[Academic Script]
[Economics Growth (Part II)]

Subject:	Business Economics
Course:	B.A., 4th Semester, Undergraduate
Paper No. & Title:	Paper – 401 Macroeconomics-II
Unit No. & Title:	Unit - 4 Economics Growth
Lecture No. & Title:	2: Economics Growth (Part II)

Objectives:

- To understand the Golden Rule of Accumulation.
- To understand the Convergence and Divergence controversy.
- To understand Absolute Convergence.
- To understand Conditional Convergence.

Introduction: Golden Rule of Accumulation

The Golden Rule of Accumulation was introduced by Edmund Phelps in his book "The Golden Rule of Accumulation: A Fable of Growthman". However, the concept of Golden Rule saving rate was first devised by John von Neumann and Maurice Allaison seeking answer to how much a nation ought to spend on present consumption rather than save and invest for future generations. But, the introduction to Golden Rule is one of the major contribution to economic science by Edmund Phelps. For the reason that, in the Solow growth model, a steady state savings rate of 100% implies that all income is going to investment capital for future production, which is practically impossible as it means consumption level of zero. On the other hand, a savings rate of 0% implies that no new investment capital is being created, so that the capital stock depreciates without replacement. This again is impractical as it makes a steady state unsustainable except at zero output, which implies a consumption level of zero. Somewhere in between is the "Golden Rule" level of savings, where the savings propensity is such that per-capita consumption is at its maximum possible constant

value. Let's put it another way, the golden-rule capital stock relates to the highest level of permanent consumption which can be sustained. Let us understand it in detail.

Golden Rule of Accumulation:

Edmund Phelps while explaining the golden age growth lays down the Golden Rule of Accumulation. According to the Golden Rule of Accumulation in the Golden-Age per capita consumption is maximised when the saving rate equals the profit rate. If the saving rate is less than profit rate, the per capita consumption is less than the attainable maximum. If the saving rate is higher than the profit rate per capita consumption will decline. Thus, it is a specific target rate of saving that maximises per capita consumption in golden age. This is called the golden rule or optimal saving rate. If the same rate of consumption is provided to members of each current and future generation, the maximum amount of per capita consumption is called the Golden Age Path. This consumption maximising golden age path is called the Golden Rule Path.

It is explained with the help of figure where golden age per-capita consumption $(C/L)^*$ is taken on the vertical axis and the savings rate on the horizontal axis. As we move along the CS curve, per capita consumption increases at low levels of saving and decreases at high level of savings. It is at the golden rule saving rate s^*g the per capita consumption is maximised at c^*g level of per capita consumption. This is the highest point H on the CS curve.

Figure:
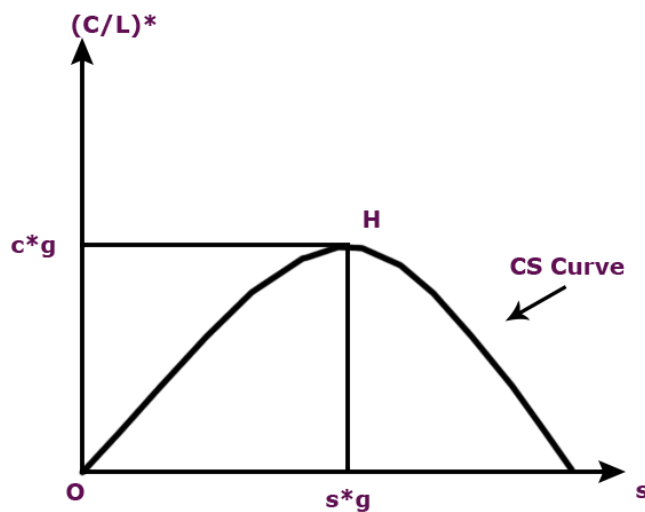

The Golden Rule Path:

A golden age path is a growth path on which every variable changes at a constant proportionate rate i.e. consumption, output, etc. and everything else is growing at the same rate. The growth rate is 'g' which is the natural growth rate. The rate is independent of the ratio of capital accumulation of output. Corresponding to this investment ratio, there exists atleast one capital – output ratio which will be maintained. The existence of a G_n implies that the K & L are substitutable in such a way that the capital output ratio can adjust to any values of s – savings. Under conditions of equilibrium growth, the capital –output ratio is as we see where

$$\frac{K*}{Q*} = \frac{s}{g} \ or \ \textbf{g = s \ (Q*/K*)}$$

Where, *denotes equilibrium value of K and Q (output), s=saving rate, g=golden rate.

The growth rate 'g' is not a function of 's' but it is 's' that determines K*/Q*. If we have 2 golden age paths with equal growth rates, the one with the higher saving rate will have the higher capital – output ratio and with positive MPs, the higher level of output. Thus, the saving rate affects the level at which the economy grows but it does not affect its growth rate. This is seen in the figure, here logarithmatically parallel 2 golden paths Q_A and Q_B pass a given check point say time zero. They are identical in all aspects. But the saving rate on path Q_B is higher. This implies that Q_B has a higher capital – output ratio and a higher level of output than Q_A.

Figure:
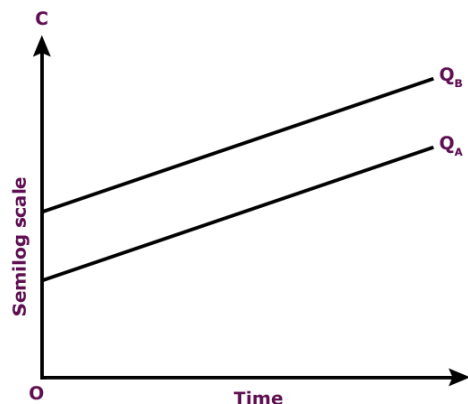
In deciding which growth path is the best, a generation will look only at the amount of consumption which each path offers, given a constant 's', every golden age path is associated with a per capita consumption path $(C/L)^*$ on which consumption grows exponentially at the same rate as output. Under conditions of equilibrium growth per capita consumption along these parallel paths $(C/L)_1^*$, $(C/L)_2^*$ and $(C/L)_3^*$ grow at an identical rate 'g'. Therefore, there exists some uniformly highest possible per capita consumption path such as $(C/L)_3^*$ than any other consumption path. All generations will naturally prefer this path with its corresponding saving rate to any lower per capita consumption path, such as $(C/L)_2^*$ & $(C/L)_1^*$.

Figure:
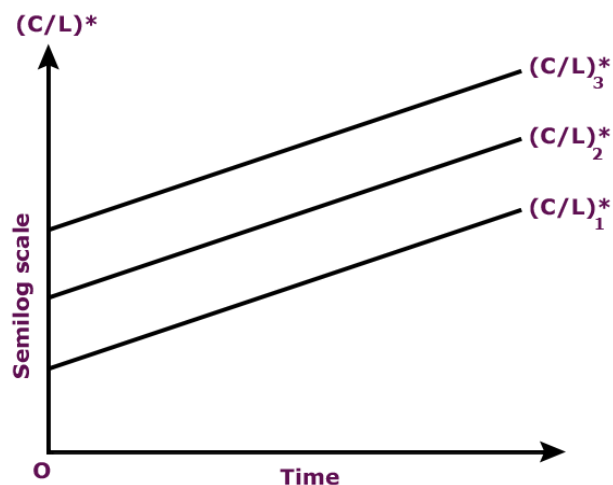
This golden age path produces a path of consumption that is uniformly higher than the consumption path associated with any other golden age path. Thus, the golden rule determines the

Equilibrium growth path that maximizes per capita consumption for all time once the economy reaches that path.

The higher the saving rate, the higher the level of output. But how much higher that depends on the MP of capital, 'r'. Having a little more capital Δk at this time would yield $r\Delta k$ more in output. In fact $r\Delta k$ is the extra output of capital. But all this is not available for consumption, having a little more capital now commits the economy to some additional investment in the present and in future to keep the slightly lower larger capital stock growing at a fixed rate 'g'. In particular, a little extra capital Δk now means that an output of $g\Delta k$ of capital goods is required simply to keep the new little capital growing at rate 'g'.

If rΔk>gΔk or r > g, having a little more capital now will yield some extra consumption and for all time. On the other hand, if r<g, having a little less capital would actually siphon off enough productive capacity to the investment sector to reduce consumption. Consumption is at a maximum where r=g (MP of capital = growth rate). The rate of profit is included in the value of the MP of capital. Thus, the optimal amount of capital under the golden rule is that which equates the profit rate to the growth rate.

Convergence – Divergence Controversy:

One of the important predictions of the Solow Model is that of convergence. Convergence is the process of "catching up" of one economy with another economy. The growth convergence prediction has led to a debate about the convergence or divergence of GNP per capita over time across economies based on diverse data sets of countries on a comparable basis. Convergence of growth is of two types:

1. Absolute or unconditional convergence, *and*
2. Conditional convergence

I. Absolute or unconditional convergence:

If two closed countries have the same saving rate, the same rate of population growth, the same depreciation rate of capital and the same production function, they will have same steady state values of capital per capita and income or output per capita. But the country with low level of capital per capita and income per captia will grow faster than the country with high level of capital per capita and income per capita. In other words, when a poor country with low level of income per capita tends to grow faster than a rich country with high level of income per capita, it is called absolute or unconditional convergence. The concept of absolute convergence is explained in the figure,
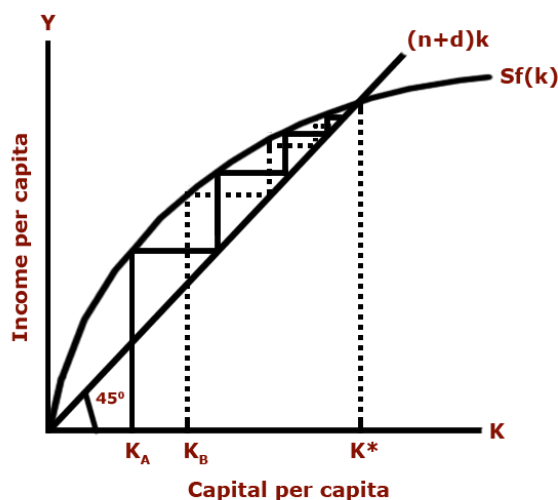
Figure:

In the figure it is observed that 45° line represents the steady state condition. The steady state level K* is determined at the intersection of the sf(k) curve with the (n+d)k line. Suppose there are two countries say country A & B having the same values of the parameters s – savings, n – population growth rate, d - depreciation

and f(k) – production function. But country A starts with an initial lower stock of capital k_A and B with initial higher stock of capital k_B. The zig-zagportion of the figure shows that country A with an initial lower capital stock grows faster than country B with an initial higher capital stock, as shown by the dotted zig-zag curve. Eventually, country A catches up or converges to the latter at point S where both the countries are at a steady state position K*. Thus absolute convergence shows a negative relationship between growth rate of income per capita.

II. Conditional Convergence

If the parameters like rates of saving, population growth, etc., differ across countries, their steady state positions will also differ. But over time their growth rates will eventually equalize or converge.

This convergence is conditional because the steady state levels of capital per capita and income per capita depend on the saving rate, rate of population growth and the position of the production function that differ across countries. Thus countries will converge on the condition that the characteristics that affect their growth rates are similar. This means that if some additional variables as level of education, political stability, etc. are also included, we can explain differences in groth rates among countries. For example, if a country has a poor educational system or unstable political system, its low growth rate can persist, despite its low level of capital per capita and income per capita.

The concept of conditional convergence is explained in the figure,
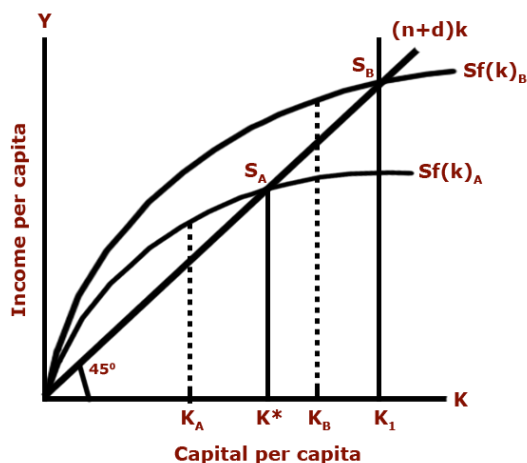
Figure:

With reference to the figure, the two countries, where in country A is a poor country and country B is a rich country. They have different initial stocks of capital per capita and different saving rates that lead to different steady state positions. The capital per capita stock of B

country is greater than that of country A, k_B is greater than k_A, and its saving function is also higher than that of A country, $sf(k)_B$ is greater $sf(K)_A$. The steady state position of country B is determined by the intersection of the $sf(k)_B$ curve with 45° line at point S_B and that of country A at points S_A with the intersection of $sf(k)_A$ curve with the 45° line. This shows that a rich country with higher saving rate and higher stock of capital per capita grows at a faster rate than a poor country with lower saving rate and lower stock of capital per capita.

The various empirical studies show that absolute convergence cannot be a powerful force in the world, otherwise the poorest countries would be growing very rapidly. In fact, poor countries remain poor and some even decline in absolute terms.

Summary:

The so-called golden rule (of capital accumulation) is a proposition about the consequences for national welfare possibilities of alternative paths of national wealth, and hence of national saving, in a closed economy. It states that the steady-growth state that gives the maximum path of consumption is the one along which national consumption equals the national wage bill and thus national saving equals 'profits'. The basic significance of the golden rule is as a warning against national policies of over-saving or counterproductive austerity.

Glossary:

Convergence: Convergence is the process of "catching up" of one economy with another economy.

Golden Rule of Accumulation: The Golden Rule of Accumulation in the Golden-Age per capita consumption is maximised when the saving rate equals the profit rate.

Economic Growth: Economic growth is a long-term expansion of the productive potential of the economy. Growth can be long term or short term, in both the cases there is slight difference. Let us understand the meaning of long-run as well as short run growth.

Short run growth: In short-run we are concern with annual percentage change in real national output.

Long-run growth: Long-run growth is represented by increase in potential GDP and thus the country's long-run aggregate supply curve shifts outward.

Balanced growth: It is balancing growth between rural and urban, rich and poor, and eradicating imbalances between all the sectors of economy. It plans the policies in such a way that there is balance between the sectors and within the sectors too.

References:

- Ahuja H.L, Macroeconomics: Theory and Policy S.Chand Publications, New Delhi.
- Blanchard, O & Johnson (2005) "Macroeconomics - (6th Edition)", Pearson Education, New Delhi.
- Dornbusch and Fischer "Macroeconomics",6th Edition, McGraw Hill, Inc. New York.

Website Links

- https://www.boundless.com/economics
- http://www.e-jei.org/upload/1w100170.pdf

- http://www.tankonyvtar.hu/hu/tartalom/tamop425/0049_17_ce nters_of_world_economy/6212/index.scorml
- http://blogs.worldbank.org/futuredevelopment/convergence-or-divergence-development

Assignments:

- ✓ Explain Golden Rule of Accumulation.
- ✓ Explain in detail the Convergence and Divergence controversy of Solow Model.
- ✓ Explain the absolute convergence in the two economies.

Frequently Asked Questions

1. What do you understand by Golden Rule?

The Golden Rule of Accumulation in the Golden-Age per capita consumption is maximised when the saving rate equals the profit rate. If the saving rate is less than profit rate, the per capita consumption is less than the attainable maximum. If the saving rate

is higher than the profit rate per capita consumption will decline. Thus, it is a specific target rate of saving that maximises per capita consumption in golden age. This is called the golden rule or optimal saving rate. If the same rate of consumption is provided to members of each current and future generation, the maximum amount of per capita consumption is called the Golden Age Path. This consumption maximizing golden age path is called the Golden Rule Path.

2. What is Absolute Convergence?

If two closed countries have the same saving rate, the same rate of population growth, the same depreciation rate of capital and the same production function, they will have same steady state values of capital per capita and income or output per capita. But the country with low level of capital per capita and income per-captia will grow faster than the country with high level of capital per capita and income per capita. This is known as absolute convergence.

3. State the two types of convergence.

1. Conditional Convergence
2. Unconditional Convergence.

4. What is population growth?

The population growth is the net increase in the total population, incorporating mortality rate, birth rate and net migration.

5. Explain Golden Rule Path.

A golden age path is a growth path on which every variable changes at a constant proportionate rate i.e. consumption, output, etc. and everything else is growing at the same rate. The growth rate is 'g' which is the natural growth rate.

6. What does Conditional Convergence says?

If the parameters like rates of saving, population growth, etc., differ across countries, their steady state positions will also differ. But over time their growth rates will eventually equalise or converge.

7. Define economic growth.

Economic growth is a long-term expansion of the productive potential of the economy. Growth can be long term or short term, in both the cases there is slight difference. Let us understand the meaning of long-run as well as short run growth.

8. What is feasible output?

The purpose of the economic feasibility assessment is to determine the positive economic benefits to the organization that the proposed system will provide. It includes quantification and identification of all the benefits expected.

9. Explain Balanced growth

It is balancing growth between rural and urban, rich and poor, and eradicating imbalances between all the sectors of economy. It plans the policies in such a way that there is balance between the sectors and within the sectors too.

Multiple Choice Questions

1. During the transition to Golden Rule, the consumption is _____at all the points of the time

a. **Higher**
b. Lower
c. Both a & b
d. Middle

2. When beginning with too less capital and if the condition arises as "$k^* < k^*_{gold}$" then increase in capital C^* requires increase in

a. Depreciation
b. **Savings**
c. Income
d. Labour

3. If there is increase in savings, then this leads to _____k^* and Y^* which may rise to C^*

a. **Higher**
b. Lower
c. Both a & b
d. None

4. Suppose the saving rate is initially greater than the golden rule saving rate. We know withcertainty that a reduction in the saving rate will cause

a. a reduction in the rate of
b. **a reduction in output per**

growth in the long run **worker**

c. a reduction in consumption per worker

d. none of the above

5. **Suppose the saving rate is initially less than the golden rule saving rate. We know withcertainty that a reduction in the saving rate will cause**

a. a reduction in the capital labour ratio

b. a reduction in output per worker

c. a reduction in consumption per worker

d. **all of the above**

6. **The golden rule level of capital refers to**

a. the level of capital that maximizes output per worker

b. the level of capital that maximizes the standard of living.

c. the level of capital that maximizes consumption per worker in the steady state

d. **none of the above**

7. **Who introduce the concept of Convergence**

a. **Solow**

b. Romer

c. Arrow

d. Lucas

8. **By what degree is the steady state condition represented:**

a. **45°**

b. 50°

c. 35°   d. 60°

9. **Convergence is the process of _____of one economy with another economy.**

a. snatching up   b. **"catching up"**

c. Distribution   d. collection

10 **The existence of a G_n–natural growth rate implies that the K & L are _____in such a way that the capital output ratio can adjust to any value of savings.**

a. **substitutable**   b. replaceable

c. complimentary   d. irreplaceable