c) population growth rate. This (n) is called the natural rate of growth.

Introducing technological progress

It is very likely that the society will witness technological progress over time. In Harrod's model, such progress is labour-saving in nature. Therefore, though labour still grows at the old rate n, the effective labour force now grows at the rate n + m. This indicates that while the number of heads grows at the rate n, the same number of people can produce more output (as if population grew at the rate n + m). Thus the natural rate is now n + m, and we now have:

(s/v) = n + m as our dynamic equilibrium condition.