Golden Rule

Meaning

The Solow model shows at least one thing very clearly — how an economy's rate of saving and the level (volume) of investment conjointly determine its steady-state of growth in an economy. But higher saving rate is not always a good thing. The aim is more consumption and improved living standards of the people. So every society has to take decision regarding optimal consumption and saving (capital formation).

Thus, pushing the saving rate to higher and higher levels is not always desirable. If, in an extreme situation, an economy saves its entire income, and there is no consumption, economic welfare, instead of rising, will fall. We can now use the Solow model to find out the optimal level of capital of a society which maximizes the economic well-being of its members in terms of consumption spending. The reason is that consumption is a measure of welfare, not saving or accumulation of capital. Saving is not an end in itself, but a means to an end.
No doubt, by fixing the saving rate, the policymakers can determine the economy's steady state. And if the objective of economic policy is maximization of social welfare, it is in the rightness of things for the policymakers to choose the steady state with the highest level of consumption.

The steady-state, value of k which maximizes consumption per worker is called the **Golden Rule** Level of Capital, a term first coined by Edmund Phelps and is denoted by $\mathbf{k^*_g}$**.**

Determining the Golden Rule Level of Capital

In order to ascertain whether the economy is at the Golden Rule level, we have to determine first the steady-state consumption per worker. Then we can find out which steady state provides the maximum consumption per worker.

We know that

$$C = Y - I \qquad (1)$$

Where,

C= Consumption, Y= output and I= Investment

For finding steady-state consumption, we have to substitute steady-state values for output and investment. Steady-state output per worker is **f(k*),** where k* is the steady-state capital stock per worker.

Moreover, in a steady state since capital stock is not changing, investment is equal to depreciation. If we substitute f(k*) for y and δk* for I, we can express steady-state consumption per worker as

$$\mathbf{C^* = f(k^*) - \delta k^*.} \qquad (2)$$

Equation (2) suggests that steady-state consumption is what is left of steady-state output after making provision for steady-state depreciation. This equation makes one point quite clear that an increase in steady-state capital has two opposite effects on steady-state consumption. One is favorable, the other is not. On the positive side, more capital means more output. On the negative side, more capital also means that more output must be used to replace worn- out capital.

In Fig. 4.7 we show steady-state output and steady-state depreciation as a function of the steady-state capital stock. Steady-state consumption is the difference between output and depreciation. From this figure it is clear that there is only one level of capital stock — the Golden Rule level of k* — that maximises consumption.

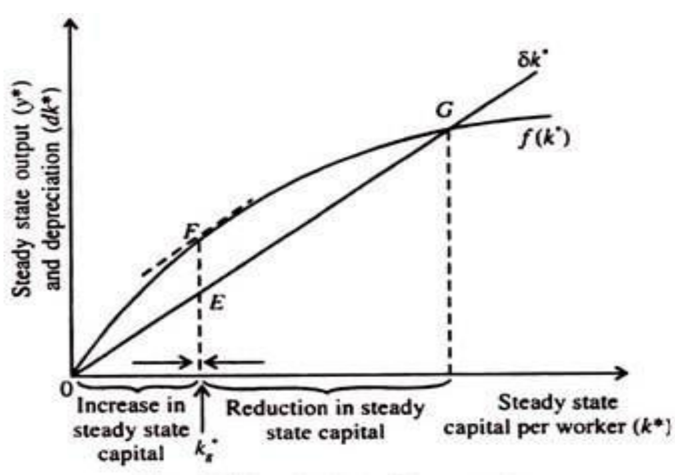

Figure: 1

The most important point which should not be missed while comparing steady states is that higher levels of capital affect both output and depreciation. If actual capital stock is less than the Golden Rule level, an increase in capital stock raises output faster than depreciation. As a result consumption rises.

In such a situation, the production function f(k*) is steeper than the steady-state depreciation line (δk*). This means that the gap is vertical distance between the two curves — which equals consumption per worker — grows as k* increases. On the other hand, if the actual capital stock exceeds the Golden Rule level, an increase in the capital stock reduces consumption. The reason for this is that the increase in output is smaller than the increase in depreciation. In such a situation the production function is flatter than the δk* line. So the gap between the two curves — which measures the level of consumption — falls as k* rises. At the Golden Rule level of capital, the production function and the line of depreciation have the same slope, this implies that consumption is at the highest possible level.

Condition for the Golden Rule of Accumulation:

The Golden Rule level of capital is characterised by a simple condition. Since at the Golden Rule level of capital (k*) the slope of both the production function (i.e., the MPK) and the depreciation line (i.e., δ) are equal, we have

$$MPK = \delta \qquad (3)$$

Equation (3), which describes the Golden Rule, simply implies that at k*, the MPK is equal to the rate of depreciation.

Explanation of the Condition:

Suppose an economy is having some steady-state capital stock k* and the government is planning to increase the capital stock by one unit to k* + 1 through some policy measure. The extra output that can be obtained from this extra capital Δk isf(k*+ 1)-f(k*), which is indeed the MPK.

The amount of extra depreciation due to the increase in the stock of capital is 8. So the net effect of this extra unit of capital on consumption is then MPK – δ. If MPK – δ > 0, then increase in capital increases consumption.

This implies that k^* has to be below the Golden Rule level. If MPK- $\delta < 0$, exactly the opposite will happen. In this case, an increase in capital decreases consumption and k^* must lie above the Golden Rule level.

Thus the Golden Rule of capital accumulation is described by the following condition:
MPK –δ = 0 (4)

This means that at k^*, MPK, net of depreciation, is zero. This condition can be used by a policy-maker for finding out the capital stock for an economy which maximises the level of consumption, i.e., the so-called Golden Rule capital stock.

It is very easy to derive the Golden Rule. We know that $c^* = f(k^*) - \delta k^*$. To find the k^* which maximises c^*, we have to differentiate c^* with respect to k^*, i.e.,

$$\mathbf{dc^*/dk^* = f'(k^*) - \delta}$$

and set this equal to zero, i.e.,

$$f'(k^*) - \delta = 0$$

or $f(k^*) = \delta$.

Here $f'(k^*)$ is the MPK. Thus we get the Golden Rule condition of the Solow growth model.